Lake Washington Wastewater Lake Line Management Plan

FINAL / July 2024

CITY OF BELLEVUE
WASHINGTON

Lake Washington Wastewater Lake Line Management Plan

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Abbreviations

AC	asbestos cement
AFI	Allowance for Indeterminates
AIS	American Iron and Steel
BABA	Build America, Buy America Act
BCC	Bellevue City Code
BMP	best management practices
BSD	Bellevue Sewer District
Carollo	Carollo Engineers, Inc.
CBO	Community Based Organization
CCI	Construction Cost Index
CCTV	closed-circuit television
CI	cast iron
CIP	Capital Investment Program Plan
CIPP	cured-in-place-pipe
City	City of Bellevue
COF	consequence of failure
CWA	Clean Water Act
DAHP	Department of Archeology and Historic Preservation
DI	ductile iron
DO	dissolved oxygen
EAC	equivalent annual cost
Ecology	Department of Ecology
EIS	Environmental Impact Statement
ENR	Engineering New Record
ESA	Endangered Species Act
EUL	estimated useful life
FS	flush station
GIS	geographic information system
gpm	gallons per minute
HGL	Hydraulic grade line
HPA	Hydraulic Project Approval
I/I	infiltration and inflow
ID	identification
IYC	"It's Your City" Bellevue Newsletter
KCWTD	King County Wastewater Treatment Division
LF	linear feet
LOF	likelihood of failure

LWWLLMP	Lake Washington Wastewater Lake Line Management Plan
MG	million gallons
MODA	Multi-Objective Decision Analysis
MSA	Magnuson–Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPV	net present value
OHWM	Ordinary High-Water Mark
OPCC	opinion of probable construction costs
PS	pump station
PWWF	peak wet weather flow
RCW	Revised Code of Washington
RFQ	Request for Qualifications
RHA	Rivers and Harbors Act
ROW	right-of-way
RUL	remaining useful life
SCADA	supervisory control and data acquisition
SEPA	State Environmental Policy Act
SMP	Shoreline Master Plan
SOP	standard operating procedure
SR	state route
SRF	State Revolving Fund
TM	technical memorandum
TPC	total project cost
USACE	U.S. Army Corps of Engineers
USFWS	United States Fisheries and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Fish and Wildlife
WIFIA	Water Infrastructure Finance and Innovation Act
WQC	Water Quality Certification

EXECUTIVE SUMMARY

The City of Bellevue's (City) Lake Washington wastewater lake line system is aging and faces many challenges associated with operations, maintenance, and repair. The lake line system was mostly constructed in the 1950s and 1960s, and it is understood that the system will need to be replaced or repaired over time. To navigate these challenges, Carollo Engineers, Inc. (Carollo) along with Jacobs Engineering Group, Cascade Trenchless Consulting, Confluence Environmental Company, KPG Psomas, Shannon & Wilson, PRR, and Superior Engineering was commissioned to develop a management strategy for the Lake Washington lake line system. To that end, this Lake Washington Wastewater Lake Line Management Plan (LWWLLMP) offers an evaluation of the existing system, system alternatives and operational strategies to address these challenges, contextualized policy considerations, service area plans for the specific locations being addressed, and a strategic final implementation plan.

The City owns and operates the existing lake line system which serves customers in six jurisdictions: the City, the Town of Beaux Arts Village, the City of Medina, the Town of Hunts Point, the Town of Yarrow Point, and Unincorporated King County. The lake line system includes approximately 14 miles of lake lines along the Lake Washington shoreline, 15 pump stations and 8 flush stations. The lake lines are wastewater pipes that are in the lake or on shoreline-adjacent land. These lines are composed of differing materials including approximately 9 miles of cast iron, 3 miles of asbestos cement, and 1 mile of unknown and miscellaneous material types. Wastewater enters the lake line through City-owned collectors and numerous private laterals that discharge directly to the lake line.

The lake line system relies on lake freshwater intakes that combine with wastewater flows at flush stations, and boosted pressure at pump stations to convey wastewater to the City's upland gravity system or the King County Wastewater Treatment Division regional conveyance system.

ES.1 System Alternatives and Other System Improvements

The lake line system has many unique challenges in contrast with a traditional wastewater system. Much of the current system's condition is unknown due to limited access and the resultant challenge to regularly clean and inspect it. The system is vulnerable to blockages caused by flat pipe slopes and debris buildup in the lines. Most of the system is in a sensitive habitat that would result in impacts to important fish and wildlife species if the system requires repair or replacement.

Strategies for lake line system management include system alternatives and other system improvements. System alternatives are defined as a capital improvement that will reconstruct an equivalent of the existing lake line system that maintains sewer service to existing customers. Specific rehabilitation or replacement methods have been organized into four programmatic system alternative categories: 1) in-water, 2) onshore, 3) upland, and 4) no action. Other system improvements are designed to maintain operation of the existing lake line system until the system alternative is implemented. Other system improvements have been organized into five categories: 1) operations procedure review, 2) cleaning and inspection, 3) access improvements, 4) data collection, and 5) emergency repair planning.

ES.2 Policy Considerations

Much of the existing City sewer lake line system was constructed before many of the City's policies and codes were developed. The City also has sewer system agreements in place with neighboring communities and King County. A review of these existing City policies, codes, and agreements yielded identified modifications or additions that may be required to implement each sewer lake line alternative. Policies and/or codes that may require modifications or additions include the Shoreline Master Program, Sewer Code, and real property policies. The relevance of specific codes and policies will vary depending on the selected system alternative. Additionally, the City will need to modify the Bellevue Utilities Sewer Code and update the Bellevue Utilities Wastewater System Plan.

ES.3 Service Area Plans and Prioritization

Service area plans were developed to summarize the key characteristics, preferred system alternative, other system improvements, and regulatory considerations for each service area. The management plan recommends implementation by service area where the highest risk-based areas are prioritized first, for efficiency in system function, design permitting, and outreach. The preferred system alternative (of in-water, onshore, or upland was determined based on seven evaluation factors: permitting, environmental impact, right-of-way and easement, performance / operations & maintenance, constructability, cost, and local community and stakeholders. The preferred alternative is a preliminary selection that provides a basis for planning and budgeting. Additional data, such as topographic survey, geotechnical investigations, real property analysis, conveyance system analysis and/or public outreach may result in a different system alternative being implemented in a given service area (or portion of an area).

The service areas were prioritized based on an overall risk score calculated from the likelihood and consequence of failure of the existing lake line. Based on the risk score, the preferred system alternative's implementation was categorized as near term, medium-term, and long-term; however, in all service areas, focused capital and other system improvements of high-risk assets are recommended to extend the estimated useful life of the existing system until the system alternative is implemented. The preferred system alternative and implementation period by service area is summarized in Table ES.1.

Table ES.1 Service Area Risk and Implementation Period Summary

<table>
<tr><th>Priority</th><th>Service Area</th><th>Preferred System Alternative</th><th>Implementation Period</th></tr>
<tr><td>1</td><td>Meydenbauer Bay</td><td>Upland</td><td>Near-term.</td></tr>
<tr><td>2</td><td>Newport South</td><td>Upland</td><td rowspan="4">Medium-term.</td></tr>
<tr><td>3</td><td>Hunts Point and Yarrow Point</td><td>Onshore</td></tr>
<tr><td>4</td><td>Killarney</td><td>Upland</td></tr>
<tr><td>5</td><td>Evergreen Point</td><td>Onshore</td></tr>
<tr><td>6</td><td>Medina South</td><td>Upland</td><td>Long-term.</td></tr>
</table>

ES.4 Financial Analysis

The financial analysis estimated the potential impacts to the capital requirements of different funding strategies to pay for the implementation of the LWWLLMP. The City used this information to estimate the potential impact on the utility's overall revenue requirements and rates based on the different possible funding mechanisms. Funding alternatives were developed as a basis to illustrate the range of funding scenarios for the project and the potential impacts on customers. Subsequent analysis may include additional scenarios or strategies, and the necessary supporting financial policies for payment structure, to fund implementation of the LWWLLMP.

ES.5 Implementation Plan

The implementation plan provides a roadmap to apply the service area plans. The implementation plan provides a detailed breakdown of activities recommended in the near-term and associated costs for the all planning periods. The sequence and timing of the improvements may change as additional data is collected and service area risk is reassessed.

The City should prioritize resources and planning efforts for emergency repairs and continued operations.

Future analysis phases will be required at a project-focused level. During the implementation process, community outreach will be conducted proactively to keep residents and other stakeholders informed.

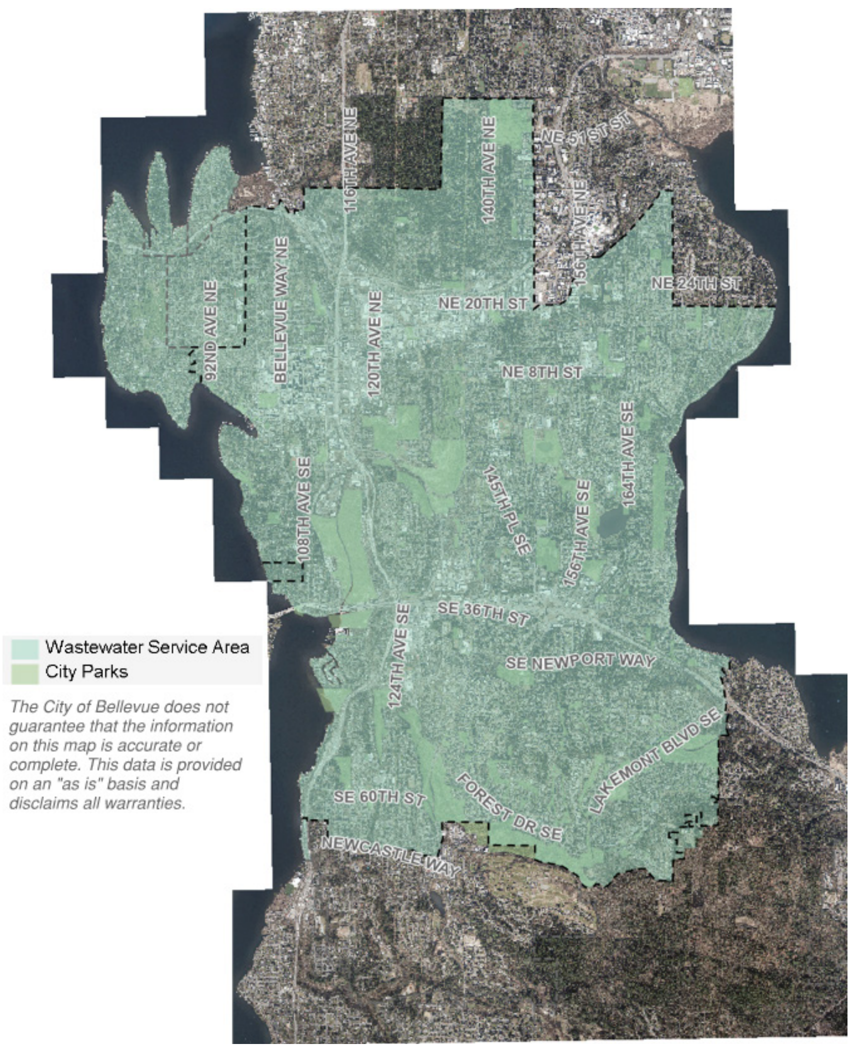
This LWWLLMP serves as an overall guide for managing the lake line system and is intended to be a living document which will change as additional data is collected, future studies and analysis are completed, priorities adapt to changing regulations, and funding is designated by the City.

CHAPTER 1 INTRODUCTION

1.1 Background and System Overview

The City of Bellevue (City) is located in King County on the east side of Lake Washington. Per the US Census Bureau, the total population is 151,854 (2020 Decennial Census). The City owns, operates and maintains wastewater collection and conveyance infrastructure that provides sewer service to the City as well as to portions of the surrounding communities.

Per the 2014 City of Bellevue Wastewater System Plan, the City's sewer system includes approximately 525 miles of sewer mains, 130 miles of service stubs (within public rights of way), 18.7 miles of lake line sewer pipe, 10 flush stations, 36 pump stations, and 14,360 maintenance holes. This includes lake line systems in both Lake Washington and Lake Sammamish.



Source: City GIS, 2024

Figure 1.1 City Wastewater Service Area

The City contracts with King County Wastewater Treatment Division (KCWTD) for treatment and disposal of all sewage flows generated within the City's wastewater service area, which eventually discharge to KCWTD regional trunks and interceptors (including the East Side Interceptor, Lake Hills Trunk and Lake Sammamish Interceptor). Wastewater flows are treated at KCWTD's Brightwater Treatment Plant in Woodinville, and the South Treatment Plant in Renton.

1.2 Ownership and Management

The City wastewater utility service area includes the entire City of Bellevue, the Cities of Clyde Hill and Medina, the Towns of Hunts Point and Yarrow Point, the Village of Beaux Arts, small adjacent portions of the Cities of Newcastle, Kirkland, and Issaquah, and unincorporated King County. The original Bellevue Sewer District on Meydenbauer Bay was founded in 1952.

The wastewater utility, including the Lake Washington Lake Line System (lake line system), is administered by the City of Bellevue Utilities Department, whose overall management is provided by the Director and the Deputy Director. The Utilities Department consists of three divisions:

- Resource Management and Customer Service.
- Engineering.
- Operations and Maintenance (O&M).

1.3 Purpose and Scope

The purpose of the Lake Washington Wastewater Lake Line Management Plan (LWWLLMP) is to provide a comprehensive guide to operational and capital investment strategies for assisting the City with managing and operating the existing lake line infrastructure and planning for future repairs and replacement. The LWWLLMP provides the public, regulatory agencies, and other stakeholders with information on the City's plans for future system management and assists with policy development and decision-making.

The LWWLLMP is a guiding document that will serve as a foundation for subsequent investments in the lake line system. The LWWLLMP will be adapted over time based on the incorporation of additional data, adaptation to evolving regulatory requirements and policies, and availability of funding. Refer to Chapter 7 - Implementation Plan for additional details for the enactment of the LWWLLMP.

1.4 Previous Studies

While the LWWLLMP is the first comprehensive study of the lake line system, the City has completed focused studies in the past on specific components. Two of these efforts that significantly informed the preparation of the LWWLLMP are:

- Sewer Lake Line Condition Assessment, Phase 2 - Lake Washington (Tetra Tech, December 2016).
- Wastewater Pump Station Evaluation Final Report (Murray, Smith & Associates, Inc., May 2015).

These reports are included in Appendix A. Refer to Chapter 2 - Existing System for additional sources of information.

1.5 Management Plan Overview

The remainder of the LWWLLMP is organized according to the chapters and appendices summarized below.

- **Chapter 2 - Existing System.** A description of the existing lake line system characteristics including history and technical data of lake line pipes, pump, and flush stations.
- **Chapter 3 - System Alternatives and Other Improvement Strategies.** A description of capital and other system improvements for use in continued operation of the existing lake line system, and alternatives for future large-scale replacement.
- **Chapter 4 - Policy Considerations.** A summary of the regulations and policies applicable to existing and replacement lake line infrastructure.
- **Chapter 5 - Service Area Plans.** A description of the delineation of service areas and associated prioritization (sequencing) for improvements. This includes six service area plans summarizing area characteristics, recommended system improvements, a preferred system alternative, and environmental and permitting considerations used as the basis for planning and cost estimating.
- **Chapter 6 - Financial Analysis.** An analysis of the financial implications of the recommendations of the LWWLLMP including impacts on rates and potential funding and financial management strategies.
- **Chapter 7 - Implementation Plan.** A roadmap for implementing the recommendations of the LWWLLMP over time including a detailed breakdown of near-term actions.

1.6 Environmental Assessment

A programmatic (non-project) Environmental Impact Statement (EIS) was prepared for the LWWLLMP, included as Appendix B. The EIS has been prepared to disclose probable significant adverse impacts associated with implementation of the LWWLLMP to repair, replace, and/or maintain the lake line system. Individual improvements identified in the plan may require that site-specific environmental review is conducted prior to implementation.

1.7 Acknowledgements

Carollo Engineers (Carollo) would like to acknowledge and thank the following individuals for their efforts and assistance in completing the LWWLLMP.

- Bellevue Utilities Directors.
- Angela Chung, Senior Utilities Planner and Project Manager.
- Christa Heller, Environmental Scientist.
- Darci Smith, Utilities Geographic Information System (GIS) Lead.
- Eric LaFrance, Utilities Planning Manager.
- Jaclyn Knoth, Utilities Asset Manager.
- Leah Mikulsky, Environmental Project Planner.
- Linda De Boldt, Engineering Assistant Director.
- Matthew Dubose, Senior GIS Analyst and Manager.

- Michaelene Fowler, Utilities Public Information Officer.
- Mike Evans, Senior Engineering Technician.
- Reilly Pittman, Environmental Planning Manager.
- Richard Peckler, Senior Engineering Technician.
- Scott Pickard, Utilities Fiscal Manager.
- Seth Mattox, Senior Engineering Technician.
- Tatsu Komada, Utilities Engineer.

CHAPTER 2 EXISTING SYSTEM

2.1 Introduction

This chapter provides an overview of the lake line system. The lake line system includes approximately 14 miles of lake lines along the Lake Washington shoreline with 15 pump stations and eight flush stations, as shown in Figure 2.1. The lake lines are sewer pipes that follow the shoreline of Lake Washington underwater, and in some cases on land adjacent to the lake. The pipe materials include cast iron (CI), asbestos cement (AC), and unknown or miscellaneous material types. Most of the lake line system was constructed in the 1950s and 1960s. Wastewater enters the lake line through City-owned collectors and numerous private side sewers that discharge directly to the lake line.

The lake line system relies on pump and flush stations to convey wastewater to the gravity system or the KCWTD regional conveyance system. All of the lake line infrastructure is located on the waterfront, with pump and flush stations and lake line pipes commonly located on private properties.

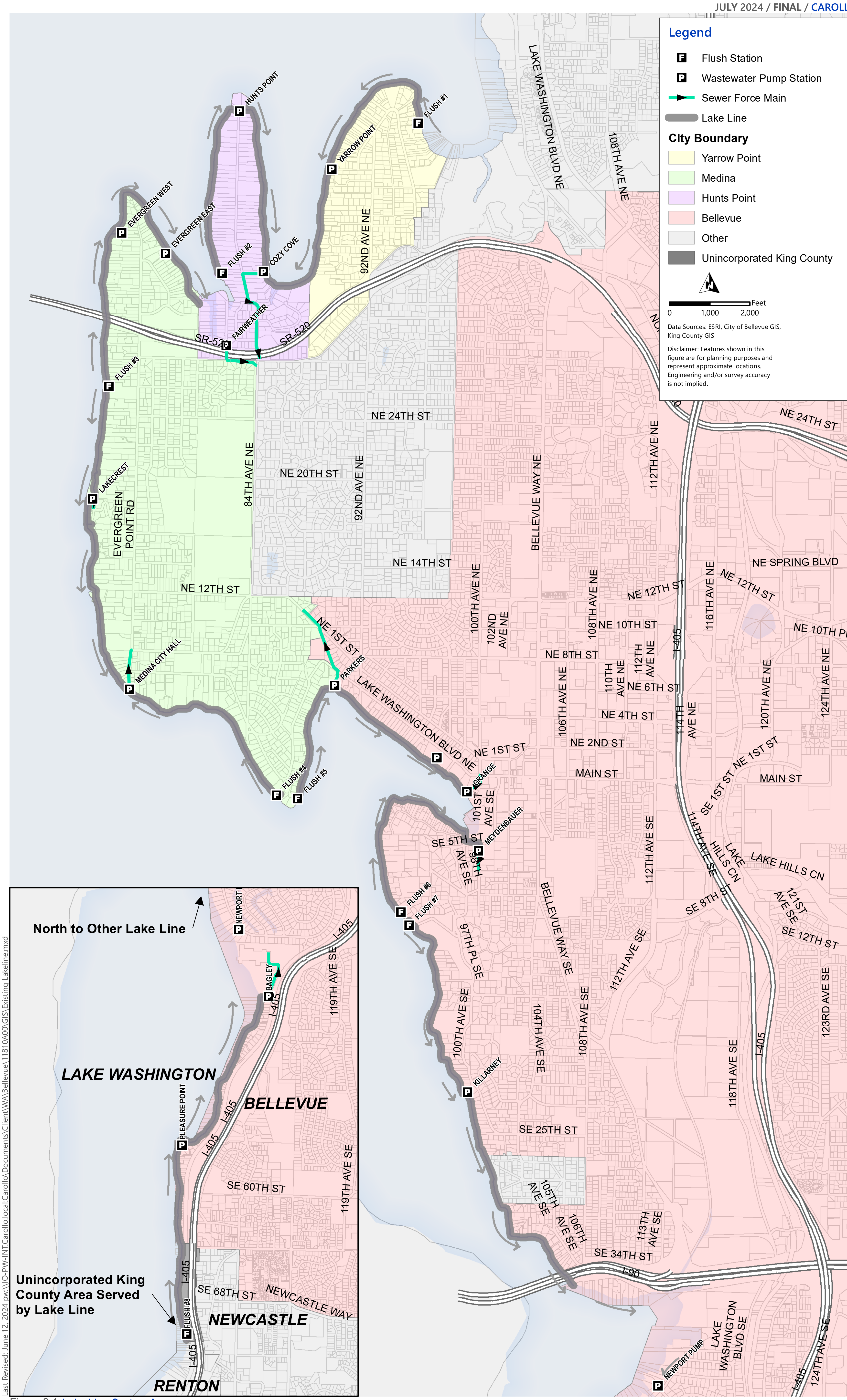


Figure 2.1 Lake Line System Area
CITY OF BELLEVUE
LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT PLAN

2.2 Lake Line System Infrastructure

The lake line system requires many infrastructure elements to function. These are summarized below:

- **Flush stations**: Pump stations that use lake water to "flush" – or assist the movement of sewage – through the lake line. Flush stations are typically run at least once per day on a set schedule, often overnight when sewer flows are lowest to maximize flushing effectiveness.
- **Lake lines**: Wastewater conveyance main pipelines buried near the shoreline in Lake Washington or the adjacent shoreline. The lake lines have unique and complex hydraulics that require different operation from the City's gravity collection mains and force mains. The lake lines are primarily low-pressure (not gravity) systems that require flushing or pumped flow to provide conveyance. Gravity main and side sewer connections convey flow to the lake lines. The buried depth varies; in some areas of the lake the pipe is exposed as a result of lakebed erosion, as shown in Figure 2.2. In the 1990s and early 2000s there were several capital improvement plan projects that placed lakebed gravel over the most vulnerable locations.
- **Lake line cleanouts and maintenance holes**: Access points to lake lines within Lake Washington that are primarily reached by boat.
- **Pump station**: Conveys wastewater flows through the lake lines or upland force main until they are discharged into the upland sewer system.
- **Force mains**: Pressurized pipelines that convey wastewater from pump stations to upland gravity sewer systems.
- **Recirculation maintenance holes**: Specialized maintenance holes located at select flush stations and intermediate pump stations that protect low-lying customers by limiting the pressure in the lake lines. Once the downstream lake line operating capacity is reached, the recirculation maintenance hole returns excess flows to the pump station rather than forcing additional flow at a higher pressure that may cause backups to low lying customers downstream.
- **Side sewer**: The piped connection extending from the wastewater source (primarily residential customers) to the public lake line. These connections are typically 4- to 6-inch diameter pipes, and many of the lake line side sewers serve more than one customer or parcel. City utility policy is that the portion of the side sewer within the right-of-way or easement area of the main (typically 10 feet wide) is owned and maintained by the City; the remainder is the responsibility of the customer.
- **Gravity mains**: Publicly owned gravity pipelines that convey wastewater to the lake line, or to an upland system.

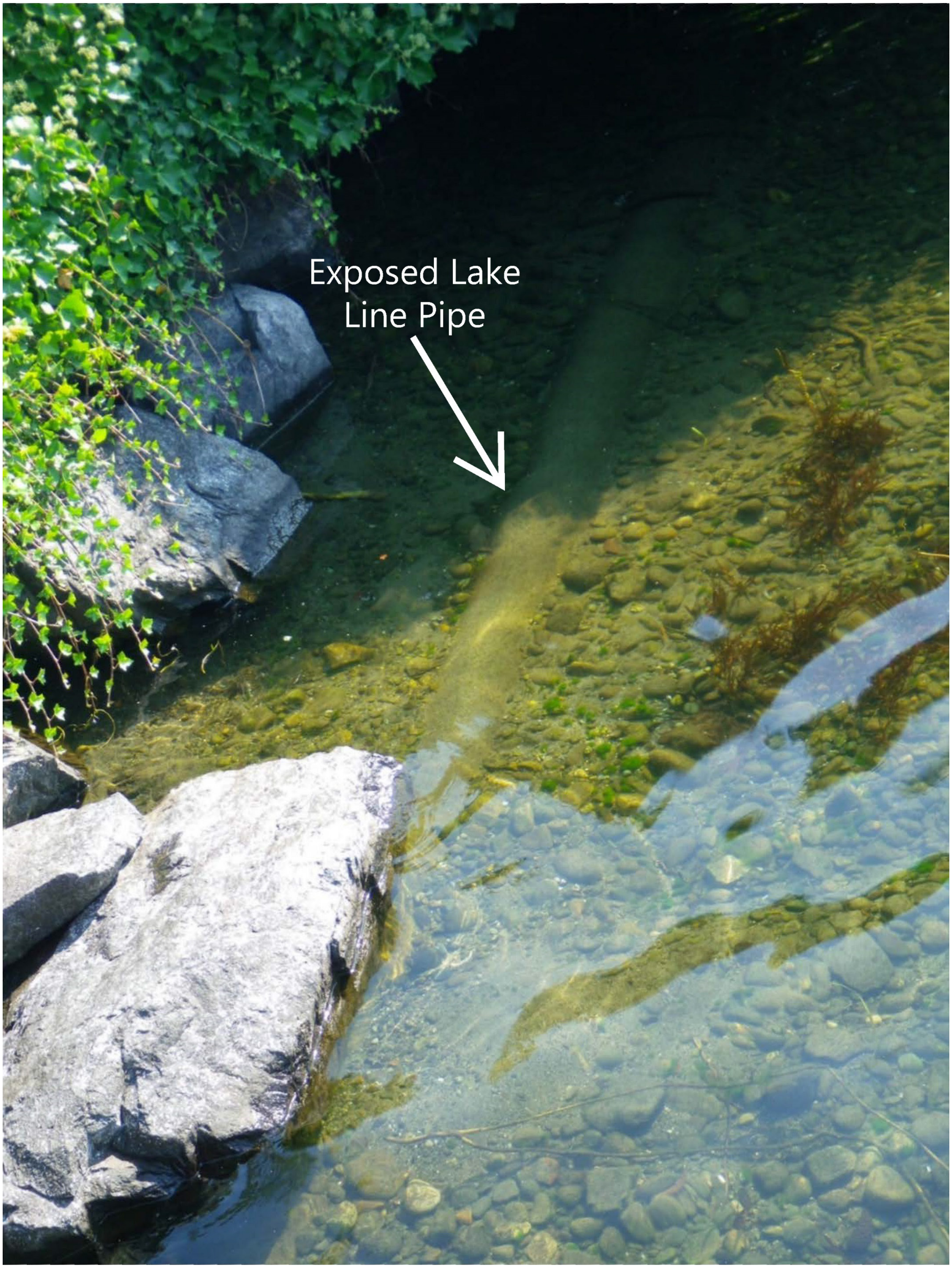


Figure 2.2 Exposed Lake Line Pipe

2.3 Lake Line System Operation

The typical lake line system operation is described in the following general steps:

- Flows from customers enter the lake line via side sewers and gravity mains.
- Flow is conveyed through the lake line by flushing flow (freshwater taken in from Lake Washington and pumped through the system) or by intermediate pump station flow (wastewater, not fresh water).
- Once flow reaches the downstream end of a reach, it is pumped to an upland gravity system where it is then conveyed to its final discharge point for treatment by KCWTD.

Sustained high flows can cause increased pressures in the lake line. High flows may be from upstream flush and pump stations, and/or infiltration and inflow (I/I) from side sewers and gravity mains, which can increase as a result of storm events. When the lake line system experiences this condition, the lake line system functions as follows:

- The recirculation maintenance hole returns the flow to a wet well to maintain lower lake line pressure. The pressure regulation that occurs is a function of the physical configuration of the recirculation maintenance hole.
- When very high wet well levels (caused by excessive inflows) are reached, most stations are relieved by an emergency overflow to Lake Washington. The overflows to Lake Washington were designed to prevent sewage from backing up into homes.

Figure 2.3 provides a schematic of the typical lake line system operation.

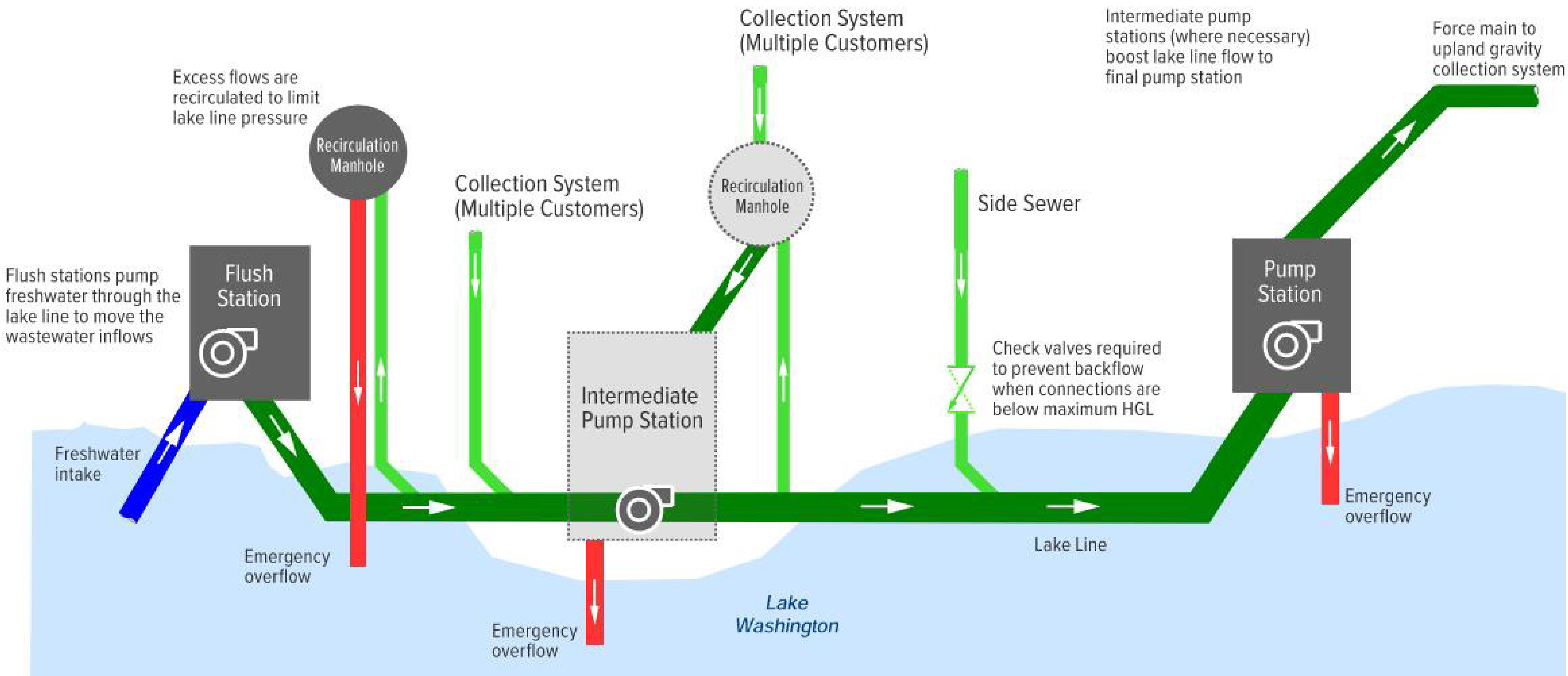


Figure 2.3 Typical Lake Line System Operation

2.4 Lake Line System Organization

The lake line system is categorized into the following classifications, as defined by the City in the 2014 Wastewater System Plan or in previous studies:

- **Basin**: The City's wastewater system is divided into basins for the purpose of system study and analysis. The City's wastewater collection system is divided into 43 major sewer basins and 14 minor basins. Generally, the basins drain to either a single connection point along KCWTD's regional collection system or to a major Bellevue pump station.
- **Sub-basin**: Each basin is divided into one or more sub-basins to cover the area connected to a specific portion of the sewer associated with an area of consistent land use zoning. Lake line sub-basins were delineated based on the previously defined lake line reaches.
- **Lake line reach**: Lake line reaches are the lake line pipes associated with each sub-basin. Lake line reaches were previously defined in 2016 Sewer Lake Line Condition Assessment Phase 2 – Lake Washington Final Report. Note: a sub-basin may include more than one lake line reach.
- **Lake line segment:** The lake line reaches are composed of pipe segments, as identified in the City's GIS data.

These components – basin, sub-basin, reach, and segment – comprise the system organization prior to the development of the Management Plan. Because the plan is a high-level management strategy, a new service area classification was defined.

The lake line system was divided into six **service areas**. The service areas were developed based on sections of the lake line with similar characteristics. A service area includes all attributes of the lake line system, such as the lake line pipe, pump/flush stations, recirculation maintenance holes, cleanouts, and side-sewers. The characteristics of a service area also include the parcels/customers, topography and land cover, zoning, critical areas, docks, and bulkheads. The service areas are, in order from north to south:

- Hunts Point & Yarrow Point.
- Evergreen Point.
- Medina South.
- Meydenbauer Bay.
- Killarney.
- Newport South.

Note that the designation of "south" in the areas of Medina South and Newport South are, respectively:

1. to provide clarification that portions the Medina South area is not limited to Medina City limits (portions of the Evergreen Point and Meydenbauer Bay are within Medina City limits), and
2. to provide clarification that the Newport South area is distinct, and south of, the Newport Shores neighborhood. See Chapter 5 – Service Area Plans for additional maps and discussion.

Refer to Figure 2.4 for a graphical illustration of the system classification hierarchy, and Figure 2.5 for a map of the lake line system.

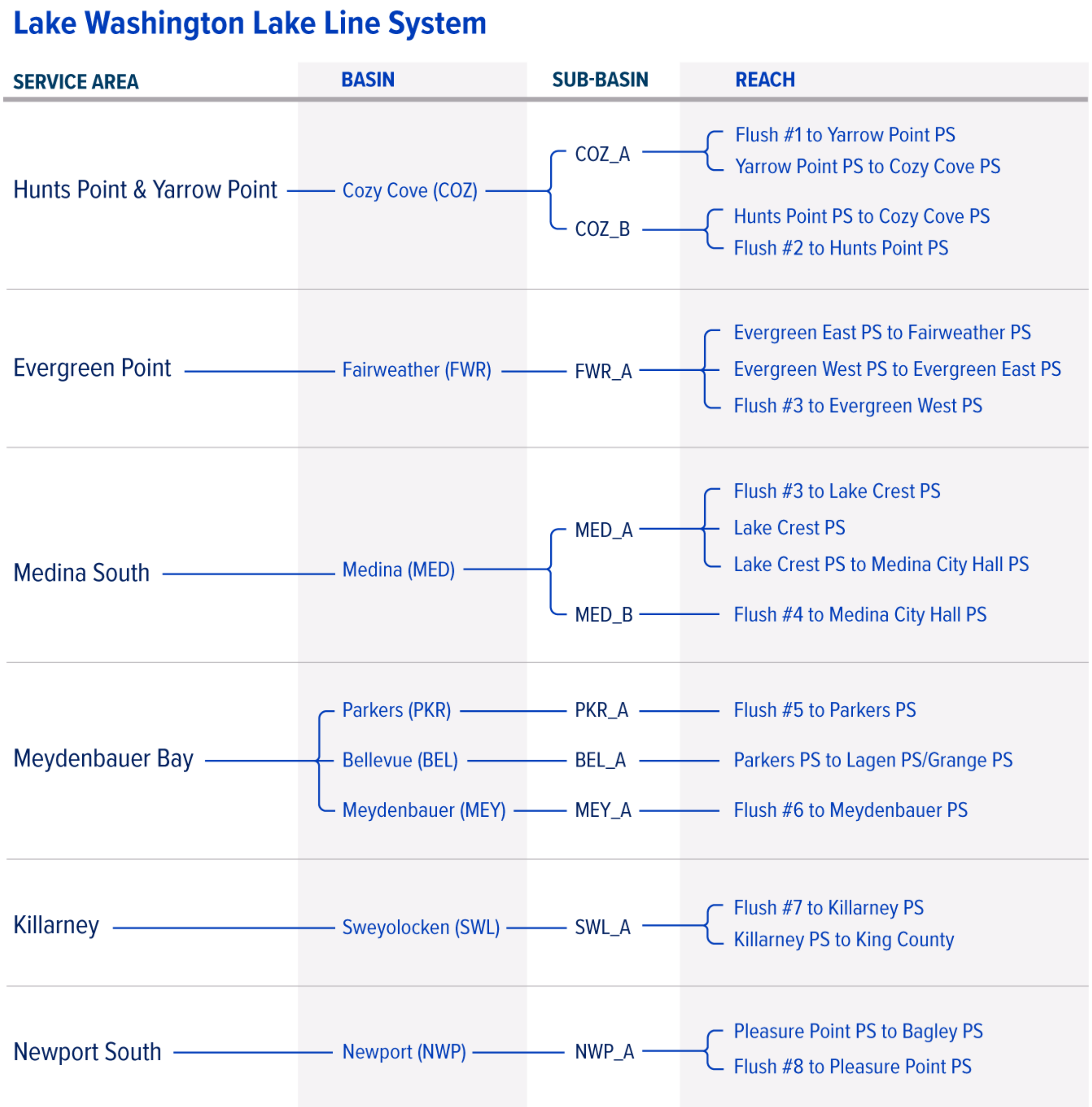


Figure 2.4 Lake Line System Classification

Table 2.1 summarizes the lake line system, organized by system classification, as well as characteristics such as pipe materials, diameters, parcels served and number of connections. Additional details of each service area can be found in Chapter 5.

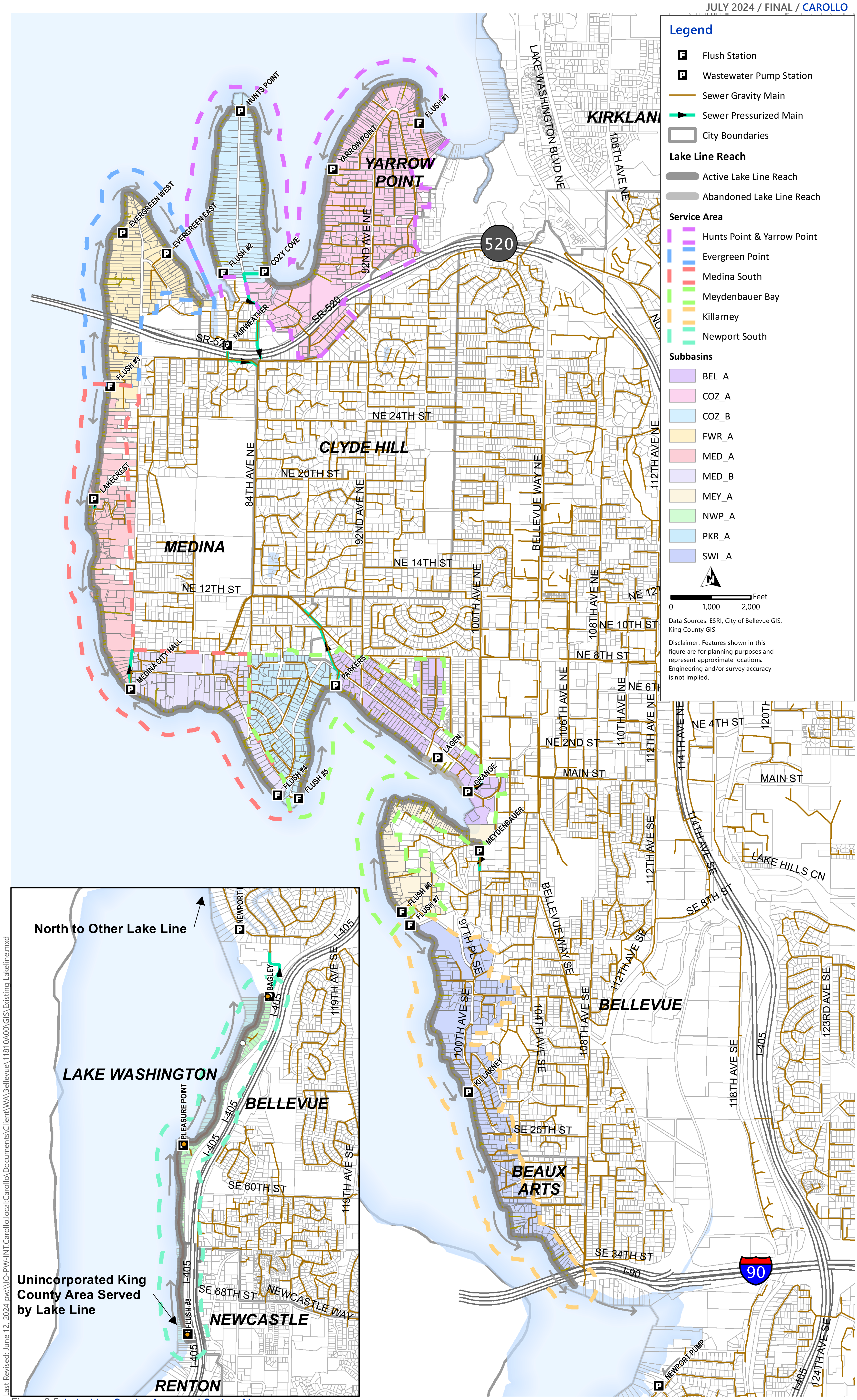


Figure 2.5 Lake Line Service Areas and System Map
CITY OF BELLEVUE
LAKE WASHINGTON SEWER LINE MANAGEMENT PLAN

Table 2.1 Lake Line System Summary

Service Area	Basin	Sub-Basin	Reach Number	Reach	Upstream FS/PS	Downstream PS	Install Date	Diameter (inches)	Material(1)	LF of Pipe	Parcels Served	Number of Connections(5)
Hunts Point and Yarrow Point	Cozy Cove (COZ)	COZ_A	1	COZ_A_1	Flush #1	Yarrow Point PS	1960	6 to 8	Mixed	4,122	245	39
			2	COZ_A_2	Yarrow Point PS	Cozy Cove PS	1960	8	CI	4,144	263	21
		COZ_B	3	COZ_B_1	Hunts Point PS	Cozy Cove PS	1960	8	CI	4,086	40	37
			4	COZ_B_2	Flush #2	Hunts Point PS	Unknown	Unknown,8	CI, Unknown	4,403	39	32
Evergreen Point	Fairweather (FWR)	FWR_A	5	FWR_A_1	Evergreen East PS	Fairweather PS	Unknown	8	AC	1,553	52	30
			6	FWR_A_2	Evergreen West PS	Evergreen East PS	1960	8	Mixed	3,096	37	26
			7	FWR_A_3	Flush #3(2)	Evergreen West PS	1960	8	CI	3,774	83	30
Medina South	Medina (MED)	MED_A	8	MED_A_1	Flush #3(2)	Lake Crest PS	1960	8	Mixed	2,726	23	14
			9	MED_A_2	N/A(3)	Lake Crest PS	1960	8	AC, CI	586	30	10
			10	MED_A_3	Lake Crest PS	Medina City Hall PS	Unknown, 1960	6 to 8	Mixed, CI	4,215	45	30
		MED_B	11	MED_B_1	Flush # 4	Medina City Hall PS	Unknown, 1959	8	CI, Mixed	4,793	115	33
Meydenbauer Bay	Parkers (PKR)	PKR_A	12	PKR_A_1	Flush #5	Parkers PS	1952	8	Mixed, AC	3,221	185	25
	Bellevue (BEL)	BEL_A	13	BEL_A_1	Parkers PS	Lagen PS/Grange PS(4)	1952	6 to 10	AC and Unknown	2,625	206	26
	Meydenbauer (MEY)	MEY_A	14	MEY_A_1	Flush #6	Meydenbauer PS	Unknown	8	Mixed, DI	5,366	100	38
Killarney	Sweyolocken (SWL)	SWL_A	15	SWL_A_1	Flush #7	Killarney PS	1965	6 to 8	Mixed	4,756	111	32
			16	SWL_A_2	Killarney PS	King County System(5)	1965	8	Mixed	6,079	182	35
Newport South	Newport (NWP)	NWP_A	17	NWP_A_1	Pleasure Point PS	Bagley PS	1965	8	CI	5,007	74	45
			18	NWP_A_2	Flush #8	Pleasure Point PS	1965	6 to 8	CI	5,168	75	58
Total										**69,720**	**1,905**	**561**

Notes:
(1) To aid in summarizing the information pipe material was characterized as CI, AC, or Mixed. Mixed was used to designate for reaches that contain short lengths of either different material interspersed with the primary material (either CI or AC).
(1) Flush Station #3 is at the service area boundary and is necessary for the operation of the lake line system in both areas.
(2) This reach is unique; it flows via gravity and does not require flushing.
(3) Lagen PS was constructed in 2016 as part of the Meydenbauer Bay Park Sewer Line Replacement (CIP S-69) and is in-line between Parkers PS and Grange PS.
(4) Discharges to King County gravity system.
(5) Includes both side sewer and upland gravity main connections to the lake line.
LF - linear feet; FS - flush station; PS - pump station.

2.5 Lake Line Pipe

The lake line system (excluding side sewers) includes approximately 69,720 feet of predominantly 8-inch diameter pipeline primarily constructed of AC or CI with a cement-mortar lining. Most of the pipeline was installed in the 1950s and 1960s.

2.5.1 Lake Line Pipe Condition

The City has previously conducted investigations to assess the condition of the lake line pipes. The pipes are generally of similar age but vary in material and installation conditions including depth of cover, and location in-water or along the shoreline. The previous condition assessments were performed by collecting small samples of the pipe called pipe coupons (considered a destructive testing method) and conducting various laboratory testing on the material properties. Phase 1 coupons were collected in 2013, and Phase 2 coupons were collected in 2016; the process and results were documented in a combined report, "Sewer Lake Line Condition Assessment Phase 2 - Lake Washington Final Report", (TetraTech, 2016). The results are summarized in Table 2.2, and the complete report is included in Appendix A. Note that additional deterioration may have occurred since the time of the original sample collections.

Table 2.2 Pipe Condition Summary - Previous Assessments

Service Area	Coupon No.	Phase	Reach	Year Installed	Diameter (inches)	Material	Condition Comments[1]
Hunts Point and Yarrow Point	N1	2	Flush #1 to Yarrow Point PS	1959	8	AC	40% Deterioration.
	N2	2	Flush #1 to Yarrow Point PS	1960	8	CI	Good condition.
	N3	2	Yarrow Point PS to Cozy Cove PS	1959	8	CI	Two layers, fractured to surface.
	N4	2	Hunts Point PS to Cozy Cove PS	1960	8	CI	Liner is no longer effective protection.
	N21	2	Flush #2 to Hunts Point PS	1960	8	CI	Liner is no longer effective protection.
Evergreen Point	EC6	1	Evergreen West PS to Evergreen East PS	1960	8	CI	Pieces of mortar debonded.
	EC8	1	Flush #3 to Evergreen West PS	1960	8	CI	Corrosion and pitting on outside of pipe.
	EC101	1	Evergreen West PS to Evergreen East PS	1960	8	AC	64% Deterioration.
	N5	2	Evergreen East PS to Fairweather PS	1960	8	AC	55% Deterioration.
	N6	2	Evergreen West PS to Evergreen East PS	1960	8	AC	70% Deterioration, Delamination.
Medina South	EC12	1	Flush #3 to Lake Crest	1960	8	CI	---
	EC14	1	Flush #3 to Lake Crest	1960	8	CI	Corrosion on outside of pipe.
	EC16	1	Lake Crest PS to Medina City Hall PS	1960	8	CI	---
	EC17	1	Flush #5 to Parkers PS	1955	8	AC	48% Deterioration.
	N8	2	Lake Crest PS	1960	8	AC	40% Deterioration.
	N9	2	Flush #4 to Medina City Hall PS	1960	8	CI	Liner fractured, separating at metal surface.
	N10	2	Flush #4 to Medina City Hall PS	1960	8	CI	Liner is no longer effective protection.
Meydenbauer Bay	EC19	1	Flush #5 to Parkers PS	1955	8	AC	46% Deterioration.
	EC20	1	Flush #6 to Meydenbauer PS	Unknown	8	DI	Less corrosion than others.
	EC21	1	Flush #6 to Meydenbauer PS	Unknown	8	AC	Less corrosion than others.
	N11	2	Parkers PS to Lagen PS/Grange PS	1960	10	AC	35% Deterioration.
	N12	2	Flush #6 to Meydenbauer PS	Unknown	8	AC	40% Deterioration.
	N13	2	Flush #6 to Meydenbauer PS	Unknown	8	CI	Liner is no longer effective protection.
Killarney	N14	2	Flush #7 to Killarney PS	1965	8	AC	40% Deterioration.
	N15	2	Flush #7 to Killarney PS	1965	8	CI	Liner is no longer effective protection.
	N16	2	Killarney PS to King County System	1965	8	CI	No liner present.
	N19	2	Flush #7 to Killarney PS	1965	8	CI	Liner is no longer effective protection.
Newport South	N17	2	Pleasure Point PS to Bagley PS	1965	8	CI	No liner present.
	N18	2	Flush #8 to Pleasure Point PS	1965	8	CI	Liner is no longer effective protection.

Notes:
(1) Refer to the complete condition assessment report included as Appendix A for condition definitions and calculations.

Refer to Chapter 5 for recommendations of additional condition assessment and data collection, and how this information was incorporated into the risk assessment and prioritization of repair and replacement of the lake line.

2.6 Pump and Flush Stations

The lake line system relies on pump and flush stations to convey wastewater to the gravity system or the King County WTD regional conveyance system. The City has previously completed comprehensive evaluations of all wastewater pump stations in the system, and they were not reassessed for the LWWLLMP. Table 2.3 summarizes lake line system flush and pump station data based on information from the following assessments:

- "City of Bellevue Wastewater Pump Station Evaluation – Phase 1" (HDR, November 2013).
- "City of Bellevue Wastewater Pump Station Evaluation – Final Report" (Murray, Smith & Associates, May 2015).

The combined report produced by Murray, Smith & Associates (which includes Phase 1 conclusions and recommendations) is included in Appendix A.

For the purposes of the LWWLLMP, the terminology of "pump station" and "lift station" is synonymous. Within the lake line system, the stations serve three different purposes.

- **Flush Station**: Freshwater intake from Lake Washington that provides flow to periodically flush wastewater through lake lines. Flush stations have "Flush" in the name, and are numbered 1-8 (Flush #1, Flush #2, etc.).
- **Mid-Run Pump/Lift Station**: Provides pumping to "boost" or continue conveyance of wastewater flows through the lake lines to the downstream lift station.
- **Pump/Lift Station**: Conveys wastewater to an upland gravity sewer discharge point.

The reported firm capacity assumes a loss of redundancy, with one pump out of service. Due to the complex hydraulics of the lake line system and presence of recirculation maintenance holes, running all pumps does not proportionally increase flow.

Table 2.3 Pump and Flush Station Summary

Service Area	FS/PS	Asset Number	Address[1]	Purpose	Recirculation Maintenance Hole	Overflow	Configuration	Number of Pumps	Pump Horsepower	Firm Capacity (gpm)	Source
Hunts Point and Yarrow Point	Flush #1	187605	4620 95th Ave NE	Flush station	Yes	Yes	Dry Pit	1	3	240(2,3)	2014 Wastewater System Plan
	Yarrow Point PS	187612	9000 NE 42nd St	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	3	380-460	2015 Pump Station Evaluation Reports
	Cozy Cove PS	187620	3268 Hunts Point Rd	Pump station	Yes	No	Wet well/Dry pit	3	10	320-410	2015 Pump Station Evaluation Reports
	Hunts Point PS	187611	4344 Hunts Point Rd	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	3	270-300	2015 Pump Station Evaluation Reports
	Flush #2	187593	3261 Hunts Point Road	Flush station	Yes	Yes	Dry Pit	1	3	240(2,3)	2014 Wastewater System Plan
Evergreen Point	Evergreen West PS	187602	3603 Evergreen Point Rd	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	3	230-260	2015 Pump Station Evaluation Reports
	Evergreen East PS	187607	3334 Lake Ln (NE 78th Pl)	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	3	490-540	2015 Pump Station Evaluation Reports
	Fairweather PS	187608	30003 Fairweather Place	Pump station	No	No	Wet well/Dry pit	3	10	750(2)	2013 Wastewater Pump Station Evaluation/ 2014 Wastewater System Plan
	Flush #3(4)	187598	2441 Evergreen Point Rd	Flush station	Yes	Yes	Dry Pit	2	3	240(2,3)	2014 Wastewater System Plan
Medina South	Lake Crest PS	187609	1823 73rd Ave NE	Mid-run pump station	Yes	No	Wet well/Dry pit	2	3	360-380	2015 Pump Station Evaluation Reports
	Medina City Hall PS	187610	501 Evergreen Point Road	Pump station	Yes	No	Wet well/Dry pit	2	15	700(2)	2013 Wastewater Pump Station Evaluation/ 2014 Wastewater System Plan
	Flush #4	187592	8875 Groat Point Drive	Flush station	Yes	Yes	Dry pit	1	3	240(2,3)	2014 Wastewater System Plan
Meydenbauer Bay	Flush #5	187594	8925 Groat Point Drive	Flush station	Yes	Yes	Dry Pit	1	5	240(2,3)	2014 Wastewater System Plan
	Parkers PS	187581	9011 Lk Wash Blvd NE	Mid-run pump station/lift station	Yes	No	Wet well/Dry pit	3	25/40/40	850(2)	2014 Wastewater System Plan
	Lagen LS	522807	9899 Lake Washington Blvd SE	Pump station	No	No	Wet well/ Dry Pit	2	5.2	245	Lagen Lift Drawings
	Grange PS	187621	9927 Meydenbauer Way	Pump station	No	No	Wet well/Dry pit	2	20	220-260	2015 Pump Station Evaluation Reports
	Flush #6	187595	903 SE Shoreland Drive	Flush station	Yes	Yes	Dry Pit	2	10	240(2,3)	2014 Wastewater System Plan
	Meydenbauer PS	187604	9931 Shoreland Dr SE	Pump station	Yes	No	Wet well/Dry pit	2	10	270-330	2015 Pump Station Evaluation Reports
Killarney	Flush #7	187596	1175 96th Ave SE	Flush Station	Yes	Yes	Dry Pit	1	3	240(2,3)	2014 Wastewater System Plan
	Killarney PS	187613	2177 Killarney Way SE	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	3	250-310	2015 Pump Station Evaluation Reports
Newport South	Pleasure Point PS	187625	5600 Pleasure Point Rd SE	Mid-run pump station	Yes	Yes	Wet well/Dry pit	2	1	240-250	2015 Pump Station Evaluation Reports
	Bagley PS	187626	4400 Lake Washington Blvd SE	Pump station	No	No	Wet well/Dry pit	2	5	175-185	2015 Pump Station Evaluation Reports
	Flush #8	187601	70011 Ripley Lane	Flush station	Yes	Yes	Dry Pit	1	3	240(2,3)	2014 Wastewater System Plan

Notes:
(1) Address provided is nearest addressed parcel, if no address is given to location of pump or flush station site.
(2) Value from 2014 Wastewater System Plan based on manufacturer pump curves.
(3) Flush stations do not require redundancy; therefore, the total capacity is assumed to be firm.
(4) Flush #3 is located at the service area boundary and is necessary for the operation of the lake line system in both areas.
gpm - gallons per minute.

2.6.1 Station Condition

The 2015 Pump Station Evaluation Reports determined the remaining useful life (RUL) of the pump and flush stations of the lake line system, which are summarized in Table 2.4. The RUL was assessed based on four following asset groups:

- **Electrical system:** Heating, ventilation, and air conditioning, lighting, generator failure, load center, outlet, transfer switch, service entrance, motor driver.
- **Telemetry system:** Communication failure, control system, device failure, supervisory control and data acquisition (SCADA).
- **Generator (if applicable):** Battery, cooling system, electrical, equipment failure, fuel, hardware, motor, time clock. Note: only permanent on-site generators were evaluated.
- **Rotating assembly:** Bearing, valve, coupling, impeller, mechanical seal, motor.

Improvements included structural repairs and recoating, motor rebuilds, pump rebuilds, site landscaping, electrical improvements, telemetry system improvements, and generator improvements. The RUL of stations not in the 2015 Pump Station Evaluation Reports are unknown.

The 2013 HDR study included recommendations for improvements within specific time frames. Improvements with high or medium ratings have surpassed the recommended replacement period.

Table 2.4 Pump Station Condition

Service Area	FS/PS	Structure RUL	Electrical System RUL	Telemetry RUL	Generator RUL	Rotating assembly (Pumps and Motors) RUL
Hunts Point and Yarrow Point	Flush #1	Not included in evaluation.				
	Yarrow Point PS	10-15	5-10	5-10	Not on-site	0-5
	Cozy Cove PS	10-15	10-15	0-5	5-10	5-10
	Hunts Point PS	20-25	5-10	0-5	Not on-site	0-5
	Flush #2	Not included in evaluation.				
Evergreen Point	Evergreen West PS	20-25	10-15	10-15	Not on-site	0-5
	Evergreen East PS	10-15	10-15	0-5	Not on-site	0-5
	Fairweather PS	Not included in evaluation.				
	Flush #3	Not included in evaluation.				
Medina South	Lake Crest PS	20-25	10-15	10-15	Not on-site	0-5
	Medina City Hall PS	Not included in evaluation.				
	Flush #4	Not included in evaluation.				
Meydenbauer Bay	Flush #5	Not included in evaluation.				
	Parkers PS	Not included in evaluation.				
	Lagen Lift	Not included in evaluation due to recent construction (2016).				
	Grange PS	20-25	10-15	5-10	5-10	5-10
	Flush #6	Not included in evaluation.				
	Meydenbauer PS	20-25	10-15	10-15	Not on-site	0-5

Service Area	FS/PS	Structure RUL	Electrical System RUL	Telemetry RUL	Generator RUL	Rotating assembly (Pumps and Motors) RUL
Killarney	Flush #7	Not included in evaluation.				
	Killarney PS	20-25	15-20	10-15	Not on-site	0-5
Newport South	Pleasure Point PS	20-25	15-20	10-15	Not on-site	0-5
	Bagley PS	10-15	30-35	10-15	Not on-site	0-5
	Flush #8	Not included in evaluation.				

2.6.2 Station Operational Information

The City provided available operational information on the lake line pump stations, which is summarized in Table 2.5. Note, the City collected information as part of periodically jetting lake lines in the past; however, these activities have been suspended due to operational challenges. Historical jetting information has not been included in the LWWLLMP due to a concern that it no longer represents the current condition of the lake lines.

2.6.3 Station Access

The City's lake line pump stations are commonly located on the waterfront and on private properties, this often makes access difficult. Table 2.6 summarizes the accessibility to pump stations based on the 2015 Pump Station Evaluation Reports. The accessibility of flush/pump stations not provided in the 2015 Pump Station Evaluation Reports is unknown.

Table 2.5 Summary of Operational Data

Service Area	FS/PS	Hydraulic Information Available	Operational Data Available	Use Of Operational Data
Hunts Point and Yarrow Point	Flush #1	▪ Pump capacity	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
	Yarrow Point PS	▪ Hydraulic grade lines. ▪ Pump draw down testing.	▪ Three months of run times. ▪ On/off times. ▪ Wet well level.	▪ Characterize wet weather operations. ▪ Validating wet well/pump station operations.
	Cozy Cove PS	▪ Hydraulic grade lines. ▪ Pump drawdown testing.	▪ Dye testing.	▪ Characterize wet weather operations. ▪ Dye testing allows velocity estimates in reach.
	Hunts Point PS	▪ Hydraulic grade lines. ▪ Pump draw down testing.	▪ Three months of run times.	▪ Characterize wet weather operations. ▪ Validating wet well/pump station operations.
	Flush #2	▪ Pump capacity.	▪ Run Times – December 19 Daily On/Off times.	▪ Characterize wet weather operations.
Evergreen Point	Evergreen West PS	▪ Hydraulic grade lines. ▪ Pump draw down testing.	▪ Available on request.	▪ Characterize wet weather operations.
	Evergreen East PS	▪ Hydraulic grade lines. ▪ Pump draw down testing.	▪ Three months of run times.	▪ Characterize wet weather operations. ▪ Validating pump station operations.
	Fairweather PS	▪ Pump drawdown testing.	▪ Available on request.	▪ Establishes actual pump station capacity.
Medina South	Flush #3	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
	Lake Crest PS	▪ Hydraulic grade lines. ▪ Pump draw down testing.	▪ Three months of run times.	▪ Characterize wet weather operations. ▪ Validating pump station operations.
	Medina City Hall PS	▪ Pump drawdown testing.	▪ Available on request.	▪ Establishes actual pump station capacity.
	Flush #4	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
Meydenbauer Bay	Flush #5	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
	Parkers PS	▪ Hydraulic grade lines.	▪ Available on request.	▪ Partial information on elevations.
	Lagen Lift	▪ None.	▪ Available on request.	▪ None.
	Grange PS	▪ Pump drawdown testing.	▪ Available on request.	▪ Establishes actual pump station capacity.
	Flush #6	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
	Meydenbauer PS	▪ Pump drawdown testing.	▪ None.	▪ Establishes actual pump station capacity
Killarney	Flush #7	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.
	Killarney PS	▪ Rehab drawings. ▪ Hydraulic grade lines. ▪ Pump drawdown testing.	▪ Three months of run times.	▪ Characterize wet weather operations. ▪ Validating pump station operations.
Newport South	Pleasure Point PS	▪ Rehab drawings. ▪ Hydraulic grade lines. ▪ Pump drawdown testing.	▪ Three months of run times. ▪ Dye testing.	▪ Characterize wet weather operations. ▪ Validating pump station operations. ▪ Dye testing allows velocity estimates in reach.
	Bagley PS	▪ Pump drawdown testing.	▪ Dye testing.	▪ Establishes actual pump station capacity. ▪ Dye testing allows velocity estimates in reach.
	Flush #8	▪ Pump capacity.	▪ Run times: December 19, 2019, daily on/off times.	▪ Characterize wet weather operations.

Table 2.6 Summary of Pump and Flush Station Access

Service Area	FS/PS	Vehicle Access to Site	Landscaping	Public Accessibility to Site
Hunts Point and Yarrow Point	Flush #1	Via private access drive from 95th Ave NE.	Grass and shrubs.	Private homeowner only.
	Yarrow Point PS	Via NE 42nd St. Removable bollards at pavement end, 50 feet from site, allow vehicle access to site if needed.	Grass.	Full access to site – public access point to lake.
	Cozy Cove PS	Gravel pull-off on private lot to access generator vault, homeowner's driveway to access station.	A lot of landscaping, service cabinet.	Located on private lot, generator vault and service cabinet on side of road.
	Hunts Point PS	End of Hunts Pt. Rd, cul-de-sac, parking adjacent to station.	Concrete Pavement.	Full access to site, turn around access to several homes.
	Flush #2	Via customer driveway but 75 feet away.	Shrubs around vault.	Private homeowner only.
Evergreen Point	Evergreen West PS	One lane steep driveway, parking adjacent to station near private residence.	Cedar fence surrounds station to obscure view of vault hatches.	Full access to site.
	Evergreen East PS	Direct, must back down narrow one lane street, no turn around.	Gravel.	Public path to dock.
	Fairweather PS	Vehicular access to this station is via Fairweather Place.	Asphalt pavement and shrubs.	Full public access, though the station is on utility owned property, and not in the ROW.
Medina South	Flush #3	Only accessible by boat.	Forested lot.	Private homeowner only.
	Lake Crest PS	Narrow paved road, parking adjacent to station.	Shrubs around vault, maintained by others.	Full access to site, with significant private security in the vicinity.
	Medina City Hall PS	The Medina Pump Station is adjacent to Medina City Hall and shares a common access road with wheelchair access to the City Hall Building.	Maintained by City of Medina staff.	Full public access.
	Flush #4	Park in homeowner's driveway, walk behind house to lakefront.	Shrubs around vault.	Private homeowner only.
Meydenbauer Bay	Flush #5	Boat access to vault or street access to private homeowner's gate. Must call security to access.	Gravel and shrubs around vault, tall grass and shrubs by recirculation maintenance hole.	Private homeowner only.
	Parkers PS	Pedestrian access only.	Grass and shrubs.	Private homeowner only.
	Lagen Lift	Must remove bollards and drive on the Meydenbauer Beach Park promenade.	Vault surrounded by concrete of promenade.	Public access, inside park adjacent to children's play area.
	Grange PS	Easily accessible, two parking stalls reserved for City staff.	Rock retaining wall 3-6 inches high along one side, station area paved, bushes surrounding.	Near marina, public access to site.
	Flush #6	Vehicle access easement from driveway above, but most commonly accessed by foot from Flush Station 7 parking. Must call private security to access.	Small building.	Private homeowner.
	Meydenbauer PS	Two-way street, parking adjacent to site.	Paved space – prune bushes near site.	Public access, adjacent to sidewalk along 100th Ave SE.
Killarney	Flush #7	Vehicle access next to station, reserved utility parking (frequently taken up by adjacent homeowner landscapers).	Arbor Vitae hedge around station.	Public ROW.
	Killarney PS	Steep driveway, switch back pavement driveway, parking 20 feet from station.	Heavy cover - fir trees.	Within unmarked/ unimproved public ROW.
Newport South	Pleasure Point PS	Private concrete driveway to station.	Shrubs surrounding vaults.	Private homeowners with shared driveway.
	Bagley PS	Gravel driveway from paved park entrance, parking 100 feet away from station.	A lot of grass, City mows area and takes care of driveway.	Minimal public access.
	Flush #8	Vehicles park on Ripley Ln and must walk down stairs between houses.	Next to grass, trees, and shrubs.	Private homeowner only.

Notes:
ROW - right-of-way.

2.6.4 Flush Station Intakes

Flush station intakes draw in fresh water from Lake Washington. Water rights, or a legal right to use a certain amount of public water for a beneficial purpose, may have been historically granted to the City, for this use. Any modification or abandonment of a flush station may be limited by water rights. Alternatively, if the water rights allow for repurposing, any abandonment or reduction in flush stations may allow other uses for these water rights, if they exist.

2.7 Lake Line System Standards

The City's Sanitary Sewer Engineering Standards (2024 edition) includes design standards and standard details for the wastewater system. The following standards and details apply specifically to the lake line:

Design Standards:

- S4-22 Mechanical Sewer Plug for Lake Line Cleanout.
- S5-19 Check Valve.
- S5-20 Lake Line Cleanout.
- S6-14.1 Lake Line Connections.
- S6-14.5 Check Valves.

Standard Details:

- S-23 Lake Line Cleanout and Check Valve Assembly Installation.
- S-24 Lake Line Cleanout and Check Valve Assembly Installation at or Below Hydraulic Gradient.
- S-25 Cleanout to Grade for Lake Line Connection.

2.8 Lake Line System Analysis

This Section presents an evaluation of the lake lines' available capacity to convey current projected sewer flows in the existing system. After updating and calibrating the City's collection system hydraulic model, major pipes and pump stations in the lake line system were evaluated using the established capacity criteria. Additional details on the hydraulic model and calibration can be found in the complete technical memorandum included as Appendix C.

2.8.1 Performance Criteria

2.8.1.1 Design Storm

Design storms are simulated rainfall events used to analyze the performance of a collection system under peak flows and have a specific recurrence interval and rainfall duration. The National Oceanic and Atmospheric Administration (NOAA) publishes isopluvial (rainfall contour) maps that can be used to approximate the total rainfall depth for a given range of design storms. Additionally, an appropriate storm hydrograph is required to distribute the projected rainfall through the design period. Finally antecedent conditions should be considered, as Pacific Northwest storms tend to span multiple days which can lead to saturated ground conditions increasing runoff. The best approach to address hydrograph and antecedent conditions is to base analysis on a historical precedent. The City has selected a wet weather event from 2017 to represent the design event hydrograph. This hydrograph's volume was scaled up to represent a 24-hour storm recurrence interval of 25 years based on the NOAA design events[1].

Figure 2.7 shows the scaled historical design storm rainfall intensity and duration used for the capacity analysis. A period of rain events occurred over three days. The storm peak lasts 24 hours, with a peak rainfall intensity of 0.30 inches per hour and a 24-hour volume of 3.75 inches.

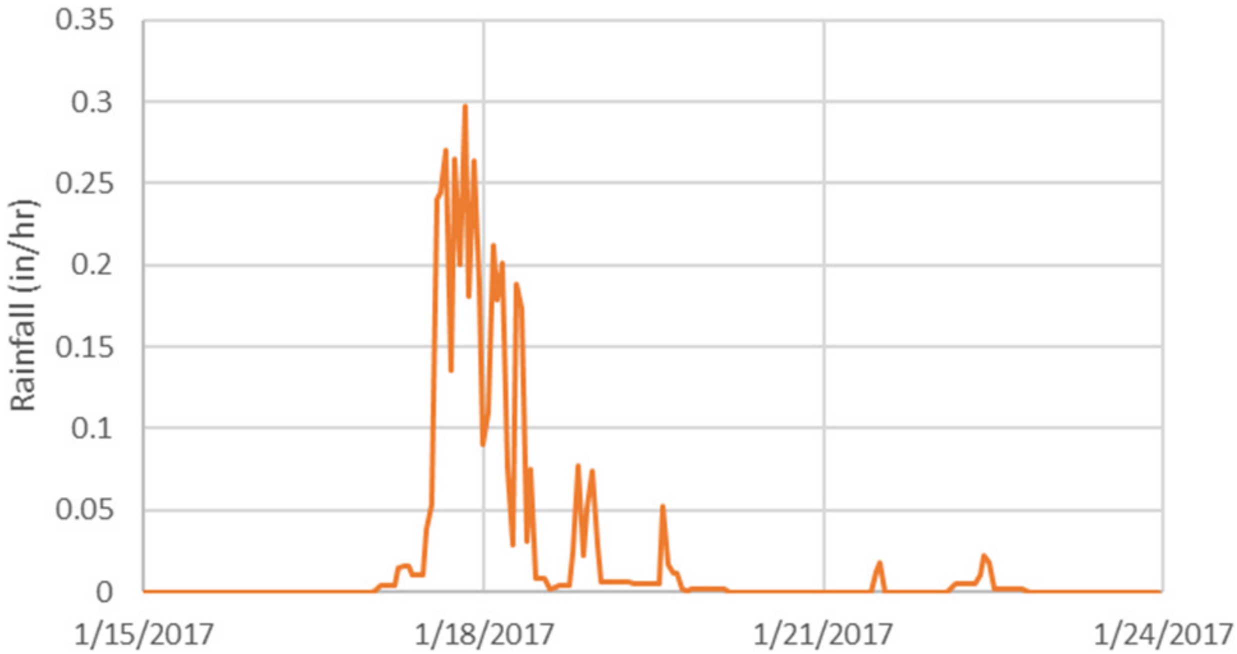


Figure 2.6 Lake Line System 25 Year Design Storm

2.8.1.2 Conveyance System

Any new pump station recommendations will need to follow the City's Sewer Standards for pump stations and force main construction to meet Department of Ecology (Ecology) requirements. Ecology's requirements are outlined below:

- The firm capacity of a pumping station shall be equal to or greater than the peak hourly design flow. Because mechanical and electrical equipment is typically designed for a 20-year life span, it is recommended that the peak design flow be based on a 20-year forecast or greater.
- The number of pumps selected shall allow the station to provide the peak design flow with the largest pump out of service.
- The station shall be designed to remain fully operational during the 100-year event.
- Pumps should be designed for pumping sewage and should be capable of passing solids at least 3-inches in diameter. Pump suction and discharge should be 4 inches or greater.

[1] NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume IX-Washington, 1973.

The City's performance criteria requirements for existing pump stations include firm capacity (i.e., capacity with largest pump out of service) and force main velocities. According to City Sewer Standards, firm pump capacity shall be provided to manage the design storm peak hour flow, also known as the peak wet weather flow (PWWF), from the pump station's tributary area with the largest pump out of service. Therefore, the City's pump stations should have sufficient firm capacity to pump the PWWF during the design storm.

The modeled occurrence of recirculation in recirculating maintenance holes and any potential overflows during the design storm will be identified.

2.8.2 System Deficiencies

Under existing calibrated conditions with all pumps allowed to run and active recirculating manholes, there are no surcharging lake lines, indicating a current low risk of pipeline capacity driven deficiencies.

Ensuring pump stations and downstream lake line have adequate capacity to convey PWWFs is important for preventing sewage overflows at or near pump stations. In accordance with the established performance criteria, the City's existing modeled pump stations were evaluated to determine if each one has the available capacity to convey existing and future PWWFs with the largest pump out of service (i.e., its firm capacity). If a pump station has inadequate capacity to pump the PWWFs, the water level in the wet well may rise to the overflow point, spilling sewage.

The estimated current PWWF was compared to the modeled pump stations' firm capacities. Pump stations with an influent PWWF above the existing firm capacity were flagged as deficient. Table 2.10 summarizes the results of the pump station evaluation. Yarrow Point and Cozy Cove are shown as deficient under PWWFs. Yarrow Point, Cozy Cove, and Evergreen East all show some volume of overflow during peak flows. Yarrow Point, Evergreen West, and Evergreen East all have active recirculating maintenance holes.

Table 2.7 Hydraulic Model Results - Pump Station Capacity Analysis

Pump Station	Total Capacity(2) (gpm)	Firm Capacity(1) (gpm)	Existing PWWF (gpm)	Volume of Overflow (MG)	Recirculating Maintenance Hole Active?
Yarrow Point PS	760	380	1,168	0.66	Yes
Hunts Point PS	540	270	120	N/A	No
Cozy Cove PS(3)	480	320	877(3)	0.04	No
Evergreen West PS	460	230	152	N/A	Yes
Evergreen East PS	980	490	304	0.38	Yes
Lake Crest PS	720	360	138	N/A	No
Medina City Hall PS	1,050	700	264	N/A	No
Parkers PS	1,275	850	502	N/A	No
Lagen Lift	490	245	198	N/A	No
Meydenbauer PS	540	270	66	N/A	No
Killarney PS	500	250	160	N/A	No
Pleasure Point PS	480	240	138	N/A	No
Bagley PS	350	175	168	N/A	No

Notes:
(1) Assumes lower end of firm capacity range.
(2) Assumes total capacity is firm capacity times number of pumps.
(3) Reported PWWF is likely reduced by loss of flow at Yarrow Point PS overflow in model.
MG - million gallons.

2.8.3 Analysis Conclusions

The system analysis results are used to inform improvements implementation as described in Chapters 5 and 7. In the Hunts Point and Yarrow Point service area, the Yarrow Point PS Cozy Cove PS, and sub-basins COZ_A, and COZ_B experienced some level of deficiency during the 25-year design storm. In the Evergreen Point service area, the Evergreen West PS, Evergreen East PS and sub-basin FWR_A indicate capacity deficiencies. See Chapter 5 for additional details on the recommended pump and flush station improvements.

The lake line hydraulic model was built with limited GIS data and uncertainty regarding lake line elevations, blockages, and losses across each reach. The calibration was performed to estimated pump station flows from wet well levels. There is some level of uncertainty, and the capacity analysis is for planning purposes. TM1 outlines the model calibration and development and provides more details on the model uncertainty. While there are limitations, this capacity analysis can help prioritize areas based on risk of capacity deficiencies.

The model can be utilized in the future to analyze a range of different storm events, changes in conditions including climate change impacts, or new or refined data sources (surveyed pipe elevations, improved flow and overflow monitoring). If the design storm or modeling standards are modified with future updates to the City's Wastewater System Plan, those modifications should also be incorporated into the lake line system model.

2.9 Environmental Conditions

The lake line system is influenced by environmental factors in upland areas, shoreline areas, and within Lake Washington (i.e., in-water areas). This section summarizes the environmental conditions and regulations relevant to the existing lake line system. For additional detail, refer to the Aquatic Existing Conditions Report that was prepared as part of the LWWLLMP, included as Appendix D.

Lake Washington is a part of the Lake Washington/Cedar/Sammamish Watershed Water Resource Inventory Area (WRIA 8) as defined by the Washington State Department of Ecology.

Additional environmental conditions and impacts are also discussed in relation to system alternatives for replacement - see Chapter 3.

2.9.1 Critical Areas

Critical areas are parts of the landscape afforded special protection status because they provide unique environmental functions that are difficult, if not impossible, to replace (Bellevue City Code [BCC] 20.25H.025). The City code protects six types of critical areas:

- Streams and Riparian Areas.
- Wetlands.
- Habitats of Species of Local Importance.
- Geological Hazard Areas.
- Flood Hazard Areas.
- Shorelines.

The City code prohibits disturbance or modifications to critical areas unless specifically allowed in the code and requires buffers and building setbacks (BCC 20.25H.035).

The Points Communities (Medina, Hunts Point, Yarrow Point) have similar critical area regulations.

Critical area ordinances require site-specific investigations to identify critical areas. Representative GIS information has been identified from the City (Bellevue 2024) and King County (2024) sources for the purposes of developing the LWWLLMP. Detailed site-specific investigations at a project level will be required as the lake line system is upgraded and replaced.

2.9.2 Fisheries and Aquatic Ecosystems

The Lake Washington/Cedar/Sammamish Watershed (WRIA 8) is a high priority area (Tier 1) for salmon recovery efforts (WRIA 8 Salmon Recovery Council 2017). Both the Cedar and Sammamish rivers connect to the lake, with the Cedar River to the south and the Sammamish River to the north. Several other streams also drain into Lake Washington, including the streams within or adjacent to the lake line system. Within the littoral zone of the lake (the transitional area between upland and open water), aquatic substrate and vegetation can provide important habitats for many invertebrates and fish species, including salmonids. A well-developed riparian area within the littoral zone also helps to support native vegetation survival, increases protection from wave action if plants occur adjacent to the shoreline, and provides macroinvertebrates to aquatic habitat that are prey for fish (Toft 2001; Toft et al. 2014). Although most of the shoreline in the LWWLLMP area has been developed and modified (e.g., bulkheads, docks, residential yards, and shoreline armoring) in ways that can prevent natural bank erosion and riparian connection to shorelines, Lake Washington is still able to provide habitat complexity and sediment processes that establish and maintain aquatic environments.

2.9.3 Surface Water Resources

Surface water resources in the plan area include Lake Washington, multiple streams, and adjacent wetland systems. Notable streams within or adjacent to the lake line system include:

- Yarrow Creek.
- Fairweather Creek.
- Meydenbauer Creek.
- Mercer Slough/Kelsey Creek.
- Coal Creek.

Additional wetland within or adjacent to the lake line system include:

- Yarrow Bay Wetlands.
- Wetherill Nature Preserve.
- Beaux Art Village Wetland.
- Mercer Slough Wetland Complex.

Approximately 79 percent of the Lake Washington shoreline is composed of single- or multi-family residential development (The Watershed Company 2011). The shoreline of Lake Washington is dominated by residential development, including bulkheads, concrete stairways, and docks, but natural and recreational areas, such as parks, bays, and wetlands, are interspersed throughout the LWWLLMP area.

2.9.4 Species Use

There are seven species of salmonids present in Lake Washington and associated streams that are considered priority habitat and species, including Bull Trout (*Salvelinus confluentus*)/Dolly Varden (*S. malma*), Chinook Salmon (*O. tshawytscha*), Steelhead (*O. mykiss*), Sockeye Salmon, Coho Salmon (*O. kisutch*), Cutthroat Trout (*O. clarki*) (WDFW 2024). Of these species, three are Endangered Species Act (ESA)-listed, including Bull Trout (in upper Cedar River watershed), Puget Sound Chinook Salmon, and Puget Sound Steelhead (NMFS 2024a, USFWS 2024). Other species are considered locally important, such as Sockeye Salmon and Coho Salmon. There are also several exotic species in Lake Washington that prey on salmonids, including Smallmouth Bass (*Micropterus dolomieu*) Largemouth Bass (*M. salmoides*), and Northern Pikeminnow (*Ptychocheilus oregonensis*) (NMFS 2024b). Habitat limitations in Lake Washington for salmonids include shoreline modification, loss of riparian vegetation, and overwater structures due to urbanization within WRIA 8 (Toft et al. 2003; Smith 2005; WRIA 8 Salmon Recovery Council 2017).

2.9.5 In-Water Work Lake Washington

Environmental protections have a strong influence on the timing and requirements of work on the lake lines within Lake Washington. In-water work is generally defined as efforts disturbing the water column or sediment. Permitted in-water work commonly requires some form of mitigation, which may include in-water work windows (also referred to as fish windows); sediment/fish barriers during construction (e.g., turbidity curtains, cofferdams); minimization of damage to riparian, wetland, and aquatic vegetation; control of sediment and erosion at the job site; and restoration of disturbed sediment or habitat.

Timing of in-water work in Lake Washington is generally limited during specific in-water work windows to protect sensitive life history stages of salmonids. These in-water work windows are influenced by the combination of four factors which include:

- Location in Lake Washington.
- Presence of known sockeye salmon spawning areas.
- Timing of rearing and migrating juvenile Sockeye Salmon, Chinook Salmon, and Bull Trout.
- Fishing seasons in accordance with tribal treaty rights.

Where factors overlap, the most conservative timing is applied. It may be possible to extend in-water work windows, depending on the condition of the lake line (i.e., high risk areas) and the potential for lakebed and shoreline restoration.

The impact of location on general work windows is shown in Figure 2.7 and broken down below:

- North of State Route (SR) 520: In-water work window from July 16 through March 15.
- Between I-90 and SR520: In-water work window from July 16 through April 30.
- South of I-90 (further than .5 miles from Mercer Slough): In-water work window from July 16 through December 31.
- South of I-90 (within .5 miles of Mercer Slough): In-water work window from July 16 through July 31 and November 16 through December 31.

Locations in or within 100 yards of known sockeye salmon spawning areas are additionally limited to an in-water work window from July 16 - September 30. Figure 2.8 shows the Washington Department of Fish and Wildlife map of the location of known sockeye salmon spawning. If in-water work needs to be conducted outside of the standard work windows, a sockeye salmon spawning survey could potentially be conducted to seek modifications to the work window.

The last impact to access is from fishing seasons associated with tribal treaty rights. Fishing seasons are set for each year and work during fishing times would need coordination with the affected tribes. The typical scheduled fishing periods are outlined below in Table 2.9, however may differ from year to year.

Table 2.8 Fishing Seasons associated with Tribal Treaty Rights

Type	Date
Sockeye Salmon Fishing	July
Chinook Salmon Fishing	August
Coho Salmon Fishing	September and August
Chum Salmon Fishing	September – Mid November

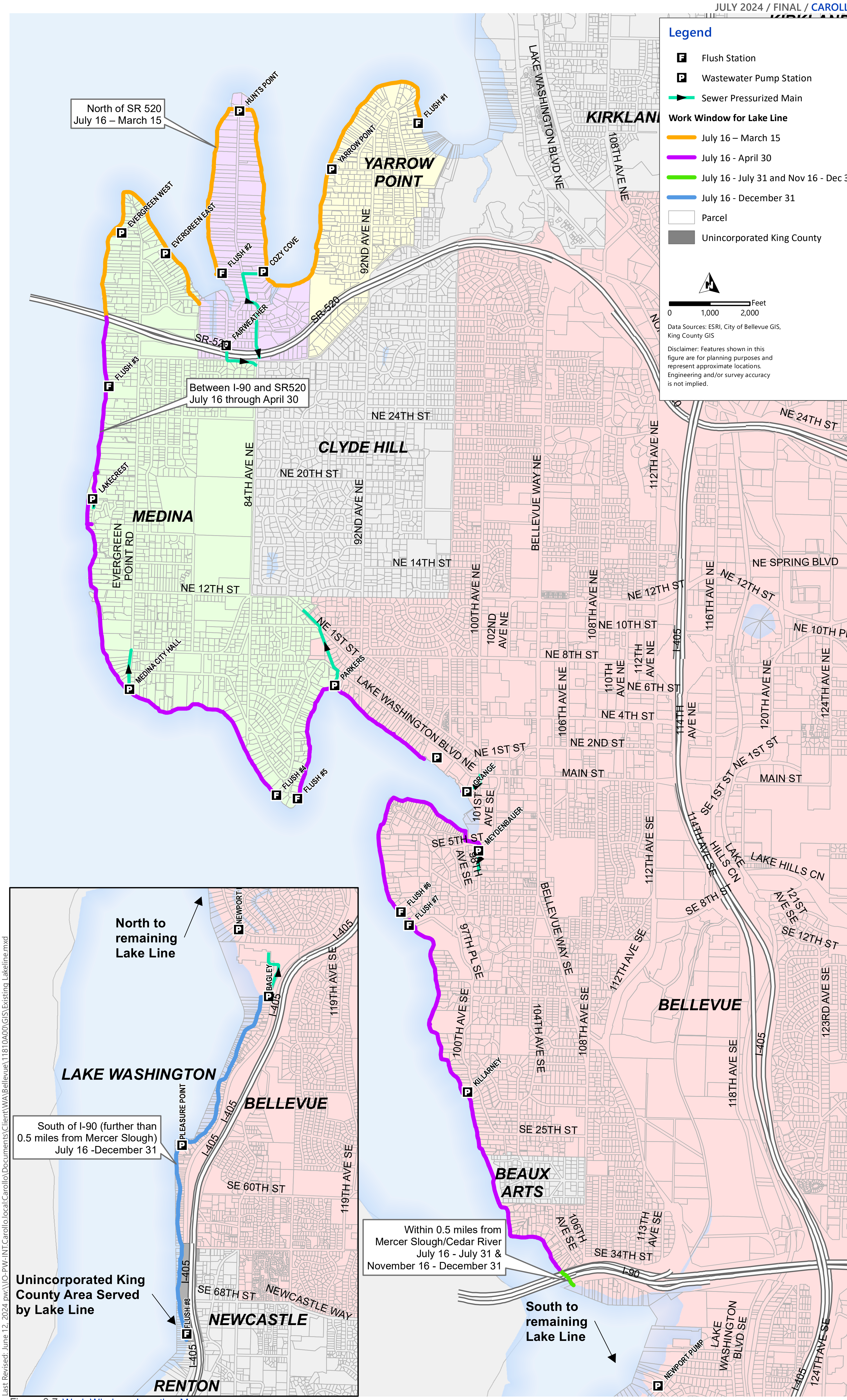


Figure 2.7 Work Windows Location Map

Figure 2.8 Lake Washington Sockeye Salmon Spawning Areas

2.10 Lake Line System Information Sources

The existing system information reported in this chapter on the lake line system and its contributing sewer basins was gathered from available data sources. Table 2.1 shows the information sources provided by the City. Major information sources included the City's GIS, available survey at the stations, pump station summary and condition reports, lake line condition reports, and available operational data. Note that few construction records exist for the lake line, except the pump stations.

Table 2.9 List of City Data/Sources

Data Sources	Type of Information
Bellevue Lake Line As-Builts	▪ Pump Station drawings.
City of Bellevue Wastewater and Lake Line GIS	▪ Lake line system components. ▪ Upland sewer collection system (sewer basins, gravity mains, maintenance holes, pump stations, force mains, etc.). ▪ King County regional sewer transmission system. ▪ Elevation contours. ▪ Floodplains. ▪ Geological hazards (liquefaction areas, steep slopes). ▪ Basemap (parcels, roads, City boundaries, lake, streams, easements, and building footprints).
King County GIS	▪ Wetlands. ▪ Lake Washington bathymetry.
Lake Washington Wastewater Lake Line HGL	▪ Minimum elevation for new development based on assumed HGL between upstream station overflow elevation and downstream elevation at station.
2015 Wastewater Pump Station Report(1)	▪ General pump station data. ▪ RUL. ▪ Easements. ▪ Hydraulics. ▪ Power/generators. ▪ Site configuration and constraints. ▪ Wet and dry well. ▪ SCADA.
2013 Wastewater Pump Station Evaluation(2,3)	▪ General pump station data. ▪ Site configuration and constraints. ▪ Wet and dry well information.
2016 Sewer Lake Line Condition Assessment Phase 2 – Lake Washington Final Report(4)	▪ Lake line condition.

Data Sources	Type of Information
Operational Data - Station Run Times	▪ Three months of run times at: » Evergreen East PS. » Evergreen West PS. » Hunts Point PS. » Killarney. » Lake Crest. » Pleasure Point. » Yarrow Point PS.
Operational Data - Station Dye Testing	▪ Velocity information from dye testing for: » Flush Station 1 to Yarrow Point PS. » Flush Station 2 to Hunts Point PS. » Flush Station 3 to Evergreen West PS and to Lake Crest PS. » Flush Station 4 to Medina PS. » Flush Station 5 to Parkers PS. » Flush Station 6 to Meydenbauer PS. » Flush Station 7 to Killarney PS. » Flush Station 8 to Pleasure Point PS. » Pleasure Point to Bagley PS.
Utilities Engineering Standards	▪ Section on lake line HGL and how customers are required to protect their homes when built within 2 feet, or below HGL.
2014 Wastewater System Plan	▪ City wastewater system information. ▪ Flush station data.
Renewal and Replacement Asset Data	▪ Age and estimated useful life of the lake line pipe.

Notes:
(1) The 2015 Pump Station Evaluation Reports prepared by Murray, Smith & Associates provided detailed information on every station except the Fairweather PS, Medina City Hall PS, Parkers PS, Flush #1, Flush #2, Flush #3, Flush #4, Flush #5, Flush #6, Flush #7, and Flush #8.
(2) The 2013 Pump Station Evaluation prepared by HDR provided partial information on the Fairweather PS and the Medina City Hall PS.
(3) Parkers PS (Lake Washington PS), Lagen Lift, and Flush #1, Flush #2, Flush #3, Flush #4, Flush #5, Flush #6, Flush No.7, and Flush #8 had little to no information available from the reports and relied on the GIS, limited as-builts, the 2014 Wastewater System Plan, and operational data.
(4) 2016 Sewer Lake Line Condition Assessment Phase 2 – Lake Washington Final Report prepared by Tetra Tech includes all lake line basins.
HGL - hydraulic grade line.

CHAPTER 3 SYSTEM ALTERNATIVES AND OTHER SYSTEM IMPROVEMENTS

3.1 Introduction

This chapter includes a discussion of the challenges of the existing lake line system, current maintenance procedures, and operational and other system improvements to maintain operation and extend the useful life of the system. Further, the chapter introduces system alternatives for repair and replacement. The existing and potential improvements and strategies presented in this chapter are generally applicable to the lake line system as a whole. For application of area-specific system alternatives and other system improvement recommendations, see Chapter 5 - Service Area Plans.

3.2 Existing System Operations

A challenge unique to the lake line is that much of the current condition of the lake line system is unknown due to limited accessibility, inspection history, and survey data. Historical flow data is also difficult to confirm as past overflows from the lake lines may not have been adequately quantified.

The existing lake line system and project areas have unique challenges that impact the City's operation of the lake line system and future rehabilitation and replacement options. In determining feasible alternatives primary concerns included the condition of the existing lake line, the number and location of improvements on each parcel (including docks and boat houses), heavy vegetation, steep slopes, and salmon spawning habitats in many locations. The below sections identify some of these key challenges and their impact on identifying potential system alternatives.

3.2.1 Operational Challenges

The lake lines are difficult to clean and have not been adequately jetted based on O&M input. Since some sewer rehabilitation alternatives require a clean host pipe, cleaning these lake lines in the future will be a priority (as long as it can be done without risking further damage to aging pipes), if certain rehabilitation alternatives are to be considered.

The current system is an operational challenge in and of itself, primarily because of flat pipe slopes and lack of access for debris removal from the line during regular cleaning operations. Access is limited by several factors; these include lack of vehicular and equipment access, limited implied or existing easements, and lack of maintenance holes and cleanouts on the line itself. If the pipeline is kept in the same alignment as it is now, these constraints will continue to hinder future O&M and life cycle costs may not be easy to reduce. This could play a role in the selection alternatives selection process, as solutions that maintain the existing pipe layout may have lingering hydraulic challenges.

The lake line system is particularly vulnerable due to having several modes of failure that result in loss of service for multiple customers (i.e., a mid-line blockage, or failure of either the flush OR pump station, results in a loss of service for all customers served by that reach). Sanitary sewer failures (relative to other utility emergencies) are particularly sensitive and likely to attract attention due to the environmental and public health risks. With much of the lake line system being located on private property or inaccessible areas, disturbances to residents – whether planned or unplanned – are likely to have significant impacts. Proactive, timely and regular maintenance and emergency preparedness is essential to uphold the functionality of the existing and future replacement of the lake line system.

3.2.2 Current Maintenance Procedures

Existing lake line infrastructure maintenance is outlined in the 2014 City of Bellevue Wastewater System Plan and includes maintenance on the pipelines, flush and pump stations, and maintenance holes. Regular inspection, condition assessments, and cleaning are scheduled for maintenance holes and pipelines to prevent blockages or structural failure. Existing maintenance based on specific system infrastructure components is summarized below.

Pump Stations - All pump stations are maintained on a monthly schedule. Inspection and wet well maintenance are performed during the first 10 business days of each month, and scheduled repairs and maintenance activities are performed during the remainder of the month. Routine minor repairs and cleaning and lubrication of pumps, controls, and pumping equipment are performed at each visit. Wet wells are hosed down until sludge and debris are discharged.

Flush Stations - Similar to pump station maintenance, flush stations are checked monthly to see that pumps, motors, dehumidifiers, and the 24-hour clock are working properly. The 24-hour clock controls flush station operation. Cell phone communication provides remote control of the flush stations' on/off capabilities.

Lake Line - Lake line, classified as special case pipelines, have limited accessibility, complicating preventive maintenance. Lake lines are primarily cleaned on an immediate response basis; some lake lines are on a regular cleaning schedule depending on past observed overflows and/or tendency for sedimentation. Cleanouts are opened and visually inspected for grease and debris buildup.

Maintenance Holes - Inspections are part of an ongoing maintenance hole survey program, and maintenance holes near lakes and other critical area buffers are surveyed more frequently. All maintenance holes are visually inspected for structural defects, system problems, and accessibility, with a goal of visually inspecting one-third of the system annually.

Emergency Repairs - Maintenance on the existing wastewater lake line system includes emergency repairs, which are distinct from planned repairs. Damage to lake line system components could lead to spills of untreated sewage. Because of the immediate nature of emergencies, the repair options available are limited and focus on reducing the threat to the proper performance of essential wastewater system functions and services. The consequences associated with emergency repairs may be higher than typical maintenance operations associated with an unplanned system failure.

3.3 System Alternatives

A **system alternative** is defined as a capital improvement that will reconstruct an equivalent of the existing lake line system. "Equivalent" is any system that maintains sewer service to existing customers of the lake line, although the system alternative may be constructed in a significantly different configuration (location, type of system, technology).

To identify the system alternatives, several workshops were conducted with the City. Specific construction methods and technologies were considered for technical, environmental, and social impacts. To conform with the non-project EIS, the specific methods of rehabilitation or replacement were organized into four programmatic alternatives: **1) no action, 2) in-water, 3) onshore, and 4) upland**. Each programmatic alternative, and the accompanying potential construction methods, are summarized in the following sections. For additional detail, refer to Appendix E - Alternatives Analysis Technical Memorandum.

3.3.1 No Action

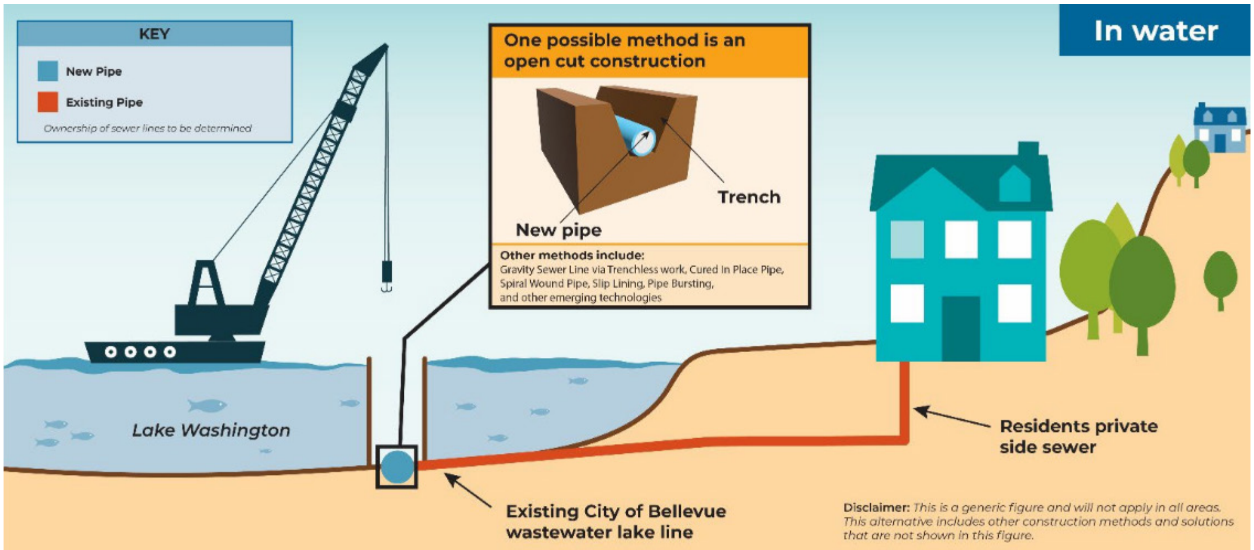
The **no action** alternative is required for consideration by the State Environmental Policy Act (SEPA). Potential implementation methods of the no action alternative include continued wastewater system operational strategies and the maintenance of existing infrastructure, cleaning and condition assessment and monitoring, piecemeal repair and replacement (projects one-by-one as needed), emergency actions, and actions taken to maintain or limit degradation of the existing system. Strategies and actions would address immediate needs but would not address long-term degradation of the existing system in a holistic manner.

Under the no action alternative, the operation and maintenance of pump stations and flush stations and associated system infrastructure would continue as before in the existing locations. Maintenance would occur as incremental and uncoordinated repairs and replacements, and the system would not function optimally. The system components will eventually fail after extending the life where feasible by conducting emergency repairs, cleaning, and condition assessments, which could result in system failures and wastewater overflows.

Other system improvements are actions taken to maintain or limit existing infrastructure degradation. Methods may include review of operations procedures, cleaning and inspection, access improvements (maintenance hole, cleanout installation), data collection, and emergency repairs. They can also include tasks for planning or preparing for capital improvements.

3.3.2 In-Water

For the **in-water** system alternative, any permanent system improvements to conveyance system infrastructure would generally be located below Lake Washington’s ordinary high-water level. The system infrastructure would either be relocated in-water or replaced in-water, as shown in Figure 3.1. Potential methods include a gravity sewer line via open cut construction or trenchless technology, or rehabilitation of the existing lake line using cured in-place pipe, spiral wound pipe, slip lining, pipe bursting, or other emerging technologies.



Source: LWWLLMP SEPA Draft EIS, Figure 1-1.

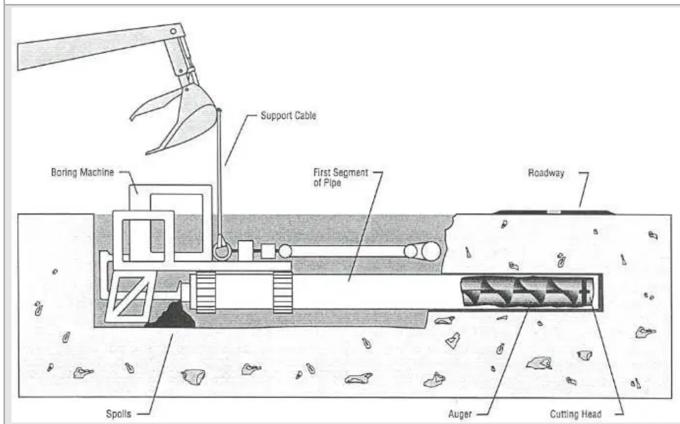
Figure 3.1 In-Water System Alternative

Table 3.1 In-Water System Alternatives

In-water System Alternative	
Gravity Sewer Line via Open Cut Construction	
	This approach involves constructing a new pipeline within the lake using open cut methods. This could include installation of a new pipe within the current alignment, or more likely a new alignment with more consistent slope and improved maintenance accessibility.

In-water System Alternative

Gravity Sewer Line via Trenchless Technology



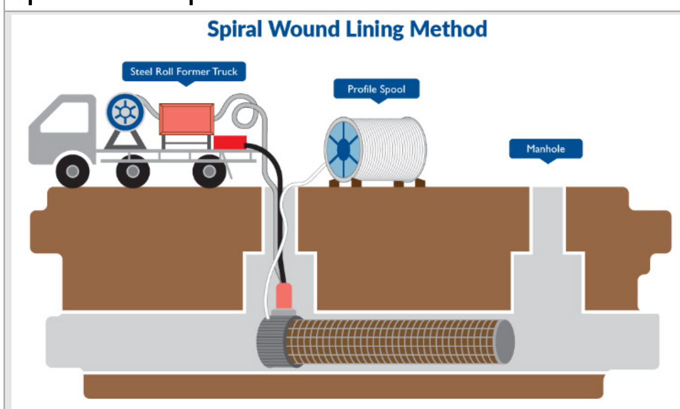
The Constructor – Trenchless Construction Methods and Their Details and Uses, n.d.

This approach would be to construct a new pipeline in a new alignment in the lake using trenchless methods. Construction would likely be done with an auger bore given site constraints and the need to maintain a tight grade tolerance to accommodate a shallow gravity sewer system.

Cured-in-Place Pipe (CIPP)

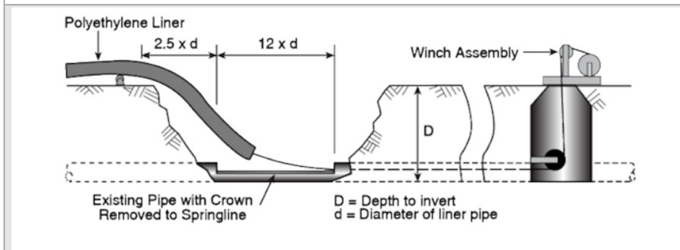
This approach rehabilitates the existing lake line sewer pipeline using a CIPP liner. This would require maintaining the alignment and elevation of the existing pipe. The reduction in capacity due to the liner thickness is typically offset by the improvement in the smoothness of the installed pipe liner.

Spiral Wound Pipe



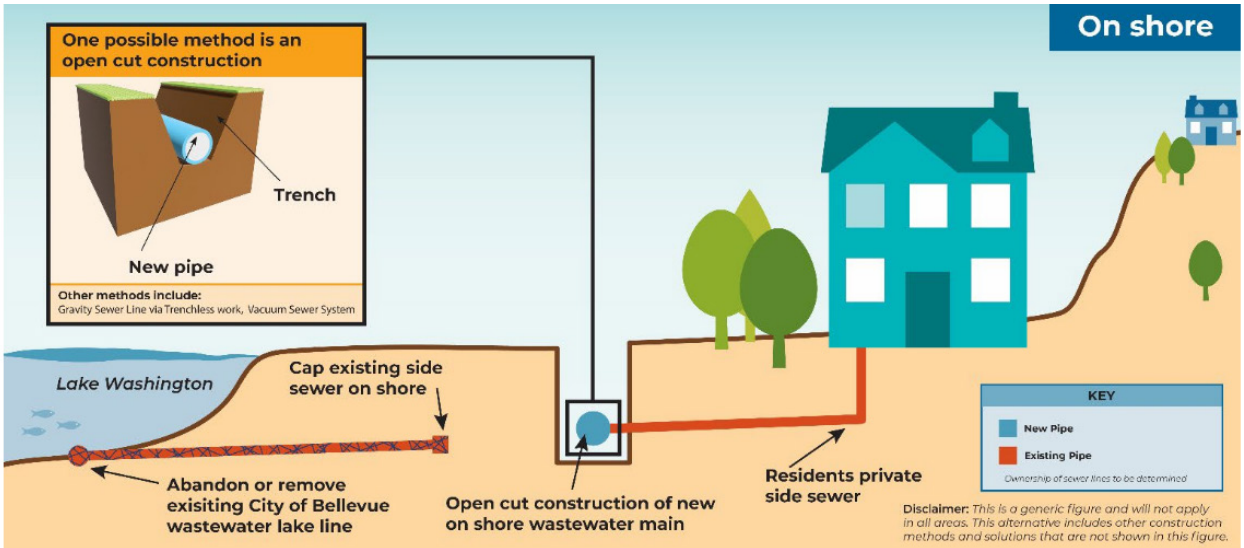
(PUB: Singapore's National Water Agency – Sewer Rehabilitation, n.d.)

This approach rehabilitates the existing lake line sewer pipeline using a spiral wound pipe repair. This would require maintaining the alignment and elevation of the existing pipe.

In-water System Alternative	
Slip Lining	
 Typical Slip Lining Access Pit and Setup for Pulling Prefused Lengths of Polyethylene Liner (Plastic Pipe Institute - Slip Lining Construction Guidelines, n.d.)	This trenchless rehabilitation approach involves insertion of a new plastic pipe through the existing lake line host pipe. This would require maintaining the current pipeline alignment and elevations of the existing pipe and would reduce the diameter of the lake line.
Pipe Bursting	
	This approach is a trenchless method of replacing the existing pipe by pulling a new pipe through the existing pipe while bursting the host pipe so that existing diameters can be maintained or increased in the new pipeline.
Emerging Technologies	
 (Atcheson, 2019)	**Fiber-reinforced flexible hose:** This involves insertion of a semi structural collapsible hose through the host pipe. **Platelet technologies:** These provide leak mitigation and repair within the existing lake line by using flow and pressure differential to deliver specially designed platelet sealant elements to the leak sites. **Spray applied polymer:** This is a rehabilitation technique to plug minor leaks within the host pipe. This method requires minimal excavation but only provides limited-service life.

3.3.3 Onshore

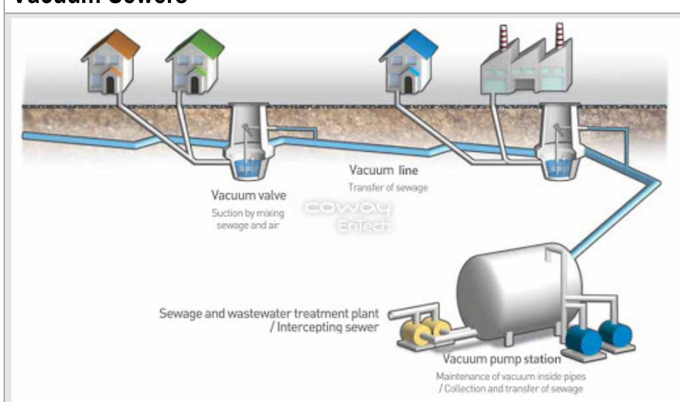
For the **onshore** alternative, any permanent system improvements to conveyance system infrastructure would generally be located between the residences, parks, commercial properties and/or public spaces, and the ordinary high-water level of Lake Washington, as shown in Figure 3.2. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, or vacuum sewers.



Source: LWWLLMP SEPA Draft EIS, Figure 1-2.

Figure 3.2 Onshore System Alternative

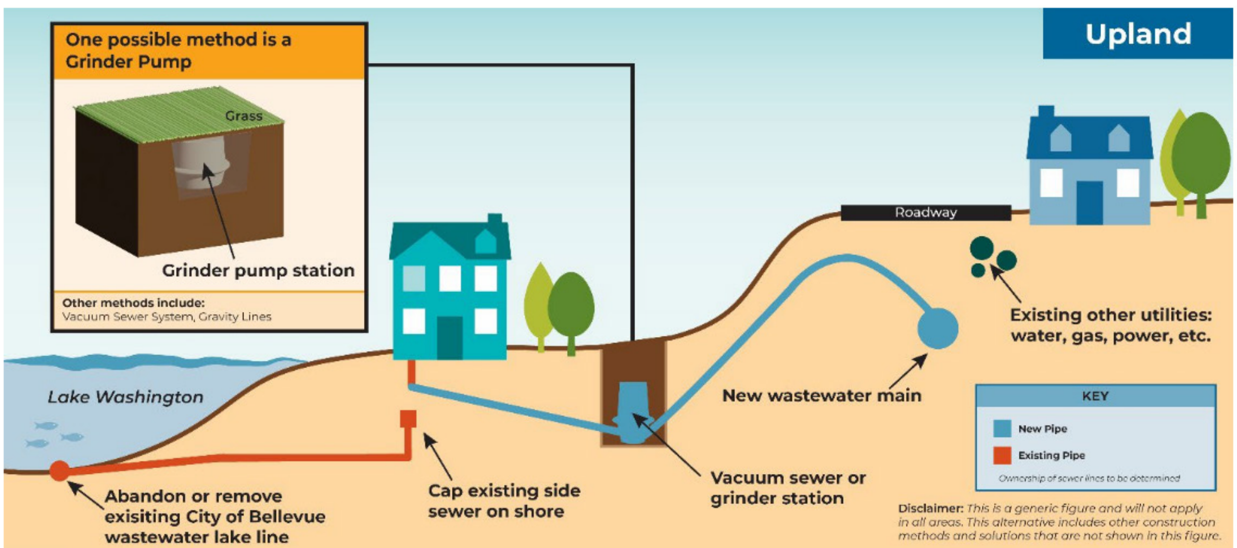
Table 3.2 Onshore System Alternative

Onshore System Alternatives	
Gravity Sewer Line via Open Cut Construction	
	This approach constructs a new pipeline on the shore using open cut methods.
Vacuum Sewers	
 Coway Entech – Vacuum Sewer System	This approach constructs a new pipeline that requires a partial vacuum to convey sewage at flat or reverse grades, and consequently is able to overcome many of the gravity and grade issues that the lake line system currently faces. Generally, these systems are more maintenance intensive than traditional gravity systems and may require the acquisition of additional property to locate the vacuum pump station.

Onshore System Alternatives	
Gravity Sewer Line via Trenchless Technology	
	This approach constructs a new pipeline along the shore using trenchless construction, likely to be an auger bore given site constraints.

3.3.4 Upland

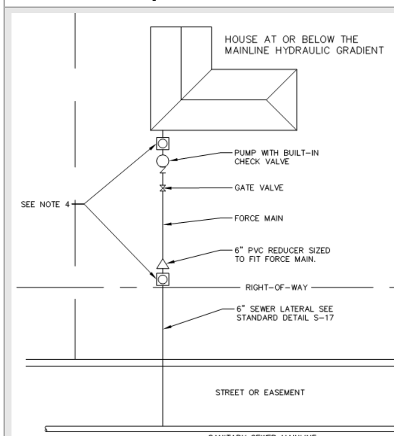
For the upland alternative, any permanent system improvements to conveyance system infrastructure would be generally located upland of the residences, parks, commercial properties and/or public spaces, and/or within the general vicinity of the public ROW, as shown in Figure 3.3. The pump and flush stations connected to the lake line system would also be in the upland area. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, vacuum sewers, or grinder pumps.

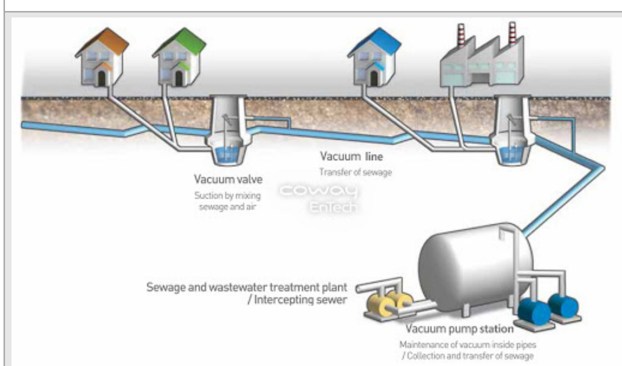


Source: LWWLLPM SEPA Draft EIS, Figure 1-3.

Figure 3.3 Upland System Alternative

Table 3.3 Upland Alternatives

<table>
<tr><th colspan="2">Upland Alternatives</th></tr>
<tr><td colspan="2">Gravity Sewer Line</td></tr>
<tr><td></td><td>This approach constructs a new pipeline upland from the lake lines either within private property or along the roadway in City ROW using either open cut or trenchless constructions. Construction of new side sewers could use open cut or trenchless technology to redirect flows away from the lake and toward the road.</td></tr>
<tr><td colspan="2">Grinder Pumps</td></tr>
<tr><td>

City of Bellevue 2019 Sewer Engineering Standard Details - S-34 Single Home Sewer Pump System</td><td>This approach constructs new grinder pumps to convey sewage up to the street and connect to either the existing sewer mainlines or new sewer lines in City ROW. Similar to the vacuum sewers, these would require additional infrastructure on private property, but multiple side sewers could be connected to a single grinder pump to reduce the amount of new infrastructure.</td></tr>
<tr><td colspan="2">Vacuum Sewers</td></tr>
<tr><td>

Coway Entech – Vacuum Sewer System</td><td>This approach constructs a new pipeline which diverges away from the lake and requires a partial vacuum to convey sewage at flat or reverse grades. Generally, these systems are more maintenance intensive than traditional gravity systems and may require the acquisition of additional property to locate the vacuum pump station.</td></tr>
</table>

3.4 Other System Improvements

Other system improvements are strategies or actions that can be taken to maintain or extend the service life of existing infrastructure. They could also include tasks for planning or preparing for implementation of a system alternative (including those described in Section 3.4). Other system improvements specific to the lake line system are categorized as follows:

- Operations Procedure Review.
- Cleaning and Inspection.
- Access Improvements.
- Data Collection.
- Emergency Repair Planning.

Specific strategies are summarized by these five categories in Table 3.4.

Table 3.4 Other System Improvements

System Improvement	Description
Operations Procedure Review	
Review Standard Operating Procedures (SOP)	▪ Review the City's catalog of standard operating procedures specific to the lake line. Document and formalize any other routine maintenance tasks completed by staff that are not SOPs. Develop new SOPs where existing procedures are deficient.
Development Review	▪ Ensure current standards relevant to the lake line are enforced. This could include permitting and inspection of any new lake line laterals, docks, bulkheads, or significant grading activities.
Facility Review	▪ Develop standard procedures for asset inventories and condition assessments, to uniformly evaluate needed facility improvements.
Cleaning and Inspections	
Cleaning and Inspection	▪ Continue feasible routine cleaning and inspection of elements critical to lake line function (i.e., removal of debris from flush station and pump intakes, solids removal from pipes where pipe access exists, etc.). ▪ Consider purchasing additional or specialized maintenance equipment to expand the City's in-house maintenance capabilities. ▪ Evaluate the use of non-traditional cleaning methods (such as ice pigging) to prevent further damage to aging pipes. ▪ Inspect existing flush station inlet screens and replace them if damaged or missing. ▪ Conduct public outreach to educate customers on the importance of keeping fats, oils and grease out of the sewer system.
Cleanout Modifications	▪ Continue work to raise cleanouts above lake surface.
Access Improvements	
Lake Line	▪ Improve future access and ability to locate lake line. This may include installation of vaults under the docks that can isolate a segment and allow bypass to clean between vaults. ▪ Construct additional maintenance holes or access points near known occurrences of debris accumulation. Maintenance holes and vaults should be designed with sumps or other means of debris collection and removal in mind.

System Improvement	Description
Pump and Flush Station Access	▪ Reduce public access to pump and flush stations by installing fencing or other barriers to reduce risk of damage or injury. ▪ Construct permanent access for necessary maintenance equipment. ▪ Obtain legal access to all pump and flush stations that currently do not have easements or public rights-of-way that supports how it is regularly accessed. ▪ Coordinate with property owners to maintain existing landscaping around existing cleanouts, pump and flush stations to facilitate O&M access.
Data Collection	
Survey	▪ Confirm pipe size, material and location of lake line pipe relative to shoreline. Feasibility of capital improvements is significantly dependent on location due to permitting restrictions and construction method limitations. ▪ Confirm locations of exposed lake line pipe and monitor as storms may move rocks and expose new areas of pipe that could be subject to damage from near shore activities.
Overflow Monitoring	▪ Implement a recirculation maintenance hole and pump station overflow monitoring system for recirculation maintenance holes that is linked to the telemetry/SCADA system.
HGL at Cleanouts	▪ Monitor and log the HGL at cleanouts. This information can be used to identify failures in the lake line system that lead to unusual operating conditions, identify properties at highest risk for overflow damages, and calibration of the lake line system hydraulic model.
I/I Evaluation	▪ Complete I/I evaluation in areas where leaks are suspected (areas experiencing unusual pump/flush station cycling, previous breaks, visible leaks).
Customer Complaints	▪ Conduct public outreach to educate customers on what type of issues to report, how to reduce risks of damaging the existing infrastructure, and proper complaint channels. Log complaints in a database that is identifiable by location and relationship to lake line system.
Flush/Lift Station Operation	▪ Monitor the existing operation of flush and lift stations closely for deviations from typical operating conditions that may be indicative of a failure within the lake line system. This may require purchasing and installing additional monitoring equipment. ▪ Install permanent flow meters downstream of pump stations to measure the combined customer and flushing flows.
Lateral Inventory	▪ Develop a database of existing laterals identifying known parameters such as age, pipe material, location, replacement/repair history, and properties served.
Structure Inventory	▪ Develop a database of existing structures that have the potential to damage the existing lake line or city-owned portion of laterals (i.e., bulkheads, docks, landscaping features).
Condition Assessment (See Section 5.4.3 for details)	▪ Collect additional pipe coupons at locations near previous evaluation to track pipe degradation over time. ▪ Conduct condition assessments of pump and flush stations that do not have a current evaluation. ▪ Perform ultrasonic thickness measurement of the pipe wall (or using other emerging pipe assessment technologies) where feasible and as allowed by permitting constraints. Conduct at regular intervals to validate RUL estimates.
Emergency Repair Planning	
Overflow SOP	▪ Development of plans to respond to overflows of the lake line system. Plan should identify documentation and reporting procedures, mitigation measures and cleanup standards.
Pipe Failure SOP	▪ Develop a plan to respond to failures of the lake line pipe based on pipe size, material, condition and location.

Refer to Chapter 5 - Service Area Plans for the other system improvements identified for each area.

3.5 Improvement Considerations

This section summarizes additional considerations associated with the potential improvements described in this Chapter.

3.5.1 Construction Challenges

The Lake Washington shoreline has changed dramatically since the lake lines were originally constructed. There are new obstructions including docks and boat houses that may limit access to the existing lake line and may also constrain space for improvement construction. Regulations may not allow reconstruction of privately owned non-conforming uses and structures if they are impacted in any way during construction.

Removal and/or demolition of existing AC pipe may also be required in some cases; necessitating special construction methods to manage, remove, and dispose of asbestos materials.

In addition to these challenges, access to the existing lake line is extremely limited. Work will likely require barges for in-water or shoreline work in areas that are difficult to access, and in-water construction may require environmental protection such as limited work windows, turbidity containment, post-construction collection and treatment of contaminants, and monitoring considerations.

Coordination and outreach with the public, stakeholders, and regulatory agencies will be critical throughout the planning, design, and construction phases.

3.5.2 Pump Stations

The lake line capacity is limited due to flat slopes and accumulated debris in the pipe, resulting in the potential for peak storm flows to overwhelm the pump station and cause a sewer overflow. Maintaining the lake line's conveyance capacity may preclude use of pipe rehabilitation methods that reduce the interior diameter of the pipe, and/or require pump station upgrades to accommodate this capacity loss. Additional pump stations may be required to implement a replacement system if significant changes to the hydraulic function are proposed.

3.5.3 Flush Stations

Capital improvements that rely on continued use of flush stations may require additional upgrades such as the installation of inlet screens, or extension to provide a deeper water intake.

3.5.4 System Hydraulic Controls

The recirculation maintenance holes located at the pump stations are unique to the lake line system. These were installed to protect properties from sewer backups by forcing recirculation to the wet well to regulate the HGL. City O&M staff appreciate the recirculation maintenance holes as they provide passive protection of the downstream system. Modifying the recirculation feature has the potential to increase system capacity but would result in an increase of the HGL downstream of each pump station and would impact connected properties.

There are very few lateral check valves in the existing system. Laterals that have a history or likelihood of experiencing a backup may benefit from the installation of a check valve.

3.5.5 Side Sewers

Side sewer connections will likely be impacted by any alternative. Current City code (Sanitary Sewer Engineering Standards S6-09) allows up to four residential structures on a single joint use side sewer system. Reconfiguration of the system location may require modification to the side sewer layout, including easements associated with joint use. For additional details, see Chapter 4 - Policy Considerations.

3.6 Mitigation

Mitigation of lake line system improvements would primarily be guided by local, state, and federal approvals and permits that would generally be required for the types of improvements presented in the LWWLLMP. Mitigation extents and associated costs at the project level cannot be defined prior to additional data collection (survey, habitat studies, environmental assessments), detailed design, and permitting. However, the mitigation measures described in this section will generally apply to lake line projects. This section presents a summary of mitigation measures; refer to the EIS included as Appendix B for additional information.

Table 3.5 Affected Environment and Potential Mitigation Measures

Affected Environment	Potential Mitigation Measures
Earth Resources	▪ Avoid construction on steep slopes, known and potential landslide zones, and areas with organic or liquefiable soils, where possible, and follow geotechnical recommendations during construction. ▪ Geologic risk assessment and design improvements to minimize geologic hazards. ▪ Use appropriate shoring during construction. ▪ Erosion control measures. ▪ Comply with relevant federal, state, and local critical areas and groundwater requirements. ▪ Dispose of soils at approved disposal sites. ▪ Materials suspected of contamination and water that encounters the material after excavation would be secured during transport to minimize escapement. ▪ Excavated areas would be returned to existing or improved conditions after construction.
Air Quality and Odors	▪ Construction specifications and measures to control dust. ▪ Reduce vehicle emissions, idling, and travel distances, and encourage carpooling for employees. ▪ If removal of asbestos concrete pipes is necessary, appropriate protocol for the removal would be followed. ▪ Incorporate specifications into construction contracts that encourage the use of fuel-efficient construction equipment.

Affected Environment	Potential Mitigation Measures
Surface Water Resources	▪ Stabilize all exposed and unworked soils and stockpile areas to prevent erosion. ▪ Restore cleared upland areas and re-plant with an approved vegetation plan to stabilize soils following construction. Implement pollution control measures and waste handling measures to ensure appropriate storage, handling, containment, and use of petroleum products and other potential pollutants on-site during construction. Isolate the work area to prevent spillage of construction materials and have spill response materials on-site during construction. ▪ Where possible, use non-petroleum-based solvents and fluids and fuel construction equipment 50 feet or more from surface waterbodies. ▪ Potential requirement of Construction Stormwater Pollution Prevention Plan if threshold is met. If trenchless construction methods are used: ▪ Establish an effectively contained mud pit outside of sensitive areas to support the drilling activities. ▪ Use mud pumps and a solids control/drilling fluid filter system to remove excess mud from the borehole. ▪ Use barriers such as wattles, sandbags, or hay bales placed downslope of the drilling rig, mud pits, and soil separation plant and other equipment to contain potential spills in compliance with jurisdictional requirements.
Plants and Animals	▪ Avoid breeding and rearing periods of sensitive species, if necessary. ▪ Follow permit conditions for construction site runoff. ▪ Retain site vegetation as much as possible and revegetate disturbed sites after construction. ▪ If site alterations occur during the avian breeding season and involve any tree, shrub, or building removal, conduct pre-construction surveys to locate any active nests and fledglings. Any detected nest sites would be buffered and monitored to ensure they are not harmed by project activities. ▪ Comply with National Bald Eagle Management Guidelines. ▪ Implement invasive species control and management. In addition, enhancement opportunities post-construction include: ▪ Lay a layer of approved fish mix gravels in nearshore shoreline areas, which could result in long-term benefits to fish. ▪ Install anchor logs for habitat complexity and bioengineered shoreline stabilization per U.S. Army Corps of Engineers requirements. ▪ Plant native species and enhance riparian areas.
Noise	▪ Identify potentially impacted receptors and buildings and determine whether noise levels at those sites would exceed permitted levels. ▪ Encourage noise-reducing measures. ▪ Work within permitted hours and noise levels to reduce nuisance to adjacent residents, adhere to applicable noise regulations. ▪ Use noise-reducing equipment on construction equipment. ▪ Comply with noise levels specified in facility design.
Cultural Resources	▪ Develop and implement an Inadvertent Discovery Plan, as appropriate. ▪ Develop an Archaeological Monitoring Plan and conduct on-site observation of excavations by an archaeologist, if determined appropriate. ▪ Potential additional coordination with the State Historic Preservation Office, and any Affected Tribes.

Refer to the EIS included as Appendix B for additional detailed discussion of potential mitigation measures applicable to lake line improvements.

CHAPTER 4 POLICY CONSIDERATIONS

4.1 Introduction

This chapter describes the approach taken to review policies and codes relevant to the lake line system and presents policy considerations for each system alternative. The purpose of this chapter is to outline the specific policy additions or modifications that would be needed to implement any of the system alternatives including upland, onshore, and in-water to inform the City's decision-making and next steps. Refer to Chapter 5 for a detailed discussion of alternatives by service area.

4.2 Policy and Code Review

4.2.1 City Policy and Code Review

Much of the existing City lake line system was constructed prior to the development of many of the City's policies and codes. The City also has sewer system agreements in place with neighboring communities and King County. A review of these existing City policies, codes, and agreements was needed in order to identify modifications or additions that would be required to implement each system alternative. Table 4.1 outlines the City policies, codes, and agreements reviewed and their relevance to the lake line system. If any additions to or modifications of one of the individual City policies, codes, or agreements are required to accommodate the implementation of the LWWLLMP, then it is noted in Table 4.1 and detailed later in this Chapter.

Table 4.1 Review of City Policy, Code and Agreements

City Policy, Code, or Agreement	Description	Relevance to Lake Line System	Additions or Modifications may be needed
City of Bellevue City Code (Chapter 24.04 Sewer Utility Code).	Codes related to sewer utility.	Policies for ownership and service (currently the City owns and maintains 5 feet of side sewer from the main line; Type of service is gravity). Rate structure policies (currently same rate structure across service area). Side sewer connections (currently – a maximum of four residential structures may be connected to a single side sewer).	Yes. Language regarding ownership and maintenance responsibilities and service type (gravity), and rate structure language. See Policy Considerations.
City of Bellevue Comprehensive Plan 2024 Update (DRAFT) (Shoreline Master Program, Capital Facilities, Environment, Land Use, and Utilities Elements).	City of Bellevue policies for capital facilities, environment, land use, shoreline management and utilities.	Shoreline Master Program: All lake line work in the City falls within the Shoreline Overlay District, and the Shoreline Master Program Policies apply. Lake lines are considered a 'utility system' and are therefore a permitted use in the Shoreline Overlay District. Lake line system management needs to mitigate potential detrimental environmental risks to Lake Washington and provide for reliable management of sewage. Also, policies for: facilities renewal and replacement, capital project coordination, environmental stewardship, management of utilities assets are necessary for implementation of the LWWLLMP.	Yes. Language in Shoreline Master Program, Environment, and Utilities; See Policy Considerations.
City of Bellevue Utilities Financial Policies (2023-2024 Budget Waterworks Utility Financial Policies).	Waterworks utility financial policies.	Policies for management, renewal and replacement of sewer assets, utility impacts to the environment, neighborhoods, and rate payers. Sewer rates are currently uniform for all users, though City policy allows for special rates or surcharges for specific areas that require extraordinary capital investments and/or maintenance costs.	Yes. Payment structure and debt service. See Policy Considerations and the Financial chapter of this report.
City of Bellevue Water System Plan.	Comprehensive Drinking Water System Plan.	Policy for abandonment of asbestos cement pipe (applies to sewer as well as drinking water).	Yes. Specific language regarding AC pipe replacement. See Policy Considerations.
City of Bellevue Wastewater System Plan.	Comprehensive Wastewater System Plan.	Policies regarding system ownership and system renewal and replacement, interlocal sewer agreements, City sewer codes and ordinances.	Yes. Specific language. See Policy Considerations.
City of Bellevue O&M SOP related to the lake line system.	City SOPs related to sewer lake line O&M activities.	There are currently no O&M SOPs specifically related to the lake line.	Yes. Develop O&M SOPs for lake line. See Policy Considerations.
Interlocal Agreements with Bellevue Sewer District (BSD), Medina, Clyde Hill, Hunts Pont, Yarrow Point, Beaux Arts, for the City of Bellevue's assumption of BSD (1967).	Agreement for the City to assume operation of BSD.	Establishes City sewer service to adjacent jurisdictions with lake lines, transferring all existing franchise agreements from BSD to City of Bellevue.	None.
Interlocal Agreements Related to the Bellevue Sewer System (WSDOT, I-90 and SR522 agreements).	Franchise agreement in WSDOT ROW.	No relevant policies, code, or agreements found.	None.
Interlocal Agreements Related to the Bellevue Sewer System (KCWTD).	Agreements and amendments for wastewater treatment by KCWTD.	No relevant policies, code, or agreements found.	None.
Interlocal Agreements Related to the Bellevue Sewer System (Medina, Clyde Hill, Hunts Point, Yarrow Point, Beaux Arts).	Utility franchise or other agreements.	Defines responsibilities of Bellevue Utilities within each jurisdiction. Defines whether the jurisdiction's franchise authority is within right-of-way, or also includes utility easements. Yarrow Point Franchise Agreement (1986) – Lake line and Yarrow Point Pump Station are subject to change management conditions if the Yarrow Point Council adopts an ordinance affecting the lake lines in NE 42nd St. If Town makes improvements to NE 42nd St that require utility relocation, then would be at the City's cost.	Yes. Yarrow Point Franchise Agreement Only. See Policy Considerations.
Interlocal Agreements Related to the Bellevue Sewer System (King County franchise, unincorporated King County on Ripley Lane).	Utility franchise agreement.	Most of the franchise area is now within Bellevue City Limits. The latest franchise map does not appear to include Ripley Lane (private road).	None.
City of Bellevue Public Sewer Easement Template.	City of Bellevue public sewer easement template.	City easement provision on maintenance access and prohibition on permanent buildings or structures in public easements.	Yes. Language modification; See Policy Considerations.
City of Bellevue Private Joint Use Sewer Maintenance Agreement Template.	Private joint use sewer maintenance agreement template.	The City does not facilitate acquisition of private easements but does require proof of easements before authorizing construction on the property needing an easement. If lake line replacement triggers the need for additional joint use side sewers, the City's template documents can be used by affected properties.	Yes. Language modification. See Policy Considerations.

4.2.2 Non-City Policy and Code Review

Both City and non-City policies and codes were reviewed as part of this exercise. The non-City policies and codes that were reviewed are outlined in Table 4.2, along with their relevance to the lake line system. As the City proceeds with implementation of the LWWLLMP, the City will need to proceed in accordance with the specific requirements identified here.

Table 4.2 Review of Non-City Policy, Code and Agreements

Non-City Policy or Code	Description	Relevance to Lake Line System
Ecology Criteria for Sewage Works Design.	Design guidelines for wastewater facilities.	Guidance on requirements for grinder pumps, including utility responsibilities (relevant for 'upland' alternative only).
SEPA and National Environmental Policy Act (NEPA) for work related to inspection/maintenance of lake lines and construction below the Ordinary High-Water Mark in Lake Washington.	Requirements for work in Lake Washington.	Permits to perform rehabilitation or replacement of the lake lines require that the projects demonstrate conformance with the State's Shoreline Management Act (as well as the City's Shoreline Master Program and Bellevue City Code mentioned in Table 4.1). City of Bellevue Utilities must maintain and/or adopt lake line policies that conform with these existing policies and codes. To rebuild the lake line in Lake Washington, City would likely need to document that all other alternatives/locations were infeasible.
Other Regulations.	Regulations associated with obtaining other applicable permits.	Additional permits and associated regulations that may apply to lake line system improvements include (but are not limited to): ▪ Section 404 of the Clean Water Act (U.S. Army Corps of Engineers [USACE]) ▪ Section 10 of the Rivers and Harbors Act (USACE) ▪ Hydraulic Project Approval (Washington Fish and Wildlife [WDFW]) ▪ Washington Administrative Code (WAC) Refer to Chapter 5 for area-specific permit matrices for the preferred system alternatives.

4.3 Policy Considerations

This section describes a baseline set of policy considerations that apply regardless of which preferred alternative has been identified for a given service area. Additional policy considerations apply that are specific to each alternative (in-water, onshore, or upland). Policy considerations applicable to all service area alternatives are described in the following section, followed by considerations specific to individual service area alternatives. In Table 4.3 below, policy considerations are organized using seven factors:

- Permitting.
- Environmental impact.
- ROW and easement.
- Performance, O&M.
- Technical/constructability
- Cost.
- Local Community.

These are the same factors used to identify a preferred system alternative in each service area. Refer to Chapter 5 and Appendix E for additional details regarding the selection and definition of factors.

4.3.1 Policy Considerations Applicable to All Alternatives

Policy considerations applicable to the future implementation of the LWWLLMP regardless of service area alternative are summarized in Table 4.3. This table outlines the specific modifications or additions that are needed, organized by factor.

Table 4.3 Policy Considerations and General Recommendations by Service Area Alternative

Factors for Consideration	Applicable to all Service Area Alternatives	Specific to Service Area Alternative		
		In-Water	Onshore	Upland
Permitting	None.	USACE (NEPA) would require documentation of infeasibility of other alternatives, in order to permit rebuilding sewer in Lake Washington (see Table 4.2).	No additional considerations specific to this alternative.	Consider Ecology Guidelines for Sewer Works Design (see Table 4.2). Update Sewer Utility Code (building code, who obtains permits for construction).
Environmental Impact	None.	Shoreline Master Program discourages new lake line features, encourages moving new lake line facilities away from shoreline; would need to update Shoreline Master Program.	Shoreline Master Program discourages new lake line features, encourages moving new lake line facilities away from shoreline (likely need to update Shoreline Master Program). Update Sewer Code to establish a shoreline buffer.	No additional considerations specific to this alternative.
ROW/Property	Update Bellevue Sewer Code for City system ownership language. Requires additional easements (both permanent and during construction); are these compensatory?	No additional considerations specific to this alternative.	Consider changes to City ownership and/or easement policies specific to lake line areas along shorelines.	Consider changes to City ownership and/or easement policies specific to upland lake line areas. Can the type of service be changed from gravity to grinder pumps? Who owns and maintains grinder pumps? Are easements compensatory? Update both City of Bellevue public sewer easement template and private joint use sewer maintenance agreement template specific to lake lines.
Performance, O&M	Develop O&M SOPs specific to lake line (and specific to selected alternative).	No additional considerations specific to this alternative.	Update Bellevue Sewer Code for who operates and maintains onshore pipe, laterals, etc.	Update Bellevue Sewer Code for who operates and maintains upland grinder pumps, force mains, etc.
Technical/Constructability	Update City Engineering Standards so all technologies and configurations of system alternative are included. Update Wastewater System Plan to reflect current City policies.	No additional considerations specific to this alternative.	No additional considerations specific to this alternative.	Update language of Sewer Code to accommodate sewer configurations (ex: more than four properties connected to private system).
Cost	Utilities Financial Policies – Determine payment structure and decide if/when to use loans (and debt service). Update Sewer Utility Code If surcharge added or rate structure changed.	No additional considerations specific to this alternative.	Update Sewer Utility code - Determine who pays for restoration, protection of structures within utility setbacks.	Update Sewer Utility code - Determine who pays for restoration, protection of structures within easements.
Local Community	Utilities Financial Policies - Determine payment structure (considering intergenerational equity). Update Yarrow Pont Interlocal Franchise Agreement (see Table 4.1). Conduct detailed public process specific to alternative (build off of EIS public process).	No additional considerations specific to this alternative.	No additional considerations specific to this alternative.	Update Sewer Utility Code to change type of service from gravity to grinder pumps, and determine who owns/maintains grinder pumps. Decide if the City can maintain private facilities or construct new private facilities. Consider best practices and lessons learned by other Washington State communities regarding lake lines.

4.3.2 Policy Considerations Applicable to Specific Alternatives

Policy considerations applicable for specific service area alternatives are shown in the last three columns of Table 4.3. Once a system alternative is selected, the policy considerations specific to the selected system alternative will apply, as well as all universally applicable policy considerations. In the following sections, the policies applicable specifically to each system alternative are described.

4.3.2.1 In-Water Alternative

Should the City proceed with the in-water system alternative, the City may need to prove from a permitting perspective that it is infeasible to site the lake line in any other location. Also, the City would need to update its Shoreline Master Program because the Shoreline Master Program currently discourages new lake line features and encourages moving new lake line facilities away from the shoreline. Similarly, other communities served by the City's sewer system would need to update their Shoreline Master Programs.

4.3.2.2 Onshore Alternative

Since the onshore system alternative calls for gravity pipes and force mains proximate to the Lake Washington shoreline, the City would likely need to update the Shoreline Master Program because of the existing language about encouraging moving new lake line facilities away from the shoreline. The City should update its ownership and/or easement policies specific to the lake line along shorelines. The City will need to update its Sewer Code for the party responsible for operations and maintenance of onshore pipe and laterals, and to will need to clarify who pays for restoration and/or protection of structures within utility setbacks. The City may also consider establishing a required physical setback from the lake (also known as a buffer) within its Sewer Code.

4.3.2.3 Upland Alternative

To implement the upland system alternative, the City should update its ownership and/or easement policies specific to grinder pumps and force mains as part of the upland system alternative. The City will need to update its Sewer Code to:

- Change the type of service from gravity to grinder pumps.
- Specify who owns and operates/maintains upland assets (grinder pumps and force mains).
- Accommodate potential sewer configurations of the upland system alternative (e.g., more than four properties connected to a private system).
- Allow for City to maintain private facilities and construct new private facilities, and who obtains permits for their construction.

The City should update its ownership and/or easement policies specific to an upland sewer line and update both the City of Bellevue public sewer easement template and private joint use sewer maintenance agreement template specific to lake lines.

Upland assets should be built in compliance with Ecology Guidelines for Sewer Works Design (see Table 4.2) and City Building Code, with City Building Code to be reviewed to allow for the City to construct new private facilities as mentioned above.

The City should consider best practices and lessons learned by other Washington State communities regarding lake lines, including the Cities of Renton, Gig Harbor, and Bremerton.

4.4 Summary of Policy Considerations

To implement the LWWLLMP the City will need to conduct a detailed public process with specific system alternatives identified by location. The City will need to determine financial policies regarding payment structure to fund plan implementation. Additionally, the City will need to modify the Bellevue Utilities Sewer Code and update the Wastewater System Plan.

In addition to the policy considerations listed above, the following steps are recommended regardless of alternative:

- Develop O&M SOPs specific to the lake line system.
- Revise the City Utilities' Department Sanitary Sewer Engineering Standards.
- Revisit the franchise agreement with Yarrow Point regarding the responsibilities for relocation of facilities (see Table 4.1).

Should the City implement the in-water system alternative, the City would need to prove the infeasibility of any other location for its sewer and will also need to update its Shoreline Master Program. For the onshore system alternative, the City will likely need to update its Shoreline Master Program and will need to update the Sewer Code and update its real property policies for onshore sewer assets. For the upland system alternative, the City would need to update Sewer Code and update its real property policies and easement templates for upland sewer assets, including those specific to grinder pumps and force mains as described earlier in this Chapter.

This chapter provides a summary of policy considerations. Future policy efforts will include a detailed workplan and level of effort estimate for implementing the policy changes recommended for the selected system alternative.

CHAPTER 5 SERVICE AREA PLANS

5.1 Introduction

This chapter presents the service area prioritization, which was completed to assist the City in sequencing the service areas for implementation of system alternatives and improvements. This chapter describes the prioritization methodology, presents the components used to develop likelihood of failure and consequence of failure scores for each service area, and summarizes the overall risk score and prioritization of the service areas.

This chapter also includes an overview of the system alternatives and other system improvements considered for each service area as presented in the LWWLLMP SEPA Draft EIS. The preferred alternative for each service area, along with the analysis criteria, is included in the chapter.

Service area plans were developed to summarize the key characteristics, preferred system alternative (and regulatory considerations), and near-term improvements for each service area and are included in this chapter. An implementation cost summary for the near-term, medium-term, and long-term planning periods is also provided for each service area.

5.2 Service Area Prioritization

To assist the City in sequencing the service areas for implementation of system alternatives, the six service areas were prioritized based on a risk of failure score. This score is a calculated as a composite of the likelihood and consequences of failure of each service area in the lake line system. Six weighted components are used for this determination. The components were selected in collaboration with the City based on similar planning assessments and modifications unique to the lake line system.

Likelihood of Failure:

- Lake Line Estimated Useful Life.
- Lake Line Material.
- Lake Line Couponing.
- Pump/Flush Station Condition.
- Outside Influences.

Consequence of Failure

- Environmental Impacts.
- Land Use.
- Parcels Served.
- Flow.
- Lake Line Location.
- Operational Access.

Each of these components were weighted based on input from the City and the community. The components were then defined as low, medium, or high-risk (with corresponding numerical values of 1, 2 and 3). Each component and their associated numerical values are described in detail in the following sections.

5.2.1 Likelihood of Failure

As indicated by the name, the likelihood of failure represents how likely an asset is to fail. The likelihood of failure for the lake line system in each service area was determined from data analysis on the existing condition of the pipe, pump stations and flush stations, outside influences on the lake line system, and the documented history of overflows.

The weighted criteria are:

- Pump/Flush Station Condition - 35 percent.
- Overflow History - 20 percent.
- Couponing - 13 percent.
- Estimated Useful Life (EUL) - 11 percent.
- Pipe Material - 11 percent.
- Outside Influences - 10 percent.

Each criteria is described in detail in the following sections.

5.2.1.1 Lake Line Estimated Useful Life, Couponing and Material Score

Parameters that characterize the condition of the lake line pipe were developed by the City, in a manner consistent with Utilities Department renewal and replacement asset management program. This included EUL, pipe material, and estimated pipe wall loss from coupon data.

The EUL and the couponing wall loss estimates were as reported in the Phase 1 (2013) and Phase 2 (2016) Lake Line Condition Assessments. These results are summarized in the report titled “Sewer Lake Line Condition Assessment, Phase 2 – Lake Washington” (TetraTech, December 2016).

A total of 10 coupons were collected in Phase 1, and 21 coupons in Phase 2. Ten of the 18 reaches only have a single coupon to represent the entire condition of the reach, despite variations in pipe material and location. Note that the first couponing phase was completed in 2013 and additional degradation of the pipeline condition may have occurred since then. Corrosion rates are not linear and are typically estimated to increase over time.

Wall loss is a measurement of the reduction in pipe wall thickness due to corrosion and/or failure of the liner. Estimated useful life is 40 years for AC pipe; 75 years for CI pipe; and 50 years for non-AC or non-CI pipe.

The pipe material score was solely based on the pipe material and categorized as follows: ductile iron (DI), other (non-AC or non-CI), CI or unknown, and AC.

5.2.1.2 Pump and Flush Station Condition

Pump station conditions were provided in the “Wastewater Pump Station Evaluation Final Report” (Murray, Smith & Associates, May 2015). This report summarized a prior assessment conducted by HDR in 2013, which covered seven stations, as well as the subsequent phase that included 26 additional stations. As with the coupon condition assessment, further degradation of the pump stations and flush stations may have occurred since 2013 and 2015 when the assessments were completed. Additionally, changes to applicable design codes and standards used as the basis for recommended improvements may have changed.

Note that several of the reaches share a downstream pump station (e.g., Yarrow Point PS to Cozy Cove PS, and Hunts Point PS to Cozy Cove PS). Because the reaches rely on the pump stations to function hydraulically, the pump stations shared between reaches contributed each reach's risk score.

Because the flush stations are required for the lake line system to operate, they were given equal consideration to the downstream pump stations that convey lake line flow to an upland gravity system or discharge point. The more critical condition between the upstream flush station and downstream pump station was used for scoring because a failure of either one would lead to inoperability of the reach.

The Meydenbauer Bay Park Sewer Line Replacement Project (CIP S-69), completed in 2017, included replacement of approximately 1,500 LF of lake line through Meydenbauer Bay Park, construction of the Lagen PS, and improvements to the existing Grange PS. Due to its recent construction, improvements to this segment of pipe and Lagen PS are not included.

5.2.1.3 Outside Influences

The outside influences component captures the risk posed by external disturbances (versus material degradation) that could cause a lake line failure. Examples include the lake line pipe being caught by a boat anchor, disturbance by bulkhead failure or lakebed settlement, or damage during construction of yard improvements by a homeowner. It was assumed that the risk of damage by outside influences was proportional to the total pipe length in the reach (greater length of pipe results in a greater likelihood that damage will occur). The boundaries between low, medium, and high were established so that the median and average of reach lengths fall within the middle (medium) rating.

5.2.1.4 Overflow History

The City tracks recorded overflows in a history log, which contains recorded incidents from 2010 through 2020. System overflows that occurred on parcels served by the lake line were tallied for each reach and were used as the basis for scoring.

The number of overflows may be underreported since they are dependent on homeowners reporting any events. Overflows at the flush stations are not recorded due to the design of the recirculating manhole system.

5.2.1.5 Likelihood of Failure Scoring and Weighting

Table 5.1 summarizes how each likelihood of failure component was scored and weighted for each reach.

Table 5.1 Likelihood of Failure Scoring and Weighting

Component	Weight	Score		
		Low (1)	Medium (2)	High (3)
Lake Line EUL	11%	Within EUL.	At or beyond EUL (non-AC/CI).	At or beyond EUL (AC/CI).
Pipe Material	11%	DI or other (Non-AC/CI).	CI or unknown.	AC.
Couponing	13%	0-10 percent wall loss.	11-25 percent wall loss.	26 percent or greater wall loss.
Pump/Flush Station Condition	35%	No current recommended pump/flush station improvements (Lagen only).	Pump/flush station structure with an EUL 20-25 years, and/or less than $500k recommended improvements by 2026.	Pump/flush station structure with an EUL 10-15 years, and/or greater than $500k recommended improvements by 2026.
Outside Influences	10%	Total pipe length less than 3,500 LF.	Total pipe length between 3,500 and 5,000 LF.	Total pipe length greater than 5,000 LF.
Overflow History	20%	0.	1.	More than 1.

5.2.2 Consequence of Failure

The consequence of failure represents what effect infrastructure or asset failure would have on the system. The consequence of failure for the lake line system in each service area considers environmental impacts, land use, the number of customers served, lake line flow, lake line location, and operational access.

The weighted criteria are:

- Number of Customers - 25 percent.
- Environmental Impacts - 20 percent.
- Land Use - 20 percent.
- Operational Access - 15 percent.
- Flow - 10 percent.
- Lake Line Location - 10 percent.

Each criteria is described in detail in the following sections.

5.2.2.1 Environmental Impacts

The environmental impacts component is based on the mapped sockeye spawning area. If any portion of a reach was in a mapped sockeye spawning area as designated by the WDFW (see Figure 2.6), a high rating for consequence of failure was assigned for the reach. If a pipe failure were to occur, the leaking wastewater can cause harm to the ecosystem, and necessary repairs can damage spawning areas.

5.2.2.2 Land Use

The land use component is an assessment of the type of customers served by the lake line. Land uses for essential facilities, such as schools, hospitals, fire or police stations, and City government buildings, are considered to have a higher consequence of failure than public access land use (public beaches, shorelines, and parks adjacent to the lake line) and residential land use.

5.2.2.3 Parcels Served

The parcels served category is a count of the total number of parcels served by the lake line. This includes parcels that are upland in the basin served by a gravity system that is tributary to the lake line (i.e., the maximum number of parcels affected by a catastrophic failure of a given reach).

5.2.2.4 Flow

The flow component is the modeled value at the downstream pump station, using values calculated in the hydraulic model utilizing “Storm 1”. Storm 1 is a historical rainfall event that occurred February 3-9, 2020, with 2.03 inches of rainfall in 24-hours, and a peak intensity of 0.14 inches per hour. Storm 1 is one of three events (Storms 1, 2 and 3) used to calibrate the hydraulic model. Refer to Appendix C for the completed Model Development and Calibration Technical Memorandum (TM).

The value includes flow from upland gravity systems that are tributary to the lake line. Flow is intended to capture the degree of failure of the downstream pump station, with greater flow having the potential for greater consequences (flooding, erosion, discharge to Lake Washington) and a resulting higher risk rating.

5.2.2.5 Lake Line Location

The lake line location component represents the percent of the lake line that is in the water. Failures that occur in the water are considered to be of greater consequence due to difficulty of access for repair crews (mobilization of divers, barges, and specialized work equipment), and the impact on the sensitive aquatic environment. While the exact location of the lake line is not known for much of the system, the lake line location was based on a visual assessment of the mapped location relative to the shoreline using the City’s GIS. The City’s GIS is also representative of an approximate location. Further definition of the lake line location would require field locating of the pipe and delineation of the ordinary high-water level; it is anticipated that this will occur during subsequent phases of detailed design.

5.2.2.6 Operational Access

The operational access component is a rating of the ability to access the pump and flush stations of a reach. The more restrictive condition of either the upstream or downstream pump or flush station of a reach was the basis of the rating. Stations with no vehicle access are accessible by pedestrian footpath or boat only.

5.2.2.7 Consequence of Failure Scoring and Weighting

Table 5.2 summarizes how each consequence of failure component was scored and weighted for each reach.

Table 5.2 Consequence of Failure Scoring and Weighting

Component	Weight	Score		
		Low (1)	Medium (2)	High (3)
Environmental Impacts	20%	Not a sockeye salmon spawning area.	(None).	Mapped sockeye spawning area.
Land Use	20%	Residential only.	Public access.	Essential facilities.
Number Of Customers	25%	Less than 50.	Between 50 and 100.	Greater than 100.
Flow	10%	< 100 gpm.	101-200 gpm.	> 200 gpm.
Lake Line Location	10%	0-60% of lake line in-water.	60-89% of lake line in-water.	90-100% of lake line in-water.
Operational Access	15	On land, from easement/ ROW/public parcel.	On land, private lot.	No vehicle access.

5.2.3 Risk Score Calculation

Risk scores, representing a combined likelihood of failure and consequence of failure, were calculated for each reach. Risk scores were weighted with likelihood of failure accounting for 70 percent of the score, and consequence of failure constituting the other 30 percent:

Reach Risk = LoF + CoF

Weighted Reach Risk = (70% x LoF) + (30% x CoF)

Service Area Risk = Total Weighted Reach Risk / Number of reaches in service area.

Greater weight was given to likelihood of failure so that the total risk score of a service area will reflect any capital improvements that are made, which will more significantly impact likelihood than consequence. As assets are renewed → likelihood of failure score decreases → total service area risk decreases. Relatively limited change is anticipated in the Consequence of Failure scores over time, given that the area is largely developed in the present condition (unlikely to have significant changes in environmental conditions, land use, number of customers, flow, access).

Table 5.3 summarizes the likelihood of failure, consequence of failure, and risk score for each reach and the service area risk score.

Table 5.3 Risk Score Summary by Service Area

	Hunts Point and Yarrow Point				Evergreen Point			Medina South				Meydenbauer Bay			Killarney		Newport South	
Reach	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
LOF Score	2.35	2.31	2.31	2.31	2.69	2.40	1.89	1.59	2.05	1.76	1.96	2.25	2.45	1.99	2.09	2.10	2.21	2.21
COF Score	2.05	2.25	1.95	1.35	1.45	1.55	2.25	2.00	1.50	1.70	3.00	2.60	2.70	1.95	2.30	2.30	2.30	2.15
Risk Score	4.52	4.58	4.40	4.04	4.64	4.29	4.00	3.43	3.77	3.48	4.54	4.71	5.05	3.96	4.31	4.32	4.47	4.38
Service Area Risk Score	4.39				4.31			3.81				4.57			4.31		4.43	

Notes:
COF - consequence of failure; LOF - likelihood of failure.

5.2.4 Prioritization Results

The calculated risk score values are clustered into three groups; considered relatively high, medium, and low-risk. Based on the scoring distribution, service areas were categorized into the following time periods for service area plan implementation:

- Near-term, highest risk.
- Medium-term, intermediate risk.
- Long-term, lowest risk.

The timing of implementation periods will depend on City resourcing, funding availability, and adoption of supporting policies. Table 5.4 summarizes the service area risk score priority ranking and corresponding implementation period.

Table 5.4 Service Area Risk and Implementation Period Summary

Priority	Service Area	Risk Score	Implementation Period
1	Meydenbauer Bay	4.57	Near-term
2	Newport South	4.43	Mid-term
3	Hunts Point and Yarrow Point	4.39	
4	Killarney	4.31	
5	Evergreen Point	4.31	
6	Medina South	3.81	Long-term

The risk level and priority categorization is relative only to the other service areas of the Lake Washington lake line system, and not relative to other City wastewater or utility assets. For example, Medina South is assigned a long-term implementation period as it has the lowest service area risk score relative to the other five service areas; but it should not be considered a low-risk system/assets itself. The lake line system is an inherently complex and high-risk system relative to a traditional land-based gravity conveyance system. The risk score priority rank is expected to change over time, as additional data is collected, assets are renewed, and modifications to the system and surrounding infrastructure are completed.

Note that the implementation period does not imply the estimated useful life of the system in that area, as the risk level was used to sequence the priority of the service areas. Refer to Chapter 7 for additional discussion regarding the implementation period, assumed project delivery capacity, and a detailed breakdown of recommended near-term actions.

5.3 System Alternatives

Four system alternatives were identified for the future repair and replacement of the aging lake line system. The EIS provides a summary of the system alternatives under consideration, an evaluation of potential environmental impacts and permitting for each alternative, and a summary of any potential unavoidable adverse impacts.

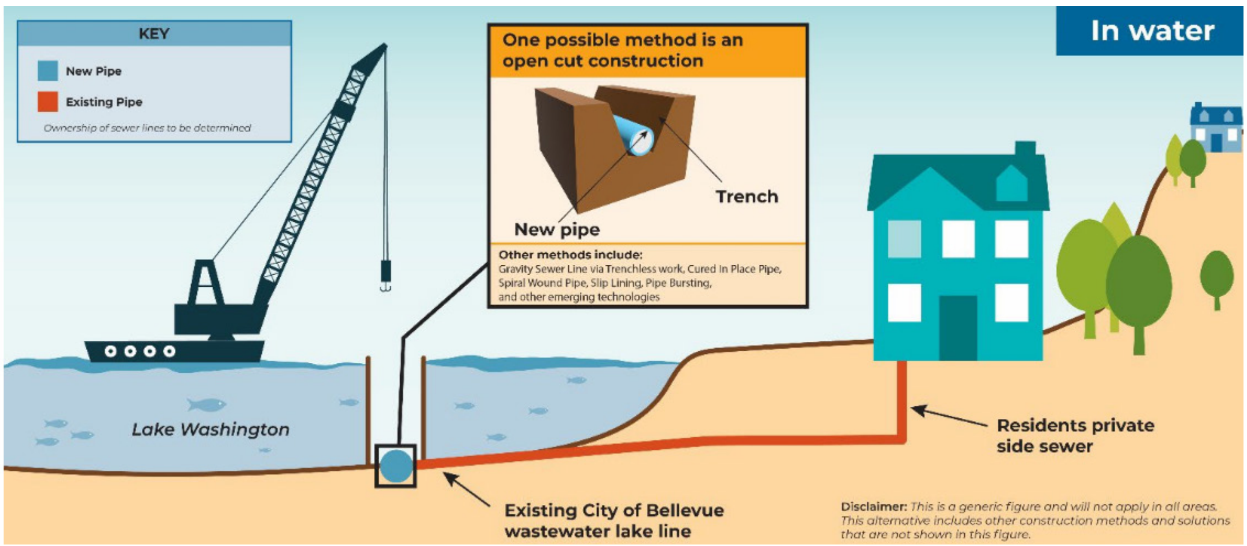
This section provides an overview of the system alternatives considered for each service area and a summary of the alternatives analysis performed to identify a preferred alternative for each service area.

5.3.1 Overview of System Alternatives

This section provides an overview of the four system alternatives considered for replacement and repair of the lake line system. The four system alternatives are in-water, onshore, upland, and no action.

5.3.1.1 In-water Alternative

Any permanent conveyance system infrastructure improvements would generally be located below the ordinary high-water level of Lake Washington. The system infrastructure would either be relocated in-water or replaced in-water, as shown in Figure 5.1. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, cured in-place pipe, spiral wound pipe, slip lining, pipe bursting, or emerging technologies.

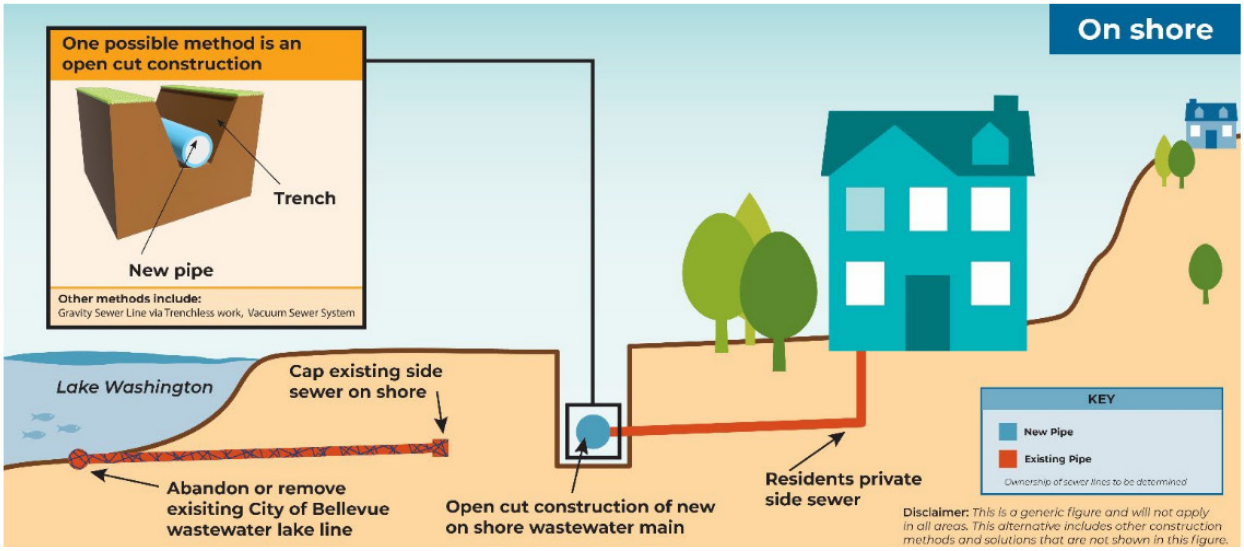


Source: LWWLLMP SEPA Draft EIS.

Figure 5.1 In-Water System Alternative

5.3.1.2 Onshore Alternative

Any permanent system improvements to conveyance system infrastructure would be generally located between the residences, parks, commercial properties and/or public spaces, and the ordinary high-water level of Lake Washington, as shown in Figure 5.2. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, or vacuum sewers.

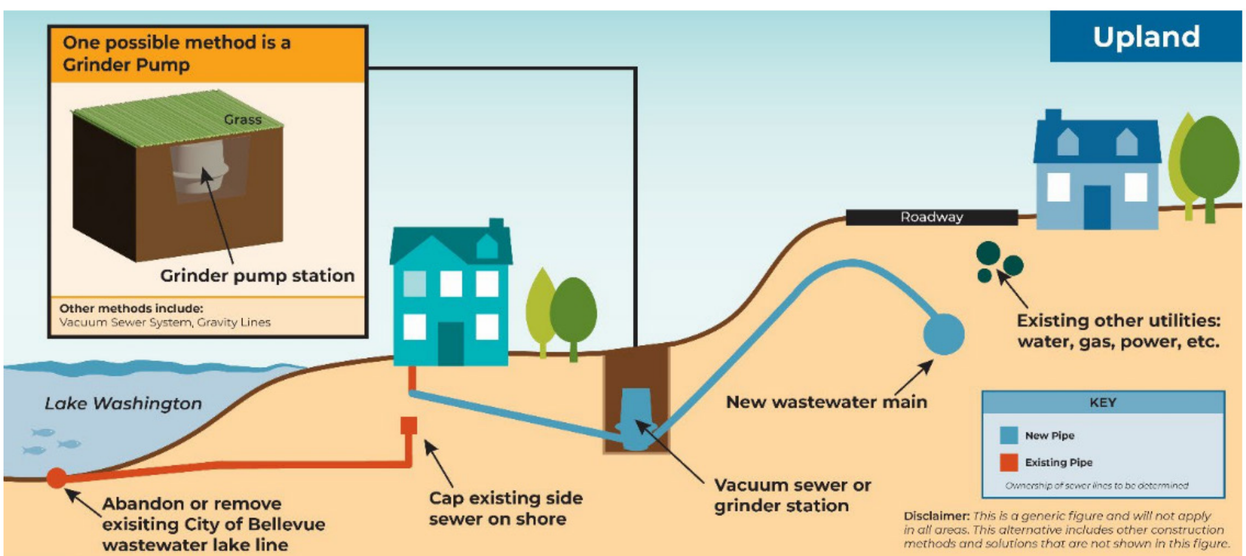


Source: LWWLLMP SEPA Draft EIS.

Figure 5.2 Onshore System Alternative

5.3.1.3 Upland Alternative

Any permanent system improvements to conveyance system infrastructure would be generally located upland of the residences, parks, commercial properties and/or public spaces, and/or within the general vicinity of the public right-of-way, as shown in Figure 5.3. The pump and flush stations connected to the lake line system would also be in the upland area. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, vacuum sewers, or grinder pumps.



Source: LWWLLMP SEPA Draft EIS.

Figure 5.3 Upland System Alternative

5.3.1.4 No Action

Required by SEPA - Potential implementation methods include continued wastewater system operational strategies and maintenance of existing infrastructure, cleaning and condition assessment and monitoring, piecemeal repair and replacement (projects on-by-one as needed), emergency actions, and actions that are taken to maintain or limit degradation of the existing system. Strategies and actions would address immediate needs but would not address long-term degradation of the existing system in a holistic manner.

5.3.2 Alternatives Analysis

An alternatives analysis was completed for each service area to determine a preferred system alternative using the following seven evaluation factors that were weighted for scoring and selection: permitting, environmental impact, right-of-way and easement, performance/operations and maintenance, constructability, cost, and local community, as represented in Figure 5.4.

Figure 5.4 System Alternatives Analysis Evaluation Factors

The alternatives analysis was completed independent of the service area prioritization results. The full alternatives analysis can be found in Appendix E.

A summary of the alternatives analysis for each service area can be found in the respective service area plans included in later sections in this chapter. Note that the preferred system alternative is a preliminary selection that forms the basis of future planning and budgeting. Additional data, such as topographic survey, geotechnical investigations, real property investigations, conveyance system analysis and/or public outreach may result in the selection of a different alternative for a given service area (or portion of an area).

The preferred system alternative for each service area is provided in Table 5.5.

Table 5.5 Service Area Preferred System Alternative and Implementation Period

Priority	Service Area	Preferred System Alternative	Implementation Period
1	Meydenbauer Bay	Upland	Near-term
2	Newport South	Upland	Mid-term
3	Hunts Point and Yarrow Point	Onshore	
4	Killarney	Upland	
5	Evergreen Point	Onshore	
6	Medina South	Upland	Long-term

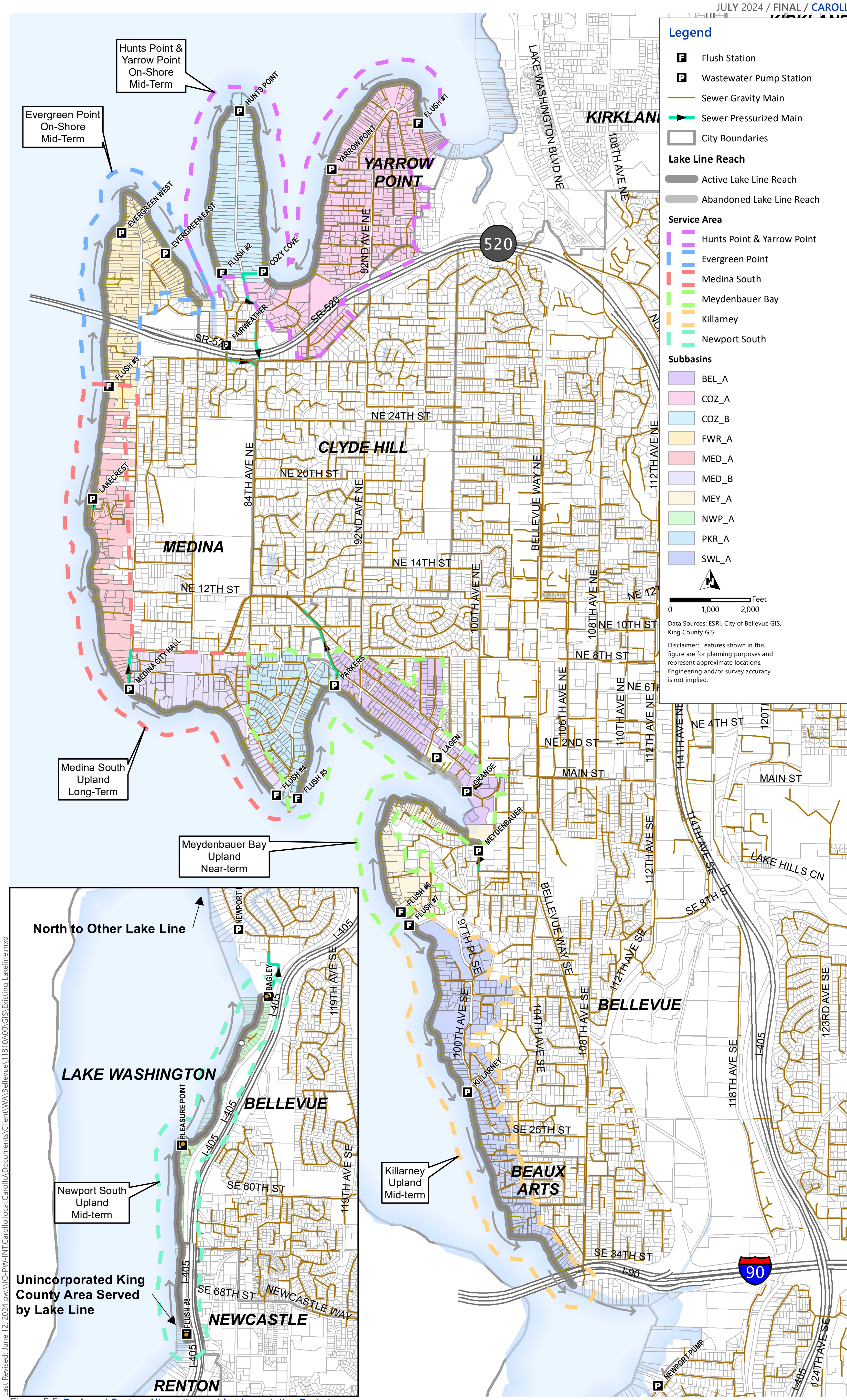


Figure 5.5 Preferred System Alternative and Implementation Period

5.4 Other System Improvements

The operational toolbox of other system improvements is described in Chapter 3. Other System Improvements are categorized into five types:

- Operations Procedure Review.
- Cleaning and Inspection.
- Access Improvements.
- Data Collection.
- Emergency Repair Planning.

Specific system improvements are recommended as components of the service area plans. These are considered essential to continued function of the lake line.

Select system improvements are assumed to be completed by City staff, and not assigned a planning level cost. The remaining system improvements: hydro-jetting and closed-circuit television (CCTV) inspection, topographic survey, and phased coupon collection have been assigned a planning level cost, with the methodology described in the following sections.

5.4.1 Cleaning and Inspection - Hydro-Jetting and CCTV

The existing lake lines have limited access points which preclude standard hydro-jetting and CCTV inspection with standard City equipment. However, cleaning and inspection is a critical operational improvement to prolong the remaining useful life of the system and prevent blockages. Due to the nature of the lake line system, which requires continuous conveyance flow from a flush station to a pump station, any blockage in the pipe can result in a loss of service for the entire reach. The flat slope of the lines, scouring of the lakebed and shoreline, and delamination of aging interior pipe linings is conducive to debris accumulation.

Hydro-jetting and CCTV of the lake line is anticipated to require the installation of temporary access points where a portion of the existing line is removed and replaced with a tee, and a caisson is attached to provide a temporary manhole extension to the water surface (Figure 5.7). Cleaning and inspection can then be performed by vacuum trucks and other equipment brought to the access point by barge (Figure 5.6). Alternate access points from shore can be used in conjunction with the temporary access points, where they exist.

Figure 5.6 City of Renton Emergency Lake Line Cleaning - Vactor Barge (2018)

Figure 5.7 City of Renton Emergency Lake Line Cleaning - Temporary Caisson Access

Figure 5.8 City of Renton Emergency Lake Line Cleaning - Diver Lake Line Access

The basis of cost for hydro-jetting and CCTV inspection is an emergency cleaning project completed by the City of Renton on the Kennydale lake line in 2018. The estimated cost includes field work to obtain coupons, laboratory testing and analysis, and engineering services to generate a study report. The costs were escalated from 2018 to 2023 dollars resulting in $243/LF. Cleaning and inspection of the entire lake line system is recommended in the near-term; however, due to the scale of this effort the City may wish to complete it in phases. Refer to Chapter 7 for a possible phased implementation plan.

5.4.2 Topographic Survey

A majority of the existing system and geographic information used in this plan's development comes from the City's GIS data, which is a consolidation of previous surveys, as-builts, and other mapping sources. GIS data is appropriate for a planning level analysis; however, a detailed topographic survey will be critical for subsequent detailed alternatives analysis phases, permitting, and design. Due to the sizable area of the lake line systems, this is a substantial cost component and thus it is included in the operational costs and associated financial plans. A planning level cost of $250/LF (in 2023 dollars) was used. For service areas with onshore as the preferred system alternative, the total length to be surveyed was assumed equivalent to the existing lake line length. For service areas with upland as the preferred system alternative, the total length to be surveyed was a multiplier of 1.5 times the existing lake line length to account for the additional upland piping required.

5.4.3 Phased Coupon Collection

Given the age of the previous condition assessments of the lake line, and the relatively high cost given the complexity of obtaining underwater coupons, a follow-on assessment is recommended in two phases. Phase 1, to be completed within 0-5 years, would include samples at any pipe given a high-risk rating by the City, in addition to any reaches that did not contain representative samples from previous studies. The exception is the Meydenbauer Bay service area; since this area is priority number one, it is assumed that the service area plan will be implemented, and the existing condition of the system does not require any further assessment. Phase 2, to be completed in 5-10 years, would supplement the previous studies including Phase 1 and collect samples in pipe segments that have been identified by the City as high-risk.

This is a planning level estimation of future coupon collection. Coupon collection was used as the basis for planning to provide consistency with the previous studies; this will allow for a more linear comparison of conditions. Alternative sampling and assessment methods, such as non-destructive ultrasonic testing, could provide a similar level of insight into the pipe condition and estimated useful life. The exact location, number, and sampling method should be refined as part of scoping of a future condition assessment project.

The basis of cost of the coupon collection is the City of Renton's Phase 2B Coupon Collection and Remaining Useful Life Determination project completed on the Kennydale lake line in 2018. The estimated cost includes field work of obtaining coupons, laboratory testing and analysis, and engineering services to generate study report. The costs were escalated from 2018 to 2023 dollars resulting in $45,000 per coupon.

Refer to Figure 5.7 for Phase 1 and Phase 2 Coupon locations. Coupon locations as shown are representative of an approximate location within a given reach. Table 5.6 summarizes the number of coupons in each area and associated costs. The coupon cost by area is included in the individual service area plan costs.

Table 5.6 Phased Lake Line Condition Assessment Costs

Area	Phase 1 (0-5 years) Number of Coupons	Phase 2 (5-10 years) Number of Coupons
Hunts Point and Yarrow Point	1	4
Evergreen Point	2	1
Medina South	2	5
Meydenbauer Bay(1)	--	--
Killarney	2	2
Newport South	1	2
Total Coupons	**8**	**14**
Estimated Cost(2)	**$360,000**	**$630,000**

Notes:
(1) Meydenbauer Bay is excluded given the anticipated implementation of the system alternative within the near-term.
(2) Estimated cost of $45,000 per coupon includes field work of obtaining coupons, laboratory testing and analysis, and engineering services to generate study report. Cost is provided per coupon for service area planning purposes only; additional phasing may result in higher cost per coupon due to mobilization costs for specialized barge and diver work.

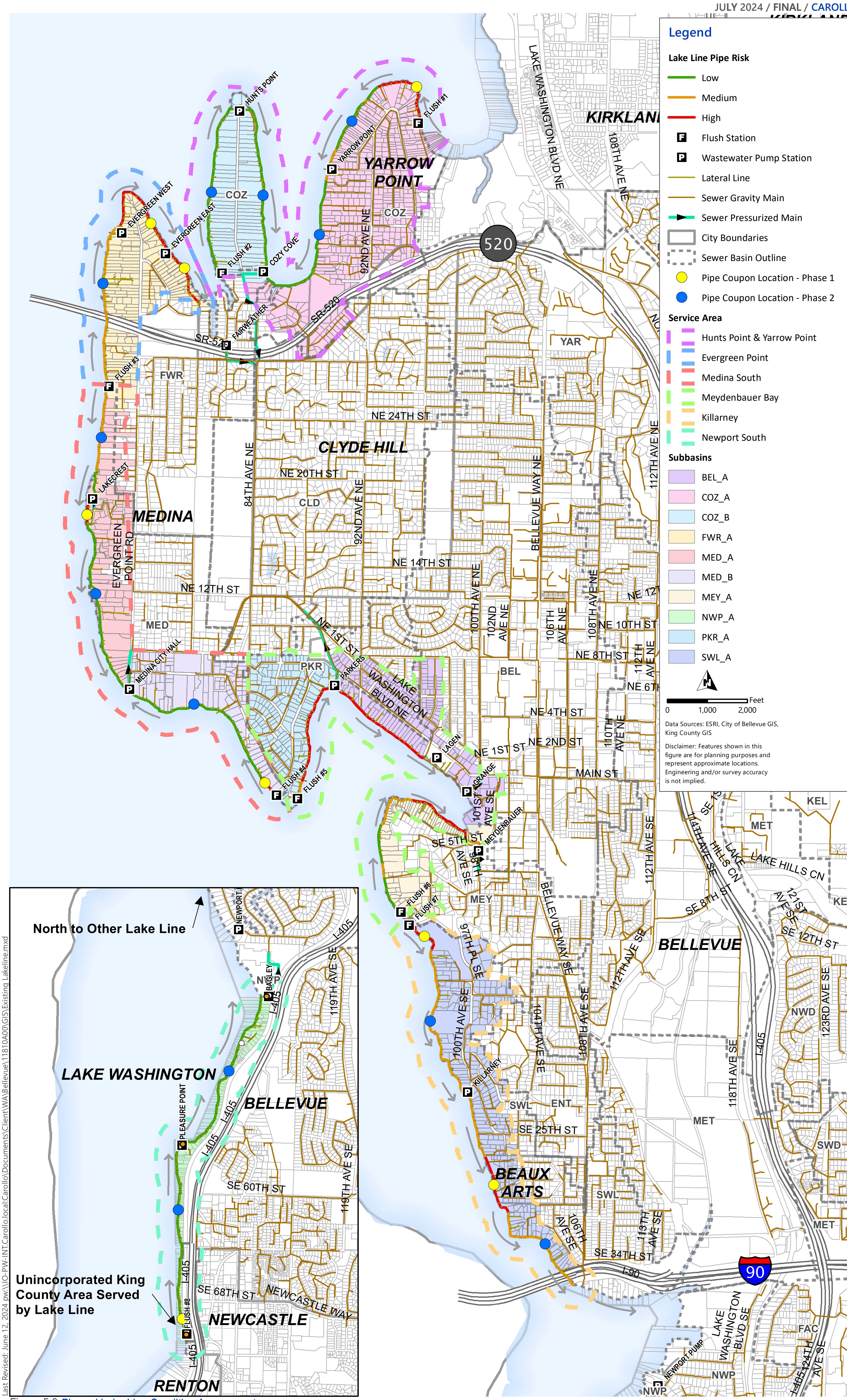


Figure 5.9 Phased Lake Line Condition Assessment
CITY OF BELLEVUE
LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT

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5.5 Service Area Plans

This section provides an overview of the service area plans' structure, followed by detailed plans for each of the six service areas.

The plans are presented in geographic order from the northern limits of the lake line system at Yarrow Bay, to the southern limits at the City of Renton boundary.

5.5.1 Plan Structure

As previously discussed in Chapter 2, the lake line system has been divided into six service areas for analysis and planning. The service areas were developed by grouping sections of the lake line system based on the surrounding interdependencies of lake line system hydraulic function, land use, jurisdiction, and environmental conditions. A **service area** includes all attributes of the lake line system such as the lake line pipe, pump/flush stations, recirculation maintenance holes, cleanouts, and lateral side-sewers, as well as the characteristics of the basin such as parcels/customers, other utility systems, topography and land cover, zoning, critical areas, docks, and bulkheads.

A **service area plan** summarizes the key characteristics of the area including land use, number of customers, lake line system components and area priority. A service area plan consists of four primary components: system alternative, pump and flush station improvements, emergency repair fund, and other system improvements as shown in Figure 5.10. Associated estimated costs and regulatory considerations are also included.

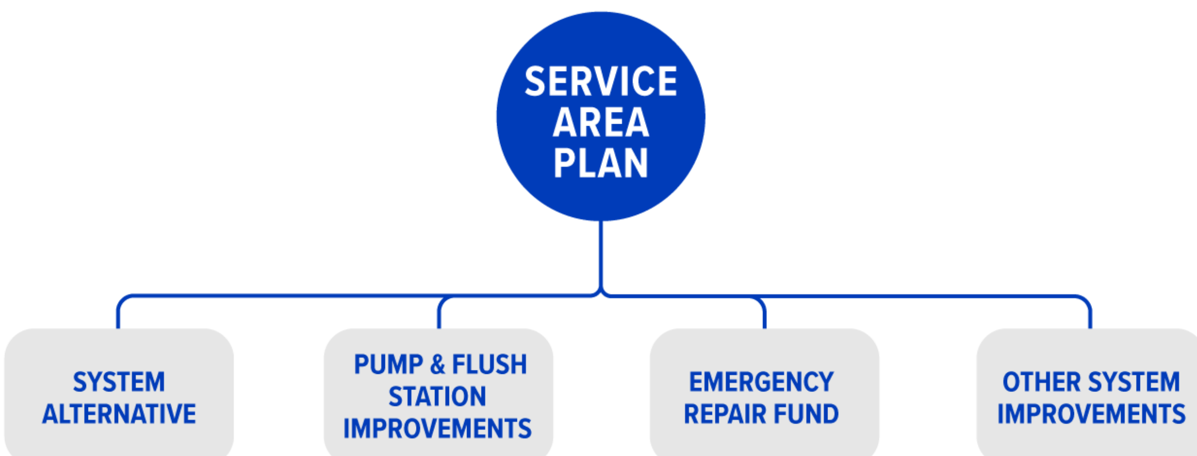


Figure 5.10 Service Area Plan Components

The **system alternative** is the programmatic alternative (in-water, onshore, or upland system) that has identified as the preferred alternative to replace the existing lake line system on an area-specific scale. The service area plans summarize the determining factors in selecting the preferred alternative for each area. While a preferred alternative is indicated for each service area, this is intended to provide a basis for budgeting and planning and may not represent the final solution for the entire service areas. Refer to Chapter 7 - Implementation Plan for additional discussion, and Appendix E for the complete Alternatives Analysis TM.

As part of the alternatives analysis, Class 5 opinion of probable construction costs (OPCC) were developed for each alternative and service area. The costs provided in the service area plans include:

- Total bid amount: the Class 5 OPCC represents the "total bid amount" including 30 percent Allowance for Indeterminates (AFI) and sales tax, and excluding 40 percent construction contingency, inflation/escalation, soft costs, easements, real estate, permitting, environmental mitigation, and operational or other system improvements.
- Construction hard cost: the total bid amount with a construction contingency.
- Soft cost: engineering design, engineering services during construction, City labor, legal and printed materials, construction management by the City with a soft cost contingency.
- Total project cost (TPC): the sum of construction hard cost and soft cost.
- Low range and high range: these ranges are based on Association for the Advancement of Cost Engineering ranges for construction hard costs only and include estimated soft costs without a high or low range applied since these soft cost ranges are undefined and would likely differ from construction ranges.

Pump and flush station improvements are lake line pump and flush station projects identified and recommended as part of the 2015 Wastewater Pump Station Evaluation (Murray, Smith & Associates, May 2015). This evaluation was a thorough condition assessment of the lake line pump and flush stations including site, mechanical, structural, electrical and telemetry components of the stations resulting in a capital improvement plan for repair and/or replacement. The recommended improvements are considered capital upgrades, beyond typical operations and maintenance.

All pump and flush station projects identified in this report had a recommended schedule for completion between 2015-2026. Any of the recommended pump and flush station improvements that have not been completed at the time of management plan development are included as early action projects to be completed within the initial near-term implementation period of the management plan. No additional condition assessments were completed as part of the management plan development that would allow modification of the scope or timeline of repairs since the 2015 evaluation.

The 2015 Wastewater Pump Station Evaluation provided a summary of capital improvement project costs in 2014 dollars. The average 20-City Engineering New Record (ENR) Construction Cost Index (CCI) for 2014 was 9806.5. The project costs in 2014 dollars (from the 2015 Evaluation) were escalated to 2023 dollars using an average 20-City ENR CCI of 13358.17.

Refer to Chapter 7: Implementation Plan for consideration of re-evaluating the existing pump and flush station conditions given the age of the previous assessment. There is the potential for advanced degradation/decrease in estimated useful life and change in codes and standards since that time.

The **emergency repair fund** is to mitigate the risk of pipe failures by allowing for emergency spot repairs prior to implementation of the service area system alternative. The fund value was calculated based on pipe segments of the lake line that have the highest likelihood of failure rating (greater than 6, on a scale of 3 to 9). This rating was determined by the City based on the likelihood of failure factors (pipe wall loss, pipe material, and estimated useful life) as described in the prioritization section of this Chapter. Pipe coupon and condition is from the Sewer Lake Line Condition Assessment, Phase 2 – Lake Washington (Tetra Tech, December 2016).

A per linear foot cost for replacement of the highest rated pipes was used to calculate the recommended emergency repair fund for spot repair(s) in a given service area. Specific projects to repair these pipes are not proposed; rather, this is considered representative of the pipe condition of the area. Note that this cost for replacement is for spot repairs only. The cost to replace an extended segment of pipe or entire reach in-water is significantly higher due to the additional elements of extended dewatering, temporary bypass, permitting, bathymetric survey, abandonment/removal of existing pipe, and anticipated construction of manholes or other access points. Also note that this cost excludes temporary bypass; unlike other cost elements, temporary bypass is not proportional to length of the spot repair but rather per occurrence. The estimated cost of temporary bypass per repair is approximately $100,000 (approximately equivalent to 25 additional linear feet). Due to the uncertainty regarding the number of discrete repairs that may be required, this amount has not been added separately to the repair fund total.

Other system improvements are recommended measures specific to a service area to extend the useful life of the system and inform the service area strategies and implementation. This includes additional data collection measures to re-evaluate and confirm priority of service areas, particularly for assets previously identified as high-risk. Other system improvements fall into five categories: Operations Procedure Review, Cleaning and Inspection, Access Improvements, Data Collection, and Emergency Repair Planning. "Desktop" system improvements, such as Operations Procedure Review, ROW and Easement Review, and Emergency Repair Planning, are assumed to be completed by City staff and are not included in the plan estimates.

Estimated costs for the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements are provided in each service area plan. The service area plans also include an **implementation cost summary**, presented in 2023 dollars, for each planning period (near-term, medium-term, and long-term).

The service area plans also review the **regulatory considerations** for the preferred system alternative, including policies, environmental impacts (such as stormwater and runoff, turbidity and dissolved oxygen [DO], and pollutants), environmental impacts, and permitting.

Each service area plan begins with an overview summarizing the service area, prioritization results, preferred system alternative, and implementation costs.

5.6 Service Area Plan - Hunts Point and Yarrow Point

5.6.1 Overview

The Hunts Point and Yarrow Point Service Area covers the entirety of the lake line system in the Cities of Hunts Point and Yarrow Point and serves approximately 587 parcels, which are zoned primarily as residential. The lake line system in the Hunts Point and Yarrow Point Service Area consists of four reaches with approximately 3.2 miles of lake line, two flush stations, and three pump stations.

The risk score for the Hunts Point and Yarrow Point Service Area resulted in **priority number three** of six service areas. The implementation period for the Hunts Point and Yarrow Point Service Area is **medium-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting in the Hunts Point and Yarrow Point Service Area is the **onshore alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.7. All costs are presented in 2023 dollars. Only costs prior to and including the implementation of the system alternative are included.

The total implementation cost for this service area plan is **$254 million**.

Table 5.7 Plan Implementation Costs - Hunts Point and Yarrow Point

Service Area Plan Components	Estimated Cost
Preferred System Alternative	$234,700,000
Pump and Flush Station Improvements	$4,579,000
Emergency Repair Fund	$6,952,000
Other System Improvements	$8,307,000
Total	**$254,718,000**

5.6.2 Lake Line System

The lake line system in the Hunts Point and Yarrow Point Service Area consists of four reaches with approximately 3.2 miles of lake line, two flush stations, and three pump stations as shown in Figure 5.11. Flow is conveyed from the outer limits of the service area towards the center, combining at Cozy Cove PS. From the Cozy Cove PS, flow leaves the lake line system and is conveyed through an on-land force main to manhole located on the south side of State Route (SR)-520, where it discharges to a gravity system. Table 5.8 summarizes the lake line system components in the Hunts Point and Yarrow Point Service Area.

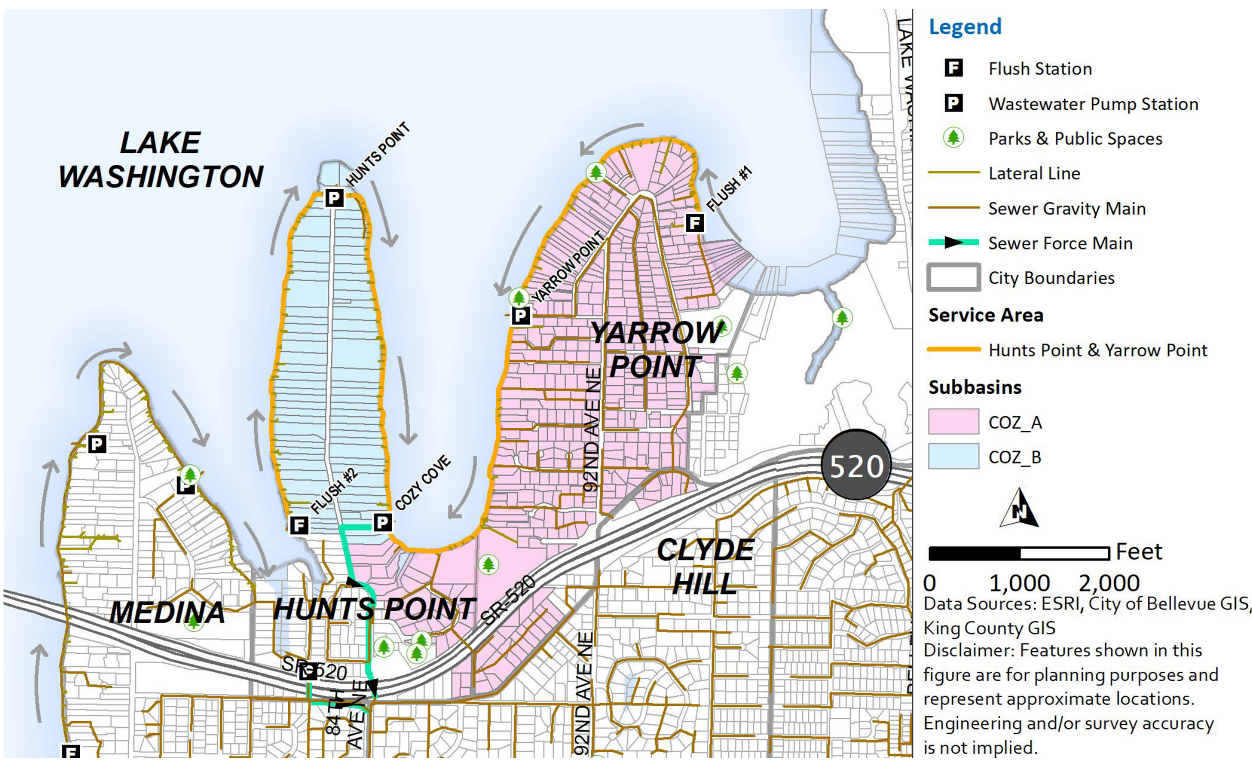


Figure 5.11 Lake Line System - Hunts Point and Yarrow Point

Table 5.8 Lake Line System Components - Hunts Point and Yarrow Point

Component	Description
Reaches	▪ Reach 1 - Flush No.1 to Yarrow Point PS. ▪ Reach 2 - Yarrow Point PS to Cozy Cove PS. ▪ Reach 3 - Hunts Point PS to Cozy Cove PS. ▪ Reach 4 - Flush No. 2 to Hunts Point PS.
Pump Stations	▪ Yarrow Point PS: 2 pumps, 380-460 gpm station firm capacity. ▪ Cozy Cove PS: 3 pumps, 320-410 gpm station firm capacity. ▪ Hunts Point PS: 2 pumps, 270-300 gpm station firm capacity.
Flush Stations	▪ Flush No. 1: 240 gpm. ▪ Flush No. 2: 240 gpm.
Pipe	▪ 16,755 LF of pipe: » 2,195 feet on land. » 14,560 feet in-water.
Parcels Served	▪ 587 parcels served (155 parcels adjacent to lake line).

5.6.3 Area Characteristics

The Hunts Point and Yarrow Point Service Area begins approximately 0.15 miles north of Morningside Park, follows the Lake Washington lake line system to incorporate the system in Hunts Point, and ends where Fairweather Bay intersects the peninsula containing Fairweather Place roadway as shown in Figure 5.9.

The Hunts Point and Yarrow Point Service Area serves approximately 587 parcels, which are zoned primarily as residential and contain approximately 154 private docks with interspersed bulkhead infrastructure. The existing zoning in the Hunts Point portion of the service area is single-family residential on lots ranging from 20,000 to 40,000 square feet (R-20 and R-40) and public use or town park property (Town of Hunts Point 2007 Zoning Map). Similarly, in the Yarrow Point section, the zoning is Public Uses and single-family residential (R-15). The public use zoning is composed of Road End Beach Park and the Wetherill Nature Preserve (Town of Yarrow Point 2015 Comprehensive Plan).

The service area is primarily low-intensity development land covered with some medium-intensity developed areas and sparse evergreen and deciduous areas and woody wetlands in Wetherill Nature Preserve. All the shoreline of the Service Area is located within a moderate to high liquefaction hazard area. The Hunts Point and Yarrow Point Service Area also contains the following critical areas: a landslide deposit at the northernmost point of Yarrow Point adjacent to Lake Washington, and some steep slopes on the east side of Yarrow Point.

The service area's characteristics are summarized in Table 5.8. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.9 Area Characteristics - Hunts Point and Yarrow Point

Characteristic	Description
Jurisdictions	▪ Town of Hunts Point. ▪ Town of Yarrow Point.
Zoning	▪ R-20 (Single Family Residential). ▪ R-40 (Single Family Residential). ▪ R-20A Town Park Property. ▪ Public Uses and R-15 (Single Family Residential).
Parks and Public Spaces	▪ Wetherill Nature Preserve. ▪ Road End Beach Park (Yarrow Point Beach Park). ▪ Loch Lane Beach Park.
Geologic Hazards or Limitations	▪ Town of Hunts Point: » Relatively limited geologically hazardous areas apart from steep slopes. ▪ Town of Yarrow Point: » Landslide deposit at northernmost point adjacent to Lake Washington. » Steep slopes along periphery adjacent to Lake Washington. » Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington. ▪ Yarrow Creek with its outlet located at the Yarrow Bay Wetlands. ▪ Water Quality Impairments: » Yarrow Creek and Yarrow Bay Wetlands, Category 5: DO and bacteria.

5.6.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period for the Hunts Point and Yarrow Point Service Area.

5.6.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Hunts Point and Yarrow Point Service Area are presented in Table 5.10.

The average risk score for the Hunts Point and Yarrow Point Service Area is 4.39, resulted in its ranking as **priority number three** of the six service areas.

5.6.4.2 Implementation Period

The implementation period for the Hunts Point and Yarrow Point service area is **medium-term**.

Table 5.10 Risk Scores - Hunts Point and Yarrow Point

	Reach 1 - Flush No. 1 to Yarrow Point PS	Reach 2 - Yarrow Point PS to Cozy Cove PS	Reach 3 - Hunts Point PS to Cozy Cove PS	Reach 4 - Flush No. 2 to Hunts Point PS
Likelihood of Failure Components				
EUL	2	1	1	1
Pipe Material	2	2	2	2
Couponing	2	1	1	1
Pump and Flush Station Condition	3	3	3	3
Outside Influences	2	2	2	2
Overflow History	2	3	3	3
Weighted LOF Score	**2.35**	**2.31**	**2.31**	**2.31**
Consequence of Failure Components				
Environmental Impact	1	1	3	1
Land Use	2	2	1	1
Parcels Served	3	3	1	1
Flow	3	3	3	2
Location	1	3	3	2
Operational Access	2	2	2	2
Weighted COF score	**2.05**	**2.25**	**1.95**	**1.35**
Weighted Total Risk Score	**4.52**	**4.58**	**4.40**	**4.04**
Service Area Average Risk Score	**4.39**			

5.6.5 Service Area Plan

5.6.5.1 System Alternative

The preferred system alternative for the Hunts Point and Yarrow Point Service Area is the **Onshore Alternative**. Table 5.11 summarizes the consideration factors for each alternative, with red shading representing a higher level of complexity for that factor, yellow representing a medium level of complexity, and green shading representing a lower level of complexity, and therefore making it the preferred alternative for that factor.

Table 5.11 System Alternatives Analysis Summary - Hunts Point and Yarrow Point

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Onshore was the preferred alternative in this case because it had the least number of red cells, therefore representing the lowest level of complexity/difficulty for this Service Area. In addition, it is estimated to be the lowest cost alternative given the substantial inherent cost of new pipelines required for an upland alternative and the generally more expensive work within Lake Washington for the in-water solution. Permitting, environmental impact, and performance/O&M were considered to be somewhat difficult for the onshore alternative, but all three of these factors are less difficult than the in-water solution. For all three alternatives, the technical complexity and constructability were considered to be high in complexity.

In-water was not identified as the preferred alternative because of difficulties obtaining permits for this work, a substantially higher impact on the environment, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington.

Upland was not identified as the preferred alternative because the upland alternative presents greater difficulty with right of way and local community impacts with substantial disruption required to install new sewers mains to collect grinder pump discharge. Currently, there is no sewer main within Cozy Cove, requiring new infrastructure to move flows away from the lake. While Yarrow Point does have sewer mains within the roadway, the number parcels between 132nd Ave NE and the lake on the west side of this sewer basin would require long runs of pressurized sewer laterals and impacts to multiple properties.

The preferred alternative, onshore, is conceptually similar to the existing lake line system. Due to the shore's topography, this is anticipated to be a low-pressure system that will require flush stations and pump stations to convey wastewater throughout the system. For the purposes of this plan, it is assumed that the contributing basin limits, and the location of the flush stations, pump stations, and point of discharge to the upstream (non-lake line) system will remain unchanged for this service area.

The system alternative cost of implementing the onshore alternative in the Hunts Point and Yarrow Point Service Area is summarized in Table 5.12. Refer to Appendix E - Alternatives Analysis TM for detailed cost information.

Table 5.12 System Alternative Cost (Onshore) - Hunts Point and Yarrow Point

	Onshore Open Cut Cost	Onshore Trenchless Cost
Total Bid Amount(1)	$83,893,000	$104,168,800
Construction Hard Cost(2)	$117,453,000	$145,838,800
Soft Cost(3)	$71,530,000	$88,815,000
Total Project Cost(4,5)	**$188,983,000**	**$234,653,800**
▪ Low Range (-19 percent)	$154,000,000	$191,000,000
▪ High Range (+62 percent)	$306,000,000	$380,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.6.5.2 Pump and Flush Station Improvements

Table 5.13 identifies the pump and flush station locations, original project identification (ID) and implementation period per the 2015 assessment, and associated project costs.

Note the Yarrow Point PS and the Cozy Cove PS indicated some level of deficiency during the 25-year design storm. Verification of the pump station sizing should be included in the scoping and verification of station improvements.

Table 5.13 Pump and Flush Station Improvements - Hunts Point and Yarrow Point

Pump/Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No 1	Parcel number: 9808700746 Address: 4620 95th Ave NE Yarrow Point, 98004	F1-1 F1-2 F1-3	2018-2022 2020-2025 2023-2026	\$5,000 \$75,000 \$630,000	\$7,000 \$103,000 \$859,000
Yarrow Point PS	NE 42nd St ROW (Undeveloped street end)	YP-1	2015-2018	\$379,000	\$517,000
Cozy Cove PS	Parcel number: 3534900070 Address: 3268 Hunts Point Road Hunts Point 98004	CC-1 CC-2	2015-2018 2015-2018	\$18,000 \$567,000	\$25,000 \$773,000
Hunts Point PS	Hunts Point Road ROW (roadway)	HP-1	2015-2018	\$373,000	\$509,000
Flush No. 2	Parcel number: 3534900525 Address: 3261 Hunts Point Road Hunts Point 98004	F2-1 F2-2 F2-3	2018-2022 2020-2025 2023-2026	\$5,000 \$75,000 \$1,230,000	\$7,000 \$103,000 \$1,676,000
Total				\$3,357,000	**\$4,579,000**

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5
(2) The 20-City ENR CCI used for 2023 was 13358.17.

5.6.5.3 High-risk Assets

Lake line pipe segments with a high-risk of failure rating (greater than 6 on a scale of 3 to 9) are noted under the following asset IDs: 197889, 197891,197892, 197930, 213181 213508. The locations of these pipes are identified in Figure 5.11.

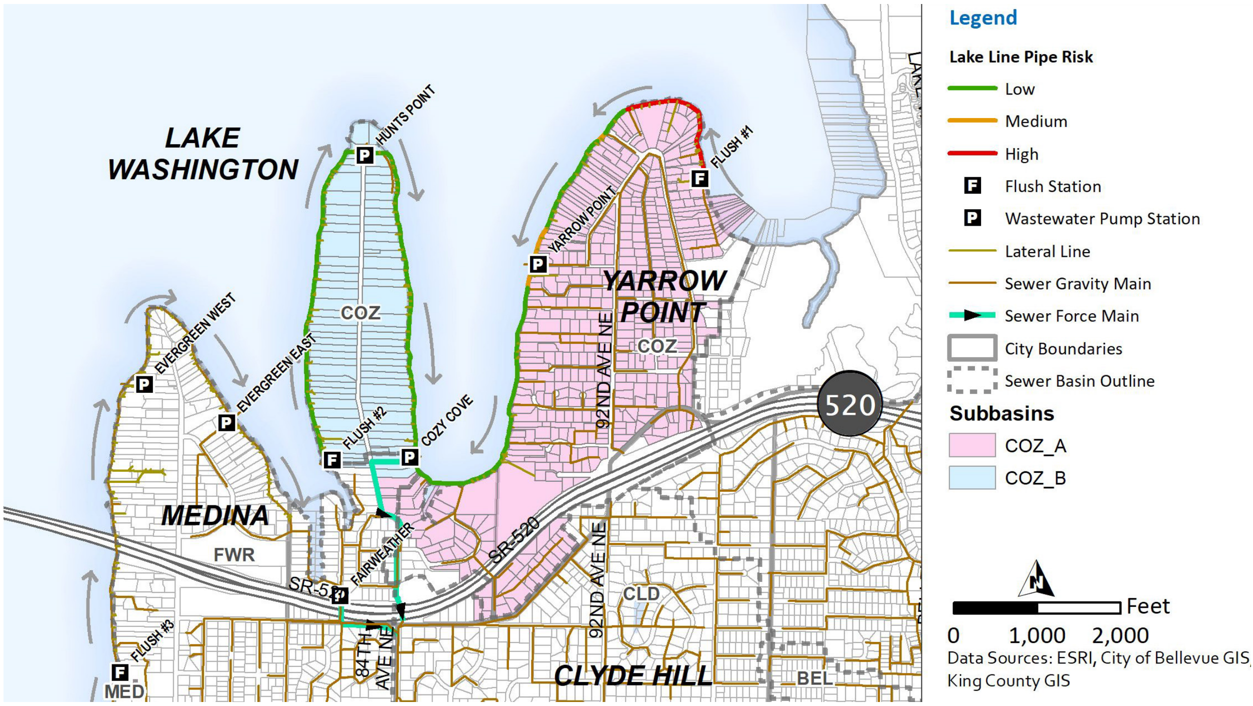


Figure 5.12 High-risk Assets - Hunts Point and Yarrow Point

The length of pipe considered high-risk is approximately 1,738 LF of 16,433 LF, or approximately 11 percent of the lake line main in the service area. At an average repair cost of $4,000/LF for in-water pipe, the recommended emergency repair fund for spot repair(s) in this service area is $6,952,000.

5.6.5.4 Other System Improvements

The other system improvements recommended for the Hunts Point and Yarrow Point Service Area are summarized in Table 5.14. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in Table 5.14). Refer to Appendix G for the detailed system improvements cost estimate.

Table 5.14 Other System Improvements - Hunts Point and Yarrow Point

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for system-wide recommendations.	Near-term	City Staff
Cleaning and Inspection	Hydro-jetting and CCTV Inspection.	Near-term	$4,073,000
Access Improvements	Vegetation/Obstruction clearing at PS and FS.	Near-term	City Staff
Data Collection	Right-of-way and Easement Review.	Near-term	City Staff
	Topographic Survey (Optional).	Medium-term	$4,189,000
	Phase 1 Pipe Coupon Collection.	Near-term	$45,000
	Phase 2 Pipe Coupon Collection.	Near-term	$180,000
Emergency Repair Planning	See Chapter 3 for system-wide recommendations.		City Staff
Total			**$8,487,000**

Notes:
(1) Approximate cost for the coupons in this service area only; coupons to be collected in five service areas in each phase.

5.6.6 Regulatory Considerations

5.6.6.1 Environmental Impacts

Construction for the Hunts Point and Yarrow Point service area would be done within onshore locations. Potential onshore construction methods include the installation of a low-pressure line via open cut-and-cover construction, installation of a vacuum sewer system, pipe rehabilitation (sliplining and cured-in-place-pipe [CIPP]), and installation of a low-pressure line via trenchless construction. Trenching or staging for construction would be the main temporary disturbance for these construction methods, which would potentially include displacement of riparian habitat to install new pipeline. Surface water resources within this service area include Wetherill Nature Preserve, and Yarrow Creek.

Clearing and grading of existing riparian habitat or wetland vegetation could potentially result in a reduced capacity to filter pollutants and protect surface waters, including areas close to Yarrow Creek and the Wetherill Nature Preserve Wetlands. Disturbance of riparian and wetland areas could also cause localized alteration of the adjacent aquatic habitat, such as minor changes in shading patterns and a possible reduction in organic material input and/or terrestrial prey resources for fish. The temporary loss of hydrologic, water quality, or habitat functions due to wetland or riparian habitat disturbance and displacement is expected to be offset after construction through site restoration. Restoration can also include potential benefits, such as removing invasive species and planting native species in areas that are disturbed.

Construction methods, potential impact, and the surface water resources present within the Hunts Point and Yarrow Point service area are summarized below in Table 5.15.

Table 5.15 Potential Environmental Impacts for Onshore Construction - Hunts Point and Yarrow Point

<table>
<tr><th>Construction Method</th><th>Stormwater and Runoff</th><th>Turbidity and DO</th><th>Pollutants</th><th>Surface Water Resources Present within Service Area</th></tr>
<tr><td>Open Cut-and-Cover</td><td rowspan="2">▪ Requires trench dewatering effluent during construction.
▪ Require installation of a shoring system to isolate the work area from the surrounding environment.</td><td rowspan="2">▪ Potential to increase turbidity and lower DO during construction through construction equipment staging/excavation shoring of the trench.</td><td rowspan="4">▪ Unassessed pollutants in soil during trenching are separated from water resources.
▪ Construction equipment leaks or spills are negligible based on distance from water resources.</td><td rowspan="4">▪ Lake Washington.
▪ Yarrow Creek.
▪ Wetherill Nature Preserve Wetlands.</td></tr>
<tr><td>Vacuum Sewer</td></tr>
<tr><td>Rehabilitation</td><td>▪ Temporary development of construction entrances and staging activities.</td><td>▪ Minimal impacts to turbidity and DO.</td></tr>
<tr><td>Trenchless</td><td>▪ Minimal disturbance of sediment.</td><td>▪ Minimal impacts to turbidity and DO.</td></tr>
</table>

Onshore alternatives avoid potential in-water impacts to sockeye salmon spawning locations (e.g., northwest tip of Hunts Point) and sensitive water quality areas (e.g., Yarrow Creek and Yarrow Bay wetlands). Potential turbidity increases to locations where DO is already a concern to surface water resources should be considered during development of construction best management practices (BMP).

Because most areas of the Hunts Point and Yarrow Point service area are developed, avoidance and minimization measures should be considered for areas with notable riparian or wetland vegetation.

Avoiding environmental impacts will be critical to onshore construction methods within the Hunts Point and Yarrow Point service area. For example, use of trenchless methods for stream crossings or within wetlands will help to avoid impacts to critical habitat. Other routes around streams and wetlands (e.g., short in-water segments that prioritize the rehabilitation of existing pipes) could also be used for these areas. Accessing the lake line system through existing maintenance holes, where feasible, and reducing direct interactions with sensitive habitats will help to avoid such impacts.

5.6.6.2 Permitting

Onshore construction is generally located between residences and the Ordinary High-Water Mark (OHWM) of Lake Washington (within 200 feet) and is thus subject to shoreline permitting and adherence to local Shoreline Master Plan (SMP) requirements. If there are areas within the Hunts Point and Yarrow Point service area where the onshore alternative is not feasible, or where there will be impacts to federal- or state-regulated wetlands or surface waters, then the project will require additional coordination with federal and state agencies and tribes. Necessary permits within the Hunts Point and Yarrow Point service area are identified in Table 5.16. Because there are sensitive resources in this services area, these coordination items were flagged as only potentially avoided in the table below.

Table 5.16 Permit Matrix - Hunts Point and Yarrow Point

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
Federal(1)			
USACE	Section 10 of the RHA and Section 404 of the CWA.	6-2 months (potentially avoided).	▪ Requires a permit for any work in, over or under navigable waters of the US. ▪ Grading or mechanized land clearing of wetlands. ▪ Discharging material in US waters. ▪ Requires compliance with the NHPA and ESA, and the MSA.
NMFS and USFWS	ESA and Essential Fish Habitat (under the MSA) Consultation.	6-24 months (potentially avoided).	▪ Required if there is a federal nexus for the project. ▪ Federal nexus = issuance of a federal permit or use of federal funding.
Federal Tribes	Tribal Agreements.	6-12 months (potentially avoided).	▪ Potential impacts within a reservation, areas of cultural significance, or Usual and Accustomed fishing areas.
State Permits(2)			
DAHP	Section 106 of the NHPA	6-12 months (potentially avoided).	▪ Required if there is a federal nexus for the project. ▪ Federal nexus =potential for ground disturbance or effects on historic properties or cultural resources.
Ecology	Construction Stormwater General Permit	6-12 months.	▪ Discharge to surface waters through the stormwater system.
Ecology	Section 401 of the CWA WQC	6-12 months (potentially avoided).	▪ Required if there is a federal nexus for the project. ▪ Federal nexus = issuing a license or permit; Ecology makes a determination on a WQC request or waives the right to review.

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
Ecology	Shoreline Permit or Variance Review	1 month.	▪ Required if there is a shoreline permit issued.
WDFW	HPA	45 days (potentially avoided).	▪ Work that uses, diverts, obstructs, or changes the natural flow or bed or bank of state waters.
Local Permits(2)			
Local Jurisdiction (Hunts Point, Bellevue, Yarrow Point)	SEPA Compliance	Issued with a land use/shoreline permit.	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process.
	Land Use Permit(s)	6-18 months.	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months.	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Clearing and Grading Permit(s)	6-12 months.	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course.
	ROW Use Permit(s)	3-6 months.	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department.

Notes:
(1) Not triggered unless wetlands or federal navigable waters are impacted.
(2) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.
CWA - Clean Water Act; DAHP - Department of Archeology and Historic Preservation; ESA - Endangered Species Act; HPA - Hydraulic Project Approval; MSA - Magnuson–Stevens Fishery Conservation and Management Act; NHPA - National Historic Preservation Act; NMFS - National Marine Fisheries Service; RCW - Revised Code of Washington; RHA - Rivers and Harbors Act; USFWS - United States Fisheries and Wildlife Service; WQC - Water Quality Certification.

5.6.6.3 Mitigation

Trenching would be the main temporary disturbance using onshore construction methods, which would potentially include displacement of riparian habitat to install new pipeline. The shoreline of Lake Washington is heavily developed or degraded, with little natural riparian vegetation except for notable wetlands along the shoreline, including Wetherill Nature Preserve, and areas surrounding streams (e.g., Yarrow Creek). Mitigation measures include the general provisions described in Chapter 3. These measures are primarily construction BMPs to avoid and minimize temporary impacts.

5.7 Service Area Plan - Evergreen Point

5.7.1 Overview

The Evergreen Point Service Area covers a small portion of Hunts Point and the western side of the Fairweather Bay peninsula north of SR-520; spans the lake line system into the City of Medina, Evergreen Point, and the portion of the system that intersects SR-520 perpendicularly; and ends approximately 0.4 miles south of SR-520. The Evergreen Point Service Area serves approximately 172 parcels where the existing zoning is primarily single-family residential and parks and public places. The lake line system in the Evergreen Point Service Area consists of three reaches with approximately 1.6 miles of lake line, one flush station, and three pump stations.

The risk score for the Evergreen Point Service Area places it as **priority number five** out of the six service areas. The implementation period for the Evergreen Point service area is **medium-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting in the Evergreen Point Service Area is the **onshore alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.17. All costs are presented in terms of 2023 dollars. Only costs prior to and those including the implementation of the system alternative are included.

The total implementation cost for this service area plan is **$255 million**.

Table 5.17 Plan Implementation Costs – Evergreen Point

Service Area Plan Components	Estimated Cost
Preferred System Alternative	$127,500,000
Pump and Flush Station Improvements	$1,878,000
Emergency Repair Fund	$16,172,000
Other System Improvements	$4,289,000
Total	**$149,839,000**

5.7.2 Lake Line System

The lake line system in the Evergreen Point Service Area consists of three reaches with approximately 1.6 miles of lake line, one flush station, and three pump stations, as shown in Figure 5.13. Flow is conveyed from the southwest limits of the service area towards the north end of Evergreen Point to the Evergreen West Pump Stations. Evergreen West is an intermediate pump station that further conveys flow around Evergreen Point to the Evergreen East Pump Station, an additional intermediate pump station. From Evergreen East, flow is conveyed to the southeast limit of the service area where the flow enters a gravity system (near the mouth of Fairweather Bay) where it is no longer classified by the City as a lake line system. This gravity system flows to Fairweather Pump Station, just north of SR-520, which also collects gravity flow from the southern non-lake line customers of Hunts Point. Table 5.19 summarizes the lake line system components in the Evergreen Point Service Area. For planning purposes, improvements to the Fairweather Pump Station are included in the service area plan because it is required as part of the system to convey flow downstream of the Evergreen East Pump Station. Note that Fairweather Pump Station also collects flow from the adjacent, non-lake line gravity systems.

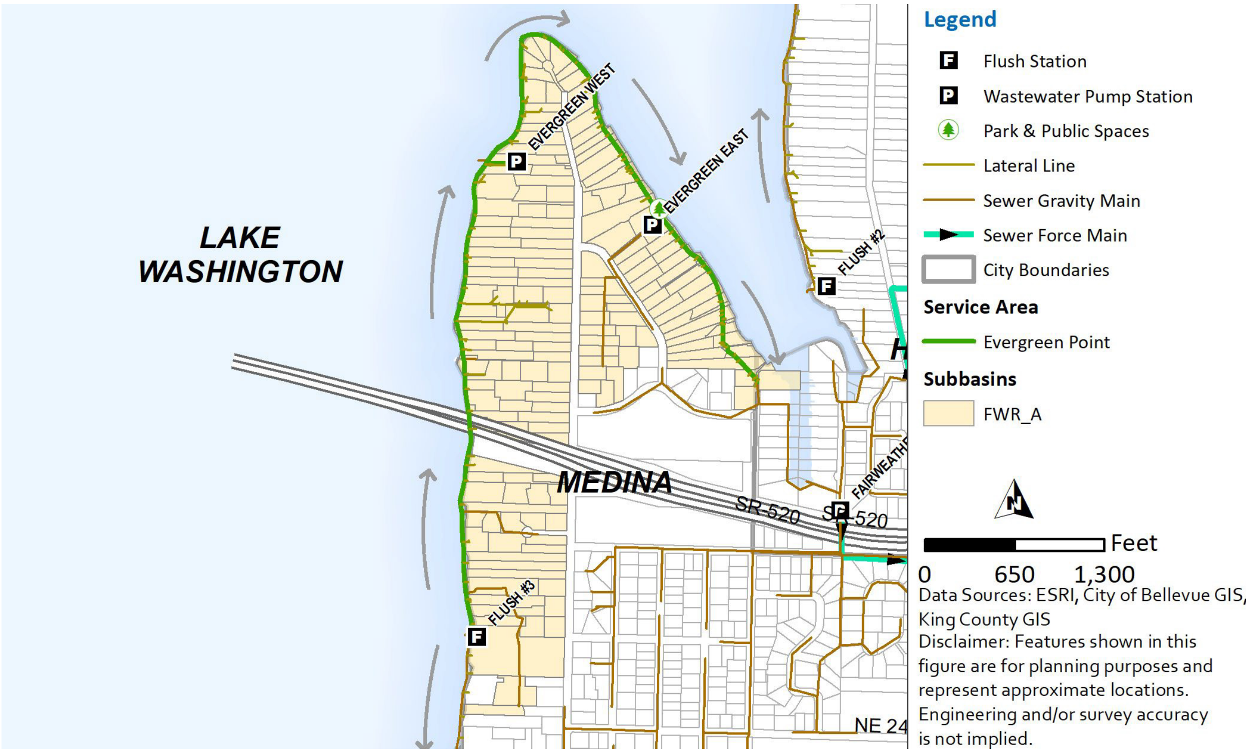


Figure 5.13 Lake Line System - Evergreen Point

Table 5.18 Lake Line System Components - Evergreen Point

Component	Description
Reaches	▪ Reach 5 - Evergreen East PS to Fairweather PS. ▪ Reach 6 - Evergreen West PS to Evergreen East PS. ▪ Reach 7 - Flush No.3 to Evergreen West PS.
Pump Stations	▪ Evergreen East PS: 2 pumps, 490-540 gpm station firm capacity. ▪ Evergreen West PS: 2 pumps, 230-260 gpm station firm capacity. ▪ Fairweather PS: 3 pumps, 750 gpm station firm capacity.
Flush Stations	▪ Flush No. 3
Pipe	▪ 8,423 linear feet of pipe: » 2,900feet on land. » 5,523 feet in-water.
Parcels Served	▪ 172 parcels served (86 parcels adjacent to lake line).

5.7.3 Area Characteristics

The Evergreen Point Service Area covers a small portion of Hunts Point and the western side of the Fairweather Bay peninsula north of SR-520; spans the lake line system into the City of Medina, Evergreen Point, and the portion of the system that intersects SR-520 perpendicularly; and ends approximately 0.4 miles south of SR-520, as shown in Figure 5.12.

The Evergreen Point Service Area serves approximately 172 parcels where the existing zoning is primarily single-family residential and parks and public places, including Lake Lane Park and Fairweather Nature Preserve and Park (Town of Hunts Point 2007 Zoning Map and City of Medina 2018 Official Zoning Map). There are approximately 72 private docks along the shoreline and a City of Medina dock at Lake Lane Park. The land cover in the service area is primarily open space and low-intensity development with medium- to high-intensity development for SR-520 and interspersed forest cover. The shoreline of the Evergreen Point Service Area is within a moderate to high liquefaction hazard area and contains a small landslide deposit along the shoreline north of NE 24th Street.

The service area's characteristics are summarized in Table 5.18. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.19 Area Characteristics – Evergreen Point

Characteristic	Description
Jurisdiction	▪ City of Medina.
Zoning and Land Use	▪ R-20 (Single Family Residential).
Parks and Public Spaces	▪ WSDOT SR-520 ROW. ▪ City of Medina Lake Lane Community Dock.
Geologic Hazards or Limitations	▪ Interspersed areas of landslide deposits west of Evergreen Point Road. ▪ Steep slopes along Lake Washington for span of Evergreen Point Road. ▪ Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington. ▪ Fairweather Creek (not adjacent to lake line).

5.7.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period for the Evergreen Point Service Area.

5.7.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Evergreen Point Service Area are presented in Table 5.20.

The average risk score for the Evergreen Point Service Area is 4.31, resulting in its ranking as **priority number five** of the six service areas.

5.7.4.2 Implementation Period

The implementation period for the Evergreen Point service area is **medium-term**.

Table 5.20 Risk Scores – Evergreen Point

	Reach 5 - Evergreen East PS to Fairweather PS	Reach 6 - Evergreen West PS to Evergreen East PS	Reach 7 - Flush No. 3 to Evergreen West PS
Likelihood of Failure Components			
EUL	3	3	1
Pipe Material	2	3	2
Couponing	3	3	2
Pump and Flush Station Condition	3	3	2
Outside Influences	1	1	2
Overflow History	3	1	2
Weighted LOF Score	**2.69**	**2.40**	**1.89**
Consequence of Failure Components			
Environmental Impact	1	1	3
Land Use	2	2	1
Number Of Customers	2	1	2
Flow	1	3	2
Location	1	1	3
Operational Access	1	2	3
Weighted COF Score	**1.45**	**1.55**	**2.25**
Weighted Total Risk Score	**4.64**	**4.29**	**4.00**
Service Area Average Risk Score	**4.31**		

5.7.5 Service Area Plan

5.7.5.1 System Alternative

The preferred system alternative for the Evergreen Point Service Area is the **onshore alternative**. Table 5.21 summarizes the factors for consideration for each alternative, with red shading representing a higher level of complexity for that factor, yellow shading representing a medium level of complexity, and green shading representing a lower level of complexity, and therefore the preferred alternative for that factor.

Table 5.21 System Alternatives Analysis Summary – Evergreen Point

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Onshore was the preferred alternative because it had the least number of red cells, therefore representing the lowest level of complexity/difficulty for this Service Area. Additionally, it was estimated that the onshore would cost less in comparison to the upland alternative. Further, the impact to right of way for the onshore alternative was deemed less significant due to a third of the existing lake line alignment already being located onshore. Permitting, environmental impact, and performance/O&M were considered to be somewhat difficult for the onshore alternative, but all three of these factors are less difficult than the in-water solution. All three alternatives were considered to have similarly difficult technical and constructability challenges.

In-water was not identified as the preferred alternative because of difficulties permitting this work, a substantially higher impact on the environment, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington. Although the impacts to the local community were considered less for the in-water work, avoiding the need to perform work on private property, the higher total number of difficult factors outweighed the local community benefits.

Upland was not identified as the preferred alternative because the existing roadway is located far from the shore, and the existing sewer infrastructure is minimal along Evergreen Point Rd. Consequently, impacts on right of way and the local community were greater than moving the sewer infrastructure onshore. Although the alternatives were relatively similar in their technical and constructability challenges, constructing an entirely new upland system with grinder pumps on every parcel would be the costliest approach.

The preferred alternative of onshore is conceptually similar to the existing lake line system, where because of the shore's topography, this will be a low-pressure system that will necessitate flush stations and pump stations to move wastewater through the system. In this plan, it is assumed that Flush Station No. 3 would require replacement of the lake intake pipe as well as electrical and instrumentation upgrades. Additionally, Flush Station No. 3, Evergreen East PS, and Evergreen West PS would all require pump replacements because their existing equipment is nearing the end of its useful life.

The cost of implementing the onshore system alternative in the Evergreen Point Service Area is summarized in Table 5.22. Refer to Appendix E – Alternatives Analysis TM for detailed cost information.

Table 5.22 System Alternative Cost (Onshore) - Evergreen Point

	Onshore Open Cut Cost	Onshore Trenchless Cost
Total Bid Amount(1)	$50,967,800	$56,550,400
Construction Hard Cost(2)	$71,357,800	$79,180,400
Soft Cost(3)	$43,457,000	$48,220,000
Total Project Cost(4)	**$114,814,800**	**$127,400,400**
▪ Low Range (-19 percent)	$93,000,000	$104,000,000
▪ High Range (+62 percent)	$186,000,000	$207,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.7.5.2 Pump and Flush Station Improvements

Table 5.23 identifies the pump and flush station locations, original project identification (ID) and implementation period per the 2015 assessment, and associated project costs.

Note the Evergreen West PS and the Evergreen East PS indicated some level of deficiency during the 25-year design storm. Verification of the pump station sizing should be included in the scoping and verification of station improvements.

Table 5.23 Pump and Flush Station Improvements – Evergreen Point

Pump/ Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No. 3(3)	Parcel number: 9808700746 Address: 3606 Evergreen Point Rd Medina, 98039	F3-1 F3-2	2015-2018 2023-2026	$75,000 $300,000	$103,000 $409,000
Evergreen West PS	Parcel number: 2425049120 3606 Evergreen Point Rd Medina, 98039	EW-1	2015-2018	$352,000	$480,000
Evergreen East PS	Parcel number: 3534900070 Address: Lake Lane ROW Medina 98039 (Adjacent to 3448 NE 78th Pl)	EE-1	2015-2018	$344,000	$469,000
Fairweather PS	Parcel number: 2472700056 (City-owned parcel) Address: Hunts Point 98004 (Adjacent to 3001 Hunts Point Cir)	N/A	Not Specified	$306,000	$417,000
Total				$1,377,000	**$1,878,000**

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5
(2) The 20-City ENR CCI used for 2023 was 13358.17.
(3) Flush No. 3 is also included in the Medina South Service Area pump and flush station improvements.

5.7.5.3 High-risk Assets

Pipe segments of the lake line with a high-risk of failure rating (greater than 6 on a scale of 3 to 9) are the following asset IDs: 198711, 198743, 198857, 213402, 198738, 198824, 198930, 198931, 198935, and 525329. The locations of these pipes are identified in Figure 5.14.

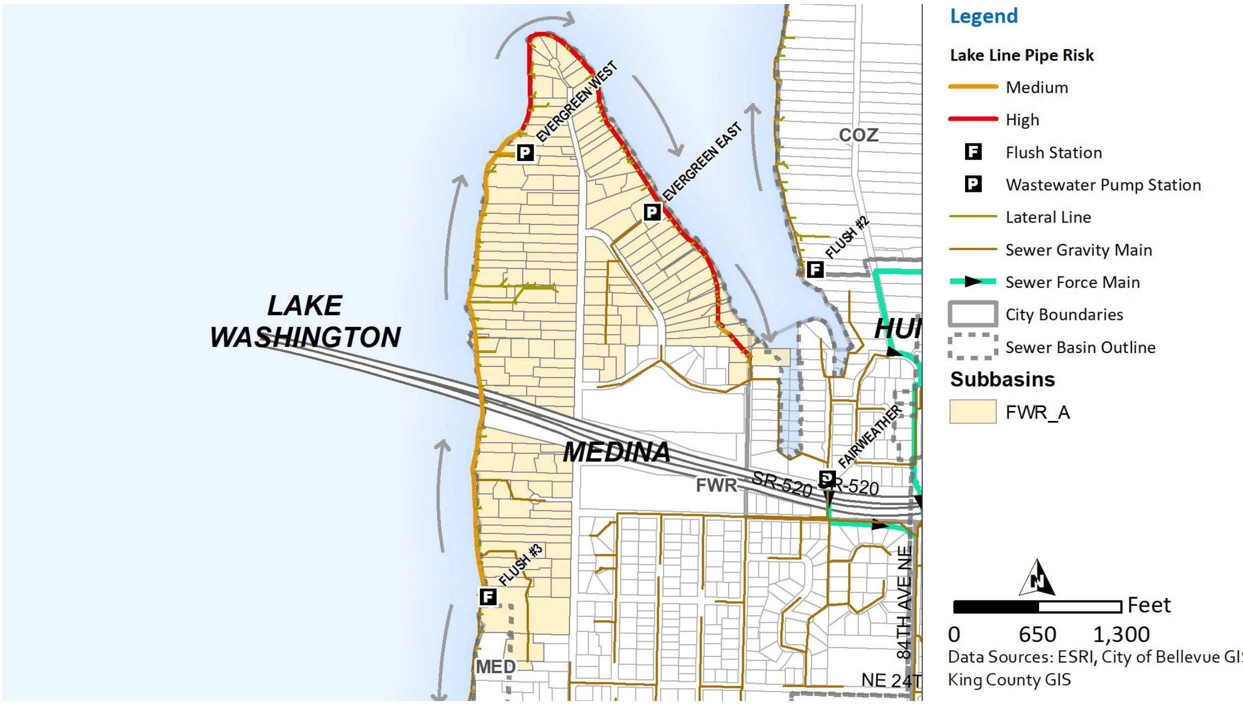


Figure 5.14 High-risk Assets - Evergreen Point

The length of pipe considered high-risk is approximately 4,043 LF of 8,423 LF, or approximately 48 percent of the lake line main in the service area. At an average repair cost of $4,000/LF for in-water pipe, the recommended emergency repair fund for spot repair(s) in this service area is $16,172,000.

5.7.5.4 Other System Improvements

The other system improvements recommended for the Evergreen Point Service Area are summarized in Table 5.24. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in Table 5.24). Refer to Appendix G for the detailed system improvements cost estimates.

Table 5.24 Other System Improvements – Evergreen Point

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for System-Wide Recommendations	Near-term	City Staff
Cleaning and Inspection	Hydro-jetting and CCTV Inspection	Near-term	$2,048,000
Access Improvements	Vegetation/Obstruction clearing at PS and FS	Near-term	City Staff
Data Collection	Right-of-way and Easement Review	Near-term	City Staff
	Topographic Survey		$2,106,000
	Phase 1 Pipe Coupon Collection		$90,000
	Phase 2 Pipe Coupon Collection		$45,000
Emergency Repair Planning	See Chapter 3 for System-Wide Recommendations		City Staff
Total			**$4,289,000**

Notes:
(1) Approximate cost for the coupons in this service area only; coupons to be collected in five service areas in each phase.

5.7.6 Regulatory Considerations

5.7.6.1 Environmental Impacts

Construction for the Evergreen Point service area would be within onshore locations. Potential onshore construction methods include installation of a low-pressure line via open cut-and-cover construction, installation of a vacuum sewer system, pipe rehabilitation (sliplining and CIPP), and installation of a low-pressure line via trenchless construction. Trenching or staging for construction would be the main temporary disturbance for these construction methods, which would potentially include displacement of riparian habitat to install new pipeline. The majority of this service area's shoreline is developed with single-family residences with modified shorelines. No surface water resources are currently identified within this service area other than the adjacent Lake Washington shoreline.

Construction methods, potential impact, and the surface water resources present within the Evergreen Point service area are summarized below in Table 5.25.

Table 5.25 Potential Environmental Impacts for Onshore Construction - Evergreen Point

<table>
<tr><th>Construction Method</th><th>Stormwater and Runoff</th><th>Turbidity and DO</th><th>Pollutants</th><th>Surface Water Resources Present within Service Area</th></tr>
<tr><td>Open cut-and-cover</td><td rowspan="2">▪ Requires trench dewatering effluent during construction.
▪ Requires installation of a shoring system to isolate the work area from the surrounding environment.</td><td rowspan="2">▪ No impacts if stormwater and runoff is controlled before discharge to stormwater system.</td><td rowspan="4">▪ Unassessed pollutants in soil during trenching are separated from water resources.
▪ Construction equipment leaks or spills are negligible based on distance from water resources.</td><td rowspan="4">▪ Lake Washington.</td></tr>
<tr><td>Vacuum sewer</td></tr>
<tr><td>Rehabilitation</td><td>▪ Temporary development of construction entrances and staging activities.</td><td>▪ No impacts.</td></tr>
<tr><td>Trenchless</td><td>▪ Minimal disturbance of sediment.</td><td>▪ No impacts.</td></tr>
</table>

Onshore alternatives avoid potential in-water impacts to sockeye salmon spawning locations (e.g., western side of Evergreen Point). Because there are no surface water resources in this service area, other than Lake Washington, if stormwater and runoff is controlled using standard BMPs during construction then there will be no impacts to potential turbidity increases or DO decreases. Most areas of the Evergreen Point service area are developed, which reduces the need to protect more sensitive riparian vegetation. Accessing the lake line system through existing maintenance holes (e.g., rehabilitation), where feasible, or prioritizing already developed locations for pipe installation and reducing direct interactions with sensitive habitat will help to avoid environmental impacts within this service area.

5.7.6.2 Permitting

Onshore construction is generally located between residences and the OHWM of Lake Washington (within 200 feet) and is thus subject to shoreline permitting and adherence to local SMP requirements. Evergreen Point Service Area falls under the jurisdiction of the City of Medina. If there are areas within the service area where the onshore alternative is not feasible, or where there will be impacts to federal- or state-regulated wetlands or surface waters, then the project will require additional coordination with federal and state agencies and tribes. However, no surface water locations were identified at the planning level. Necessary permits within the Evergreen Point service area are identified in Table 5.26.

Table 5.26 Permit Matrix - Evergreen Point

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
State Permits(1)			
Ecology	Construction Stormwater General Permit	6-12 months.	▪ Discharge to surface waters through the stormwater system.
Ecology	Shoreline Permit or Variance Review	1 month.	▪ Required if there is a shoreline permit issued.
Local Permits(1)			
City of Medina	SEPA Compliance	Issued with a land use/ shoreline permit.	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process.
	Land Use Permit(s)	6-18 months.	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months.	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Grading and Drainage Permit(s)	6-12 months.	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course.
	ROW Use Permit(s)	3-6 months.	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department.

Notes:
(1) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.

5.7.6.3 Mitigation

Onshore locations are heavily developed or degraded within the Evergreen Point service area, but there are locations that would require mitigation measures. Mitigation measures include the general provisions described in Chapter 3. Enhancement measures identified for in-water and shoreline locations are also relevant to the Evergreen Point service area.

5.8 Service Area Plan - Medina South

5.8.1 Overview

The Medina South Service Area encompasses most of the lake line system in the City of Medina and serves approximately 213 parcels zoned primarily as single-family residential and parks and public places. The lake line system in the Medina South service area consists of four reaches with approximately 2.3 miles of lake line, two flush stations, and two pump stations.

The risk score for the Medina South Service Area resulting in its ranking of **priority number six** of six service areas. The implementation period for the Medina South service area is **long-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting in the Medina South Service area is the **upland alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.27. All costs are presented in 2023 dollars.

The total implementation cost for this service area plan is **$215 million.**

Table 5.27 Service Area Plan Implementation Costs - Medina South

Service Area Plan Components	Estimated Cost
Preferred System Alternative	$199,800,000
Pump and Flush Station Improvements	$1,900,000
Emergency Repair Fund	$4,960,000
Other System Improvements	$7,930,000
Total	**$214,590,000**

5.8.2 Lake Line System

2.3 miles of lake line, two flush stations, and two pump stations as shown in Figure 5.15. Flow is conveyed from Flush Station No. 3 at the northern limit of the service area south to the Lakecrest PS. A short segment of gravity lake line also flows directly to the intermediate Lakecrest PS. The flow continues from Lakecrest PS southward to Medina City Hall PS. Flush No. 4 conveys flow from the southeast limit of the service area near Groat Point also to the Medina City Hall PS. The pumped discharge connects to a gravity system two blocks north of Medina City Hall. Note that Flush Station No. 3 provides intake flow to both the Evergreen Point and Medina South service areas. Table 5.29 summarizes the lake line system components in the Medina South Service Area.

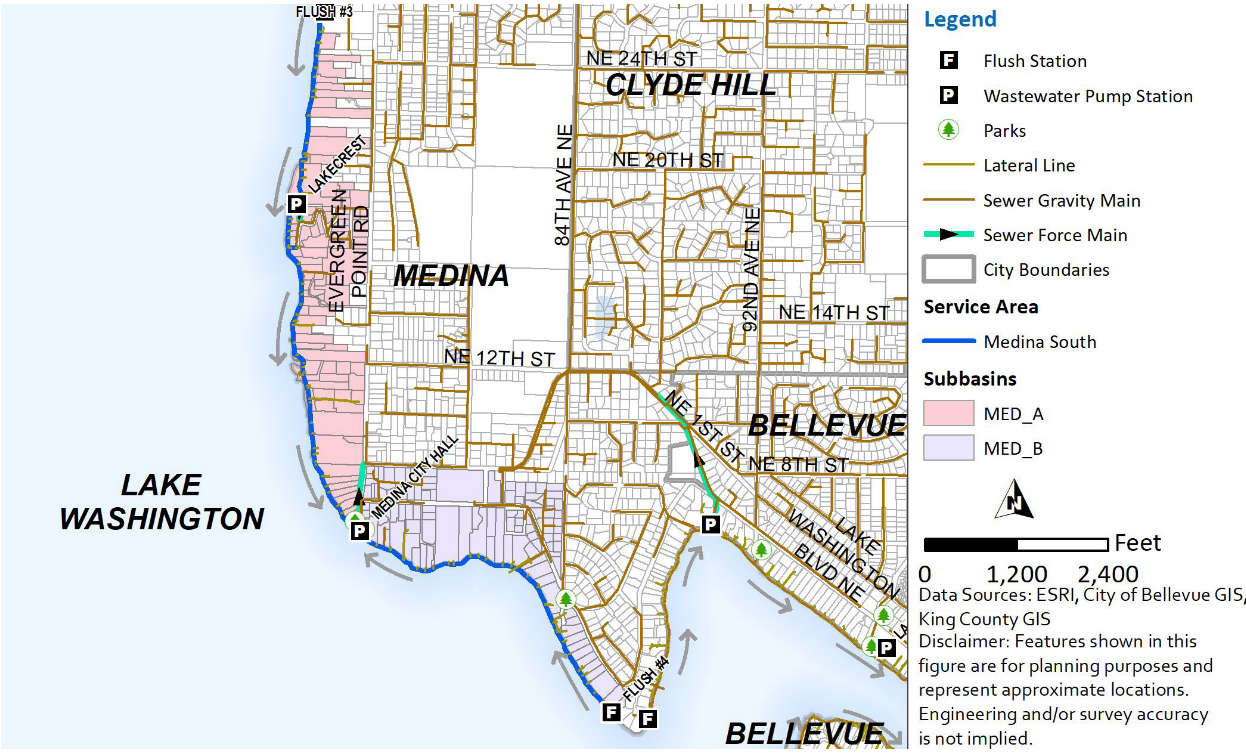


Figure 5.15 Lake Line System - Medina South

Table 5.28 Lake Line System Components - Medina South

Component	Description
Reaches	▪ Reach 8 - Flush No. 3 to Lakecrest PS. ▪ Reach 9 - Lakecrest PS (gravity reach). ▪ Reach 10 - Medina City Hall PS. ▪ Reach 11 - Flush No. 4 to Medina City Hall PS.
Pump Stations	▪ Lakecrest PS: 2 pumps, 360-380 gpm station firm capacity. ▪ Medina City Hall PS: 2 pumps, 700 gpm station firm capacity.
Flush Stations	▪ Flush No. 3. ▪ Flush No. 4.
Pipe	▪ 12,320 LF of pipe: » 586 feet on land. » 11,734 feet in-water.
Parcels Served	▪ 213 parcels served (83 parcels adjacent to lake line).

5.8.3 Area Characteristics

The Medina South Service Area encompasses most of the lake line system in the City of Medina, beginning at the southern terminus of the Evergreen Point Service Area south of SR-520, extending along the shoreline of Lake Washington, following the lake line system to the edge of Groat Point at Meydenbauer Bay, and covering about half of the Groat Point peninsula inland as shown in Figure 5.15.

The Medina South Service Area serves approximately 213 parcels and is zoned primarily as single-family residential and parks and public places, including Medina Beach Park and Viewpoint Park (City of Medina 2018 Official Zoning Map). There are approximately 75 private docks along the shoreline and a City of Medina dock at Viewpoint Park at 84th Avenue NE. The land cover in the service area is partially evergreen forest and open space development with areas of low- to medium-intensity development in the southern portion. The shoreline of the Medina South Service Area is within a moderate to high liquefaction hazard area and contains the following critical areas: interspersed areas of landslide deposits west of Evergreen Point Road near 73rd Avenue NE and steep slopes along Lake Washington for the span of Evergreen Point Road.

Characteristics of the service area are summarized in Table 5.28. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.29 Service Area Characteristics – Medina South

Characteristic	Description
Jurisdiction	▪ City of Medina.
Zoning and Land Use	▪ R-16 (Single Family Residential). ▪ R-20 (Single Family Residential). ▪ R-30 (Single Family Residential). ▪ Public (Parks and Public Spaces).
Parks and Public Spaces	▪ Viewpoint Park. ▪ Medina City Hall. ▪ Medina Beach Park.
Geologic Hazards or Limitations	▪ Interspersed areas of landslide deposits west of Evergreen Point Road. ▪ Steep slopes along Lake Washington for span of Evergreen Point Road. ▪ Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington.

5.8.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period for the Medina South Service Area.

5.8.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Medina South Service Area are presented in Table 5.30.

The average risk score for the Medina South Service Area is 3.81, resulting in its ranking as **priority number six** of the six service areas.

5.8.4.2 Implementation Period

The implementation period for the Medina South service area is **long-term**.

Table 5.30 Risk Scores - Medina South

	Reach 8: Flush No. 3 to Lakecrest PS	Reach 9: Lakecrest PS (gravity reach)	Reach 10: Medina City Hall PS	Reach 11: Flush No. 4 to Medina City Hall PS
Likelihood of Failure Components				
EUL	1	3	1	1
Pipe Material	2	3	2	2
Couponing	2	3	1	1
Pump and Flush Station Condition	2	2	2	2
Outside Influences	1	1	2	2
Overflow History	1	1	2	3
Weighted LOF Score	**1.59**	**2.05**	**1.76**	**1.96**
Consequence of Failure Components				
Environmental Impact	3	3	1	3
Land Use	1	1	3	3
Number Of Customers	1	1	1	3
Flow	2	2	3	3
Location	3	1	2	3
Operational Access	3	1	1	3
Weighted COF Score	**2.00**	**1.50**	**1.70**	**3.00**
Weighted Total Risk Score	**3.43**	**3.77**	**3.48**	**4.54**
Service Area Average Risk Score	**3.81**			

5.8.5 Service Area Plan

5.8.5.1 System Alternative

The preferred alternative for the Medina South Service Area is the **upland alternative**. Table 5.31 summarizes the factors for consideration for each alternative, with red shading representing a higher level of complexity for that factor, yellow shading representing a medium level of complexity, and a green shading representing a lower level of complexity, and therefore the preferred alternative for that factor.

Table 5.31 System Alternatives Analysis Summary - Medina South

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Upland was the preferred alternative because it had the least number of red cells, therefore representing the lowest level of complexity / difficulty for this Service Area. Upland permitting is generally the least difficult, due to the anticipated lower number of permits and permit coordination efforts with the appropriate agencies than compared to that of onshore work or in-water work. The environmental impact is also considerably less significant for the upland alternative as there are no environmentally sensitive areas in the Medina South upland service area. The upland solution would also provide easier access for maintenance and better overall performance when compared to the in-water or onshore alternatives. The construction of a grinder pump system to lift wastewater up and into the collection system would also cause less disturbances to the primarily residents along the lake than the onshore alternative. From a cost standpoint, upland is the highest cost alternative, but only marginally, and still within the general Class 5 estimating range of the other alternatives. All three alternatives were considered to have similarly difficult technical and constructability challenges.

In-water was not identified as the preferred alternative because of difficulties permitting this work, a substantially higher impact on the environment, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington.

Onshore was not identified as the preferred alternative since, comparatively speaking, it was not any less complex than the upland alternative. Permitting, environmental impacts, and performance/O&M were considered to be somewhat more difficult for the onshore alternative, but all three of these factors are less complex than the in-water alternative. Construction work would also be the most impactful to residents for the onshore alternative.

The preferred alternative of upland would require construction of grinder pumps to lift wastewater back to either a new or existing sewer main within Evergreen Point Road or Overlake Drive W. Lake Crest Pump Station would need rehabilitation with pump replacements and a new force main to Evergreen Point Road. Similar to the existing conditions, the Medina City Hall Pump Station would need pump replacements to continue conveying flow to NE 8th street. Flush Station No. 4 would be abandoned as part of abandoning the existing lake line system.

The cost of implementing the upland system alternative in the Medina South service area is summarized in Table 5.32. Refer to Appendix E – Alternatives Analysis TM for detailed cost information.

Table 5.32 System Alternative Cost (Onshore) - Medina South

	Upland Cost
Total Bid Amount(1)	$88,673,700
Construction Hard Cost(2)	$124,143,700
Soft Cost(3)	$75,603,000
Total Project Cost(4)	**$199,746,700**
▪ Low Range (-19 percent)	$163,000,000
▪ High Range (+62 percent)	$324,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.8.5.2 Pump and Flush Station Improvements

Table 5.33 identifies the pump and flush station locations, original project ID and implementation period per the 2015 assessment, and associated project costs.

Table 5.33 Pump and Flush Station Improvements - Medina South

Pump/Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No. 3	Parcel number: 9808700746 Address: 3606 Evergreen Point Rd Medina, 98039	F3-1 F3-2	2015-2018 2023-2026	\$75,000 \$300,000	\$103,000 \$409,000
Flush No. 4	Parcel number: 9389700030 Address: 8875 Overlake Dr. W Medina, 98039	F4-1 F4-2 F4-3	2018-2022 2020-2025 2023-2026	\$5,000 \$75,000 \$285,000	\$7,000 \$103,000 \$389,000
Lakecrest PS	Parcel number: 400050TRCT Address: Adjacent to 1811 73rd Ave NE Medina 98039	LC-1 LC-2	N/A 2018-2022	N/A \$360,000	\$491,000
Medina City Hall PS	Parcel number: 5427300050 (City of Medina owned parcel) Address: 501 Evergreen Point Rd Medina, 98039	(None)	2015-2018	\$292,000	\$398,000
Total				\$1,392,000	**\$1,900,000**

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5
(2) The 20-City ENR CCI used for 2023 was 13358.17.
(3) Flush No. 3 is also included in the Evergreen Point Service Area pump and flush station improvements.

5.8.5.3 High-risk Assets

Pipe segments of the lake line with a high-risk of failure rating (greater than 6 on a scale of 3 to 9) are the following asset IDs: 198720, 198766, 213512, 213513. The locations of these pipes are identified in Figure 5.16.

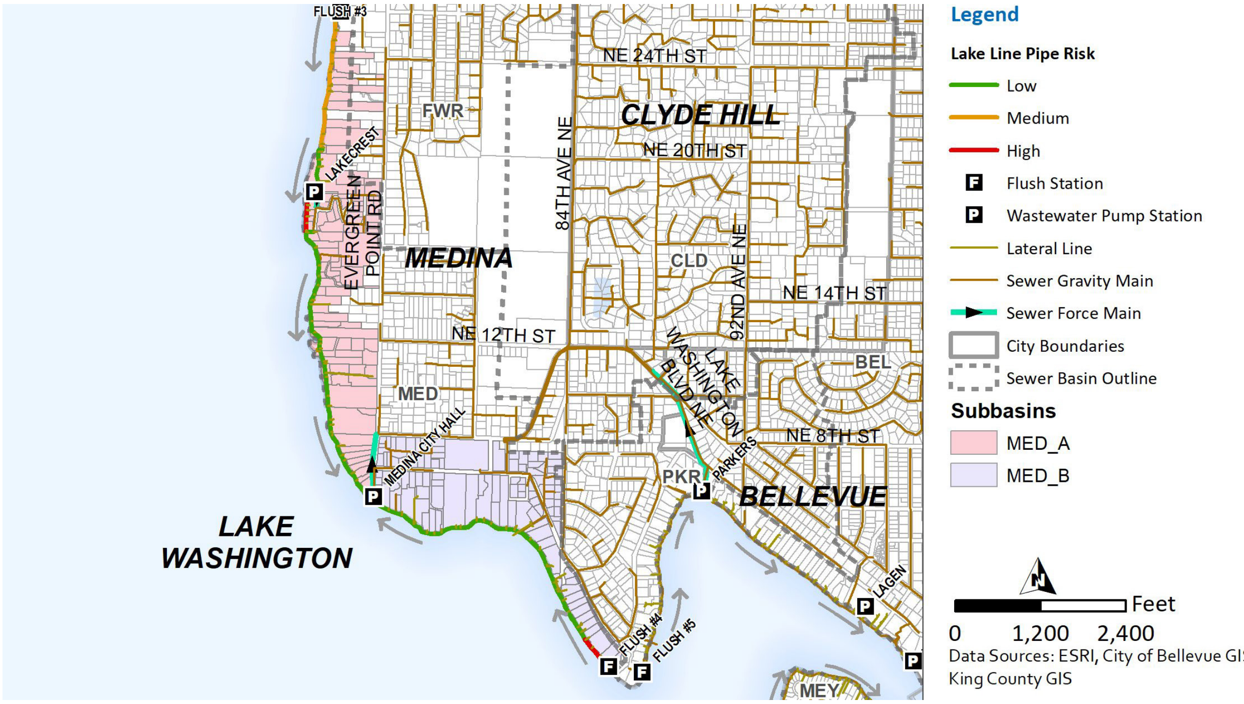


Figure 5.16 High-risk Assets - Medina South

The length of pipe considered high-risk is approximately 1,240 LF of 12,407 LF, or approximately 10 percent of the lake line main in the service area. At an average repair cost of $4,000/LF for in-water pipe, the recommended emergency repair fund for spot repair(s) in this service area is $4,960,000.

5.8.5.4 Other System Improvements

The other system improvements recommended for the Medina South Service Area are summarized in Table 5.34. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in the table below). Refer to Appendix G for the detailed system improvements cost estimates.

Table 5.34 Other System Improvements - Medina South

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for System-Wide Recommendations	Near-term	City Staff
Cleaning and Inspection	Hydro-jetting and CCTV Inspection	Near-term	$2,995,000
Access Improvements	Vegetation/Obstruction clearing at PS and FS	Near-term	City Staff
Data Collection	Right-of-way and Easement Review	Medium-term	City Staff
	Topographic Survey	Medium-term	$4,620,000
	Phase 1 Pipe Coupon Collection	Near-term	$90,000
	Phase 2 Pipe Coupon Collection	Near-term	$225,000
Emergency Repair Planning	See Chapter 3 for System-Wide Recommendations		City Staff
Total			**$7,930,000**

Notes:
(1) Approximate cost for the coupons in this service area only; coupons to be collected in five service areas in each phase.

5.8.6 Regulatory Considerations

5.8.6.1 Environmental Impacts

Construction for the Medina South service area would be within upland locations. Potential upland construction methods include installation of a gravity line via open cut-and-cover construction, installation of a gravity line via trenchless construction, installation of a vacuum sewer system, and installation of grinder pumps. Upland construction methods would avoid environmental impacts to surface water resources, fisheries, and aquatic ecosystems using appropriate BMPs. The project would prioritize installing new pipeline in locations that are already impacted (e.g., ROW, parking lots).

Construction methods, potential impact, and the surface water resources present within the Medina South service area are summarized below in Table 5.35.

Table 5.35 Potential Environmental Impacts for Upland Construction - Medina South

Construction Method	Stormwater and Runoff	Turbidity and DO	Pollutants	Surface Water Resources Present within Service Area
Gravity line Vacuum sewer Grinder pumps	▪ Construction activities within upland areas would be isolated from surface water resources and controlled using proper BMPs.	▪ No impacts if stormwater and runoff is controlled before discharge to stormwater system.	▪ Unassessed pollutants in soil during trenching are separated from water resources. ▪ Construction equipment leaks or spills are negligible based on distance from water resources.	▪ None identified – upland areas where the pipe could be moved would avoid sensitive areas.

5.8.6.2 Permitting

Upland construction is located within the general vicinity of the public ROW farther than 200 feet from the shoreline and is thus not subject to shoreline permitting requirements. No locations were identified at the planning level that overlapped with federal- or state-regulated wetlands or surface waters. Medina South service area falls under the jurisdiction of the City of Medina. Necessary permits within the service area are identified in Table 5.36.

Table 5.36 Permit Matrix - Medina South

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
State Permits(1)			
Ecology	Construction Stormwater General Permit	6-12 months	▪ Discharge to surface waters through the stormwater system.
Ecology	Shoreline Permit or Variance Review	1 month	▪ Required if there is a shoreline permit issued.

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
Local Permits[(1)]			
City of Medina	SEPA Compliance	Issued with a land use/ shoreline permit	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process.
	Land Use Permit(s)	6-18 months	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Grading and Drainage Permit(s)	6-12 months	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course.
	ROW Use Permit(s)	3-6 months	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department.

Notes:
(1) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.

5.8.6.3 Mitigation

Upland locations are heavily developed or degraded within the Medina South service area, but there are locations that would require mitigation measures. Mitigation measures include the general provisions described in Chapter 3. These measures are primarily construction BMPs to avoid and minimize temporary impacts. The main enhancement measure in upland areas is to restore/enhance disturbed riparian vegetation areas.

5.9 Service Area Plan - Meydenbauer Bay

5.9.1 Overview

The Meydenbauer Bay Service Area covers the eastern portion of Groat Point, the lake line system along Meydenbauer Bay and Whalers Cove, and ends approximately where SE Shoreland Drive turns south as it intersects SE Shoreland Place. The service area is in the Cities of Medina and Bellevue and serves approximately 448 parcels, which are zoned primarily as residential. The lake line system in the Meydenbauer Bay service area consists of three reaches with approximately 2.1 miles of lake line, two flush stations, and four pump stations.

The risk score for the Meydenbauer Bay Service Area resulting in its ranking as **priority number one** of six service areas. The implementation period for the Meydenbauer Bay Service Area is near-term, within **the near-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting in the Meydenbauer Bay Service Area is the **upland alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.37. All costs are presented in 2023 dollars.

The total implementation cost for this service area plan is **$198 million**.

Table 5.37 Service Area Plan Implementation Costs - Meydenbauer Bay

Service Area Plan Components	Estimated Cost
Preferred System Alternative	$197,200,000
Pump and Flush Station Improvements	N/A(1)
Emergency Repair Fund	N/A(1)
Other System Improvements	N/A(1)
Total	**$197,200,000**

Notes:
(1) N/A due to planned implementation of service area plan within near-term. If plan is delayed, these funds should be allocated.

5.9.2 Lake Line System

The lake line system in the Meydenbauer Bay service area consists of three reaches with approximately 2.1 miles of lake line, two flush stations, and four pump stations, as shown in Figure 5.17. Flow is conveyed from Flush Station No. 5 at Groat Point at the northern limit of the service area north to Parkers pump station. Flow is primarily pumped from Parkers upland to a gravity system, with the exception of a brief daily cycle that provides flushing flow towards the Lagen PS, located in Meydenbauer Bay Park. The Lagen PS has a gravity discharge to a recently (2016) reconstructed gravity system that conveys flow to the Grange pump station, where it is pumped to an upland gravity system. The Grante PS provides electrical service, communications, and odor control for the Lagen PS. Separately, flow from Flush No. 6 is conveyed around the south limits of the service area around to Whaler's Cove and the Meydenbauer pump station. Table 5.39 summarizes the lake line system components in the Meydenbauer Bay Service Area.

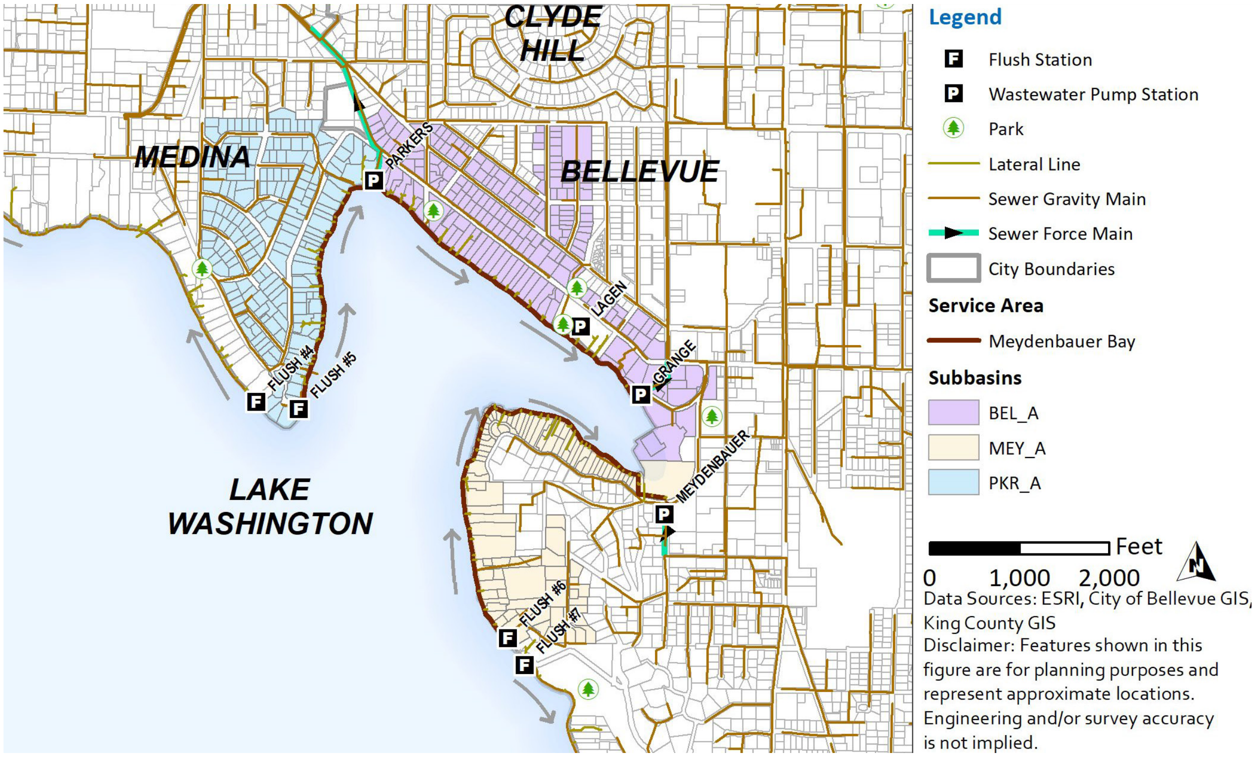


Figure 5.17 Lake Line System - Meydenbauer Bay

Table 5.38 Lake Line System Components - Meydenbauer Bay

Reaches	▪ Reach 12 - Flush No. 5 to Parkers PS. ▪ Reach 13 - Parkers PS to Lagen PS[1]. ▪ Reach 14 - Flush No. 6 to Meydenbauer PS.
Pump Stations	▪ Parkers PS: 3 pumps, 850 gpm station firm capacity. ▪ Lagen PS[(1)]: 2 pumps, 185 gpm station firm capacity ▪ Grange PS[(1)]: 2 pumps, 220-260 gpm station firm capacity. ▪ Meydenbauer PS: 2 pumps, 270-330 gpm station firm capacity.
Flush Stations	▪ Flush No. 5. ▪ Flush No. 6.
Pipe	▪ 9,082 LF of pipe: » 3,326 feet on land. » 5,843 feet in-water.
Parcels Served	▪ 448 parcels served (112 parcels adjacent to lake line).

Notes:
(1) Lagen/Grange improvement project- Lagen excluded from plan improvements.

5.9.3 Area Characteristics

The Meydenbauer Bay Service Area covers the eastern portion of Groat Point, the lake line system along Meydenbauer Bay and Whalers Cove, and ends approximately where SE Shoreland Drive turns south as it intersects SE Shoreland Place. The Meydenbauer Bay Service Area is located partially in the City of Medina to the west and transitions into the City of Bellevue on the east approximately where Overlake Drive E meets Lake Washington Boulevard NE, as shown in Figure 5.18.

The Meydenbauer Bay Service Area serves approximately 448 parcels, which are zoned primarily as residential, specifically single-family residential in the City of Medina and single- and multi-family residential in the City of Bellevue and contains approximately 92 private docks (City of Medina 2018 Official Zoning Map and City of Bellevue 2015 Comprehensive Plan). Clyde Beach Park and Meydenbauer Bay Beach Park are located in the residential zoned areas as a land use compatible with the low residential density. The land cover in the Service Area is mostly low and medium density with higher intensity development near Downtown Bellevue and interspersed forested areas.

The shoreline of the Meydenbauer Bay Service Area is also located within a moderate to high liquefaction hazard area and areas of landslide deposits along Overlake Drive E and SE Shoreland Drive, with steep slopes east of Overlake Drive E and adjacent to SE Shoreland Drive.

Characteristics of the service area are summarized in Table 5.38. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.39 Service Area Characteristics - Meydenbauer Bay

Characteristic	Description
Jurisdictions	▪ City of Medina. ▪ City of Bellevue.
Zoning and Land Use	▪ Medina: » R-20 (Single Family Residential). ▪ Bellevue: » Single Family and Multi Family .
Parks and Public Spaces	▪ Clyde Beach Park. ▪ Meydenbauer Bay Park.
Geologic Hazards or Limitations	▪ Steep slopes west and south of Downtown Bellevue. ▪ Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington. ▪ Meydenbauer Creek.

5.9.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period for the Meydenbauer Bay Service Area.

5.9.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Meydenbauer Bay Service Area are presented in Table 5.40.

The average risk score for the Meydenbauer Bay Service Area is 4.57, resulting in its ranking as **priority number one** of the six service areas.

5.9.4.2 Implementation Period

The implementation period for the Meydenbauer Bay Service Area is near-term, within **the near-term**.

Table 5.40 Risk Scores – Meydenbauer Bay

	Reach 12 - Flush No. 5 to Parkers PS	Reach 13 - Parkers PS to Lagen PS	Reach 14 - Flush No. 6 to Meydenbauer PS
Likelihood of Failure Components			
EUL	3	3	1
Pipe Material	3	3	2
Couponing	3	3	2
Pump and Flush Station Condition	2	2	2
Outside Influences	1	1	3
Overflow History	2	3	2
Weighted LOF Score	**2.25**	**2.45**	**1.99**
Consequence of Failure Components			
Environmental Impact	3	3	3
Land Use	1	2	1
Parcels Served	3	3	2
Flow	3	2	1
Location	3	3	1
Operational Access	3	3	3
Weighted COF Score	**2.60**	**2.70**	**1.95**
Weighted Total Risk Score	**4.71**	**5.05**	**3.96**
Service Area Average Risk Score	**4.57**		

5.9.5 Service Area Plan

5.9.5.1 System Alternative

The preferred alternative for the Meydenbauer Bay Service Area is the **upland alternative**. Table 5.41 summarizes the factors for consideration for each alternative, with red shading representing a higher level of complexity for that factor and a green shading representing a lower level of complexity, and therefore the preferred alternative for that factor.

Table 5.41 System Alternatives Analysis Summary - Meydenbauer Bay

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Upland was the preferred alternative because it had the least number of red cells, therefore representing the lowest level of complexity / difficulty for this Service Area. Permitting, environmental impact, and performance/O&M were considered to be the least complex of the three alternatives, since the majority of the work will be on either private property for new laterals or within public right of way. The upland alternative was also considered the least difficult technically and the easiest to construct since existing sewer infrastructure can likely be modified to accommodate these additional sewer flows diverted from the lake line system. While right of way impacts, costs, and local community impacts may be increased with the upland alternative, the increase in complexity associated with these factors was considered manageable given the other benefits of this alternative. For all three alternatives, the technical complexity and constructability were considered to be high in complexity.

In-water was not identified as the preferred alternative because of difficulties permitting this work, a substantially higher impact on the environment, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington.

Onshore was not identified as the preferred alternative because the challenges associated with permitting, environmental impacts, and performance/O&M were greater for work along Lake Washington than moving the sewer infrastructure upland into the system. The impact to the local community was also considered higher for the onshore alternative given the adverse impacts to both Clyde Beach Park and Meydenbauer Beach Park associated with construction work along the lake shore. The closer proximity between the lake shore and the roadway also limits the residential impact of the selected upland solution.

The preferred alternative of upland would require the installation of grinder pumps to lift the sewage back to either existing or new sewer mains within Overlake Dr. E, Lake Washington Blvd NE, NE 1st Street, or SE Shoreland Dr. In addition, Flush Station No. 5 and the Lagen Pump Station could be abandoned along with the abandonment of the lake line sewer pipe. The Parkers Pump Station, Grange Pump Station, and Meydenbauer Pump Stations would likely remain in some capacity as each of these stations conveys local sewer flows further into the collection system.

The cost of implementing the upland system alternative in the Meydenbauer Bay Service Area is summarized in Table 5.42. Refer to Appendix E - Alternatives Analysis TM for detailed cost information.

Table 5.42 System Alternative Cost (Upland) Alternative - Meydenbauer Bay

	Upland Cost
Total Bid Amount(1)	$87,501,600
Construction Hard Cost(2)	$122,511,600
Soft Cost(3)	$74,610,000
Total Project Cost(4,5)	**$197,121,600**
Low Range (-19 percent)	$160,000,000
High Range (+62 percent)	$320,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.9.5.2 Additional Considerations

Because Meydenbauer Bay is the highest priority service area, with improvements recommended in the near-term, this service area plan includes more detailed recommendations for system alternatives and improvements.

Area Conveyance System

Approximately 75 percent of the existing customers in the Meydenbauer Bay Service Area connect indirectly to the lake line, primarily located in the BEL_A and PKR_A sub-basins. There may be opportunities to reconfigure the basin to permanently separate customers from the lake line system, or its replacement upland system, by implementing relatively localized conveyance improvements. An example of a potential conveyance improvement is shown in Figure 5.18. With construction of approximately 575 LF of gravity conveyance system to divert flow, a total of 50 parcels would be removed from the lake line system and its replacement.

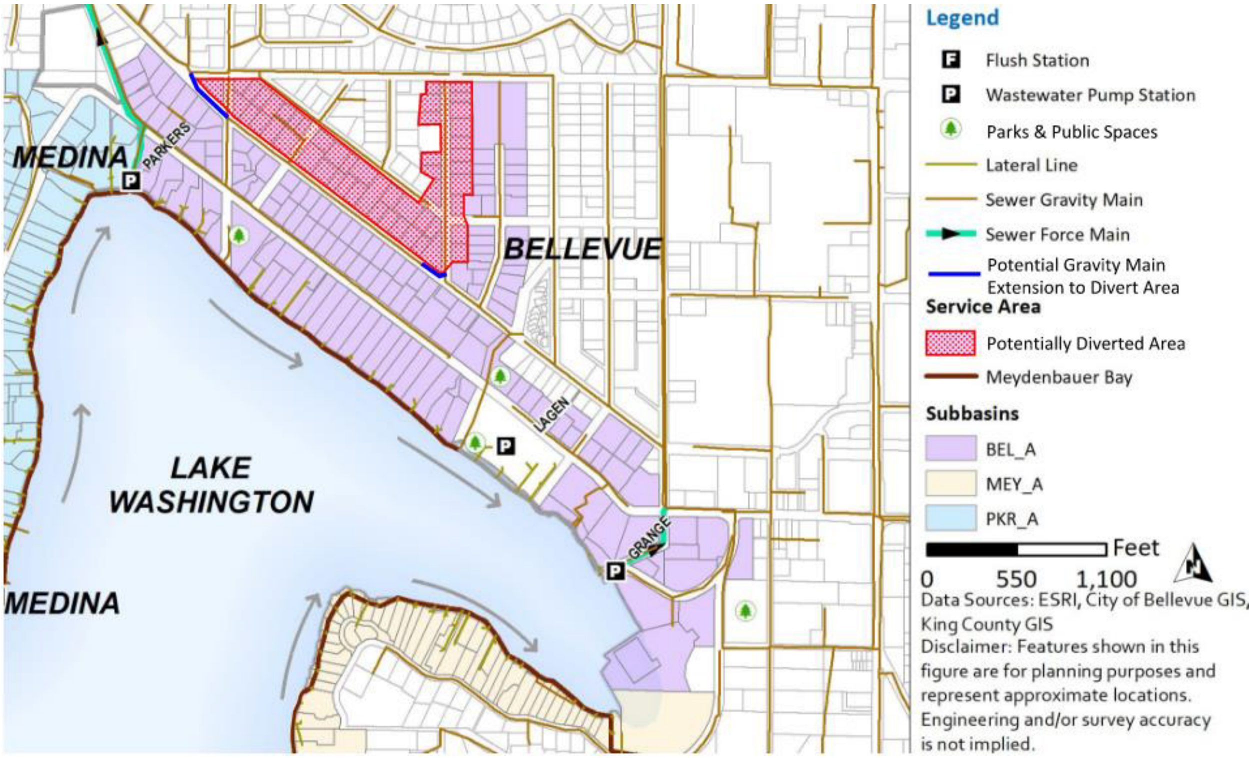


Figure 5.18 Meydenbauer Bay - Potential Conveyance Diversion Example

Planned Improvements in the Area

Given the extensive nature of the system improvements recommended in the near-term, the service area should be reviewed for potential overlap or coordination with existing planned CIP improvements. CIP projects located in the Meydenbauer Service Area in the current 2023-2029 Adopted CIP Plan include P-AD-104: Meydenbauer Bay Park Phase 2. The City has also indicated planned improvements at Clyde Beach Park, but the extent of which has not yet been determined or programmed into the CIP.

5.9.5.3 Pump and Flush Station Improvements

Table 5.43 identifies the pump and flush station locations, original project ID and implementation period per the 2015 assessment, and associated project costs.

Table 5.43 Pump and Flush Station Improvements – Meydenbauer Bay

Pump/Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No. 5	Parcel number: 2939010030	F5-1	2020-2025	$5,0000	$7,000
	Address: 8925 Groat Pt Dr Medina, 98039	F5-2	2023-2026	$122,500	$167,000
Flush No. 6	Parcel number: 9389700030	F6-1	2018-2022	$5,000	$7,000
	Address: 903 Shoreland Dr. SE Bellevue 98004	F6-2	2020-2025	$75,000	$103,000
		F6-3	2023-2026	$232,500	$317,000
Parkers PS	Parcel number: 3835501533	XX	XX	$413,000	$563,000
	Address: 9011 Lake Washington Blvd NE Bellevue, 98004				
Grange PS	Parcel number: N/A	G-1	2018-2022	$234,000	$319,000
	Address: SE Bellevue Pl ROW				
Meydenbauer PS	Parcel number: N/A	M-1	N/A	N/A	$468,000
	Address: 100th Ave SE	M-2	2018-2022	$343,000	
Lagen PS3	Meydenbauer Bay Park	N/A	N/A	--	--
Total				$1,430,000	$1,951,000

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5
(2) The 20-City ENR CCI used for 2023 was 13358.17.
(3) Lagen Pump Station was constructed in 2016 and no planned improvements have been identified.

Due to the near-term implementation period for the system alternative, the pump and flush station improvement costs are not included in the total service area plan.

5.9.5.4 High-risk Assets

Pipe segments of the lake line with a high-risk of failure rating (greater than 6 on a scale of 3 to 9) are the following asset IDs: 197748, 197759, 197767, 197770, 197774, 212384, 212746, 197697, 197752, 197779, 197794, 197800, 197809, 429570, 197099, 197109, 197120, 197128, 197145, 197147, 197153, 213171, and 213183. The locations of these pipes are identified in Figure 5.19.

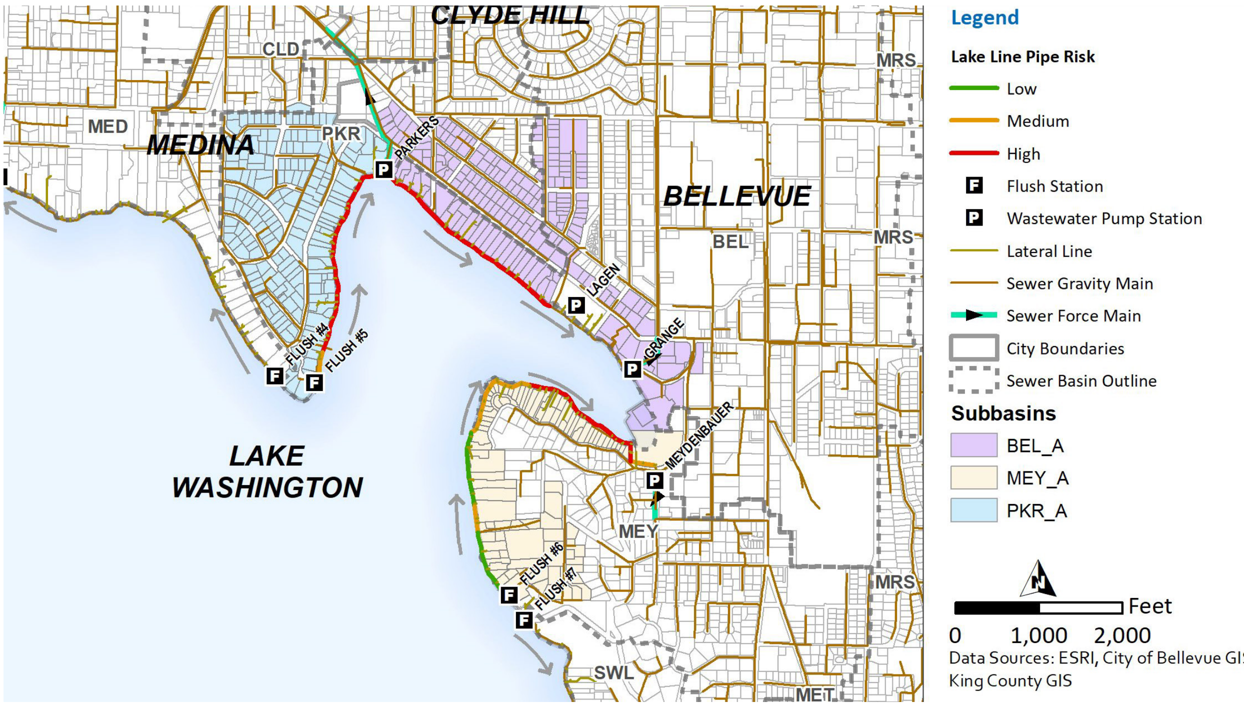


Figure 5.19 High-risk Assets - Meydenbauer Bay

The length of pipe considered high-risk is approximately 6,904 LF of 10,782 LF, or approximately 64 percent of the lake line main in the service area. This is a considerable portion, and an anticipated result given the recent repair necessitated in Meydenbauer Bay (Meydenbauer Bay Park Sewer Line Replacement, CIP S-69) constructed in 2016. Due to the near-term implementation period for the system alternative, **the emergency repair fund cost is not included in the total service area plan**.

5.9.5.5 Other System Improvements

The other system improvements recommended for the Meydenbauer Bay Service Area are summarized in Table 5.44. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in Table 5.44). Refer to Appendix G for the detailed other system improvements cost estimate.

Table 5.44 Other System Improvements - Meydenbauer Bay

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Cleaning and Inspection	Hydro-Jetting and CCTV Inspection.	Near-term	N/A(1)
Access Improvements	Vegetation/Obstruction Clearing at PS and FS.	Near-term	City Staff
Data Collection	Right-Of-Way and Easement Review.	Near-term	City Staff
	Topographic Survey.		N/A(1)
	Phase 1 Pipe Coupon Collection.		N/A(1)
	Phase 2 Pipe Coupon Collection.		N/A(1)
Emergency Repair Planning	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Total			**N/A**

Notes:
(1) Because Meydenbauer Bay is the No. 1 priority service area, other system improvements are excluded assuming the system alternative is implemented within the near-term period.

5.9.6 Regulatory Considerations

5.9.6.1 Environmental Impacts

Construction for the Meydenbauer Bay service area would be within upland locations. Potential upland construction methods include installation of a gravity line via open cut-and-cover construction, installation of a gravity line via trenchless construction, installation of a vacuum sewer system, and installation of grinder pumps. Upland construction methods would avoid environmental impacts to surface water resources, fisheries, and aquatic ecosystems using appropriate BMPs. The project would prioritize installing new pipelines in locations that are already impacted (e.g., public ROW, parking lots). Surface water and riparian resources within this service area include Meydenbauer Creek located to the south of the Meydenbauer Beach Park in Bellevue.

Clearing and grading of existing riparian habitat could potentially result in a reduced capacity to filter pollutants and protect surface waters, including areas close to Meydenbauer Creek. The temporary loss of hydrologic, water quality, or habitat functions due to riparian habitat disturbance and displacement is expected to be offset after construction through site restoration. Restoration can also include potential benefits, such as removing invasive species and planting native species in areas that are disturbed.

Construction methods, potential impact, and the surface water resources present within the Meydenbauer Bay service area are summarized in Table 5.45.

Table 5.45 Potential Environmental Impacts for Upland Construction - Meydenbauer Bay

Construction Method	Stormwater and Runoff	Turbidity and DO	Pollutants	Surface Water Resources Present within Service Area
Gravity line Vacuum sewer Grinder pumps	▪ Construction activities within upland areas would be isolated from surface water resources and controlled using proper BMPs.	▪ No impacts if stormwater and runoff is controlled before discharge to stormwater system.	▪ Unassessed pollutants in soil during trenching are separated from water resources. ▪ Construction equipment leaks or spills are negligible based on distance from water resources.	▪ Meydenbauer Creek.

5.9.6.2 Permitting

Upland construction is located within the general vicinity of the public ROW farther than 200 feet from the shoreline and is thus not subject to shoreline permitting requirements. No locations were identified at the planning level that overlapped with federal- or state-regulated wetlands or surface waters. This includes using construction methods that will avoid Meydenbauer Creek, such as trenchless methods that could install pipe under the creek bed. Meydenbauer Bay service area falls under the jurisdiction of the City of Bellevue and the City of Medina. Necessary permits within the service area are identified in Table 5.46.

Table 5.46 Permit Matrix - Meydenbauer Bay

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
State Permits(1)			
Ecology	Construction Stormwater General Permit	6-12 months	▪ Discharge to surface waters through the stormwater system
Ecology	Shoreline Permit or Variance Review	1 month	▪ Required if there is a shoreline permit issued
Local Permits(1)			
City of Medina	SEPA Compliance	Issued with a land use/ shoreline permit	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process
	Land Use Permit(s)	6-18 months	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Grading and Drainage Permit(s)	6-12 months	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course
	ROW Use Permit(s)	3-6 months	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department

Notes:
(1) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.

5.9.6.3 Mitigation

Upland locations are heavily developed or degraded within the Meydenbauer Bay service area, but there are locations that would require mitigation measures. Mitigation measures include the general provisions described in Chapter 3. These measures are primarily construction BMPs to avoid and minimize temporary impacts. The main enhancement measure in upland areas is to restore/enhance disturbed riparian vegetation areas.

5.10 Service Area Plan - Killarney

5.10.1 Overview

The Killarney Service Area begins at the terminus of the Meydenbauer Bay Service Area, continues south along the lake line system in the City of Bellevue, encompasses the lake line system in Beaux Arts Village, and extends approximately 0.2 mile south of Interstate 90 (I-90). The Killarney Service Area serves approximately 336 parcels, primarily as single-family residential and public parks and public spaces. The lake line system in the Killarney service area consists of two reaches with approximately 2.1 miles of lake line, with only one pump and one flush station.

The risk score for the Killarney Service Area resulting in its ranking as **priority number four** of six service areas. The implementation period for the Killarney Service Area is **medium-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting in the Killarney Service Area is the **upland alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.47. All costs are presented in 2023 dollars. Only costs prior to and including the implementation of the system alternative are included.

The total implementation cost for this service area is **$194M**.

Table 5.47 Service Area Plan Implementation Costs - Killarney

Service Area Plan Components	Estimated Cost
Preferred System Alternative	$174,800,000
Pump and Flush Station Improvements	$955,000
Emergency Repair Fund	$9,568,000
Other System Improvements	$8,194,000
Total	**$193,517,000**

The City has indicated that Parks and Community Services is planning a redevelopment project at Chism Beach Park (project H2O-6, Chism Beach Redevelopment, per the 2022 Parks and Open Space System Plan). Details of this project have not been defined at the time of this plan; however, potential opportunities for consolidation of permitting and construction activities should be investigated, particularly with the near-term recommended improvements to Flush Station No. 7 and the connected segment of high-risk pipe located within Chism Beach Park. Improvements are also planned, but not defined, at Enatai Beach Park.

5.10.2 Lake Line System

The lake line system in the Killarney service area consists of two reaches, with approximately 2.1 miles of lake line, one pump station, and one flush station, as shown in Figure 5.20. Flow is conveyed from Flush No. 7 at the northern limit of the service area south to the Killarney pump station. Lake line flow combines with upland gravity flow at Killarney pump station and is pumped to a King County Metro sewer discharge structure at Enatai Beach Park just south of I-90, where it leaves the City system. Table 5.48 summarizes the lake line system components in the Killarney Service Area.

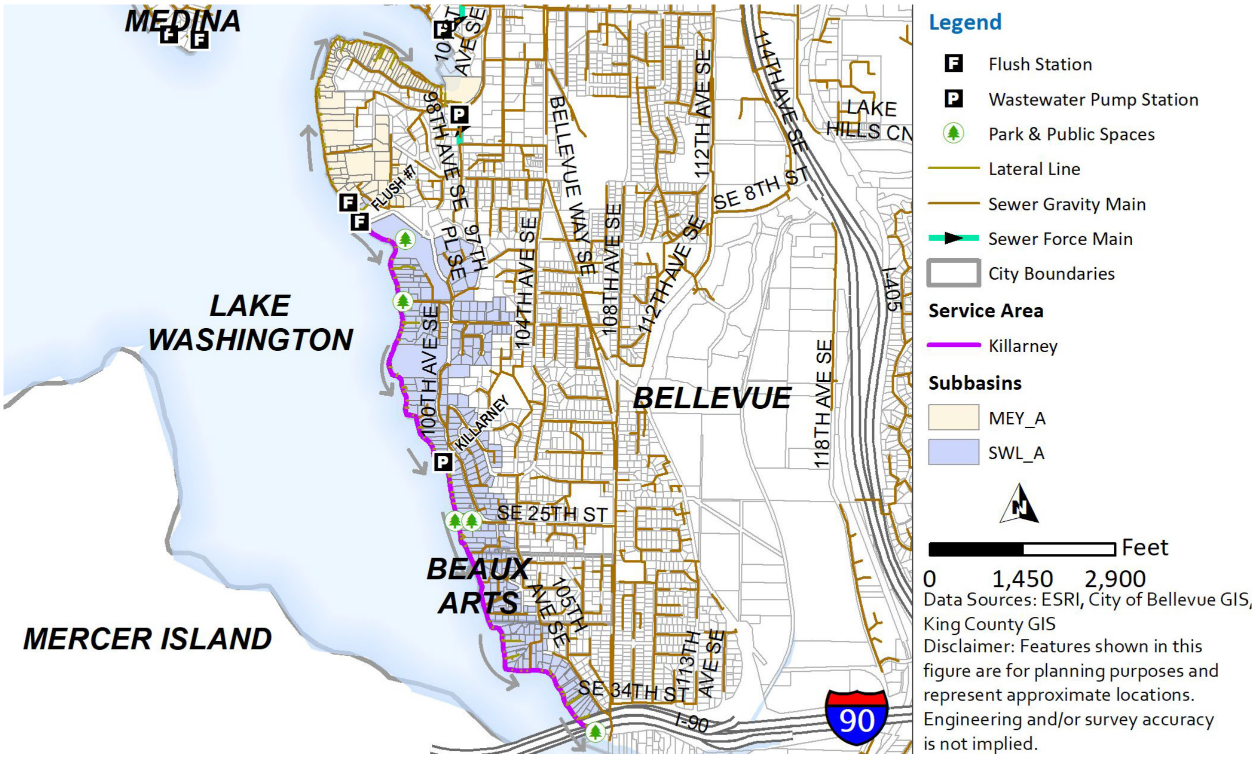


Figure 5.20 Lake Line System - Killarney

Table 5.48 Lake Line System Components - Killarney

Component	Description
Reaches	▪ Reach 15 - Flush No. 7 to Killarney PS. ▪ Reach 16 - Killarney PS to King County.
Pump Stations	▪ Killarney PS: 2 pumps, 250-310 gpm station firm capacity.
Flush Stations	▪ Flush No. 7
Pipe	▪ 12,965 linear feet of pipe: » 2,130 feet on land. » 10,835 feet in-water.
Parcels Served	▪ 336 parcels served (93 parcels adjacent to lake line)

5.10.3 Area Characteristics

The Killarney Service Area begins at the terminus of the Meydenbauer Bay Service Area south along the lake line system in the City of Bellevue, encompasses the lake line system in Beaux Arts Village, and extends approximately 0.2 mile south of I-90, as shown in Figure 5.22. The Killarney Service Area is zoned primarily as single-family residential and public parks and public spaces, including Chism Beach Park, Burrows Landing Park, Chesterfield Beach Park, and Enatai Beach Park within Bellevue; it serves approximately 336 parcels and contains approximately 93 private docks (City of Bellevue 2015 Comprehensive Plan and Town of Beaux Arts Village 2015 Comprehensive Plan). The portion of the service area in Beaux Arts Village along the shoreline is designated as open space and as single-family residential farther inland.

The land cover in the northern portion of the service area is a mix of open space, low-intensity development, evergreen and deciduous forested areas, and evergreen forest along the shore in Beaux Arts Village, with higher intensity development in the southern section near the I-90 bridge. The shoreline of the Killarney Service Area is located within a moderate to high liquefaction hazard area and contains the following critical areas: landslide deposits west of 94th Avenue SE and at Chism Beach Park. The southern section of the Service Area is atop Seattle Fault Zone, which puts the area at risk for shallow crustal earthquake and surface rupture and steep slopes along most of the shoreline.

Characteristics of the service area are summarized in Table 5.49. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.49 Area Characteristics - Killarney

Characteristic	Description
Jurisdictions	▪ City of Bellevue. ▪ King County. ▪ Town of Beaux Arts Village.
Zoning and Land Use	▪ Single family. ▪ Open Space.
Parks and Public Spaces	▪ Chism Beach Park. ▪ Burrows Landing Park. ▪ Chesterfield Beach Park. ▪ Enatai Beach Park.
Geologic Hazards or Limitations	▪ Landslide deposits west of 94th Ave SE and at Chism Beach Park. ▪ Moderate to high liquefaction hazard area. ▪ Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington

5.10.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period for the Killarney Service Area.

5.10.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Killarney Service Area are presented in Table 5.50.

The average risk score for the Killarney Service Area is 4.31, resulting in its ranking as **priority number four** of the six service areas.

5.10.4.2 Implementation Period

The implementation period for the Killarney service area is **medium-term**.

Table 5.50 Risk Scores - Killarney

	Reach 15 - Flush No. 7 to Killarney PS	Reach 16 - Killarney PS to King County
Likelihood of Failure Components		
EUL	1	2
Pipe Material	2	2
Couponing	2	2
Pump and Flush Station Condition	2	2
Outside Influences	2	3
Overflow History	3	2
Weighted LOF Score	**2.09**	**2.10**
Consequence of Failure Components		
Environmental Impact	3	3
Land Use	2	2
Parcels Served	3	3
Flow	2	2
Location	2	2
Operational Access	1	1
Weighted COF Score	**2.30**	**2.30**
Weighted Total Risk Score	**4.31**	**4.32**
Service Area Average Risk Score	**4.31**	

5.10.5 Service Area Plan

5.10.5.1 System Alternative

The preferred alternative for the Killarney Service Area is the **upland alternative**. Table 5.51 summarizes the factors for consideration for each alternative, with red shading representing a higher level of complexity for that factor and a green shading representing a lower level of complexity, and therefore the preferred alternative for that factor.

Table 5.51 System Alternatives Analysis Summary - Killarney

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Upland was the preferred alternative because it had the least number of red cells, therefore representing the lowest level of complexity/difficulty for this Service Area. The permitting, impact on the environment, and operations and maintenance of sewer infrastructure for the upland alternative was deemed the least challenging when compared to the onshore or in-water alternatives. All three alternatives were considered to have similarly difficult technical and constructability challenges.

In-water was not identified as the preferred alternative because of difficulties permitting this work, a substantially higher impact on the environment, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington. While the right of way and local community impacts were preferred for the in-water alternative, the other benefits of the upland approach outweighed these two factors.

Onshore was not identified as the preferred alternative because it was assumed that the higher impact of shoreline work would result in residents' negative outlook on the construction efforts. The challenges associated with permitting, environmental impacts, and performance/O&M were greater for work along the Lake Washington shoreline than moving the sewer infrastructure upland into the system.

The preferred alternative of upland would require constructing grinder pumps on private property to convey flows up to a new sewer main within the collection system. The Killarney Pump Station would remain in the conveyance system but would require constructing a new force main from the pump station to a new main line located in SE 23rd Street. Flush Stations No. 7 would be abandoned as part of abandoning the existing lake line system.

The cost of implementing the upland system alternative in the Killarney Service Area is summarized in Table 5.52. Refer to Appendix E - Alternatives Analysis TM for detailed cost information.

Table 5.52 System Alternative Cost (Onshore) - Killarney

	Upland Cost
Total Bid Amount(1)	$77,554,000
Construction Hard Cost(2)	$108,584,000
Soft Cost(3)	$66,129,000
Total Project Cost(4)(5)	**$174,713,000**
Low Range (-19 percent)	$142,000,000
High Range (+62 percent)	$283,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.10.5.2 Pump and Flush Station Improvements

Table 5.53 identifies the pump and flush station locations, original project ID and implementation period per the 2015 assessment, and associated project costs.

Table 5.53 Pump and Flush Station Improvements - Killarney

Pump/Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No. 7	Parcel number: N/A Address: SE 11th St ROW (Chism Beach Park)	F7-1 F7-2 F7-3	2018-2022 2020-2025 2023-2026	\$5,000 \$75,000 \$225,000	\$7,000 \$103,000 \$307,000
Killarney PS	Parcel number: 9389700030 Address: Killarney Way ROW Bellevue 98004 (Adjacent to 2177 Killarney Way SE	K-1 K-2	2018-2022 2023-2027	\$181,000 \$213,000	\$247,000 \$291,000
Total				\$699,000	**\$955,000**

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5
(2) The 20-City ENR CCI used for 2023 was 13358.17.

5.10.5.3 High-risk Assets

Pipe segments of the lake line with a high-risk of failure rating (greater than 6 on a scale of 3 to 9) are the following asset IDs: 197730, 197731,197732, 213210, 201026, 213208, 213258, 213259, 213260, 213262, 213263, and 213264. The locations of these pipes are identified in Figure 5.21.

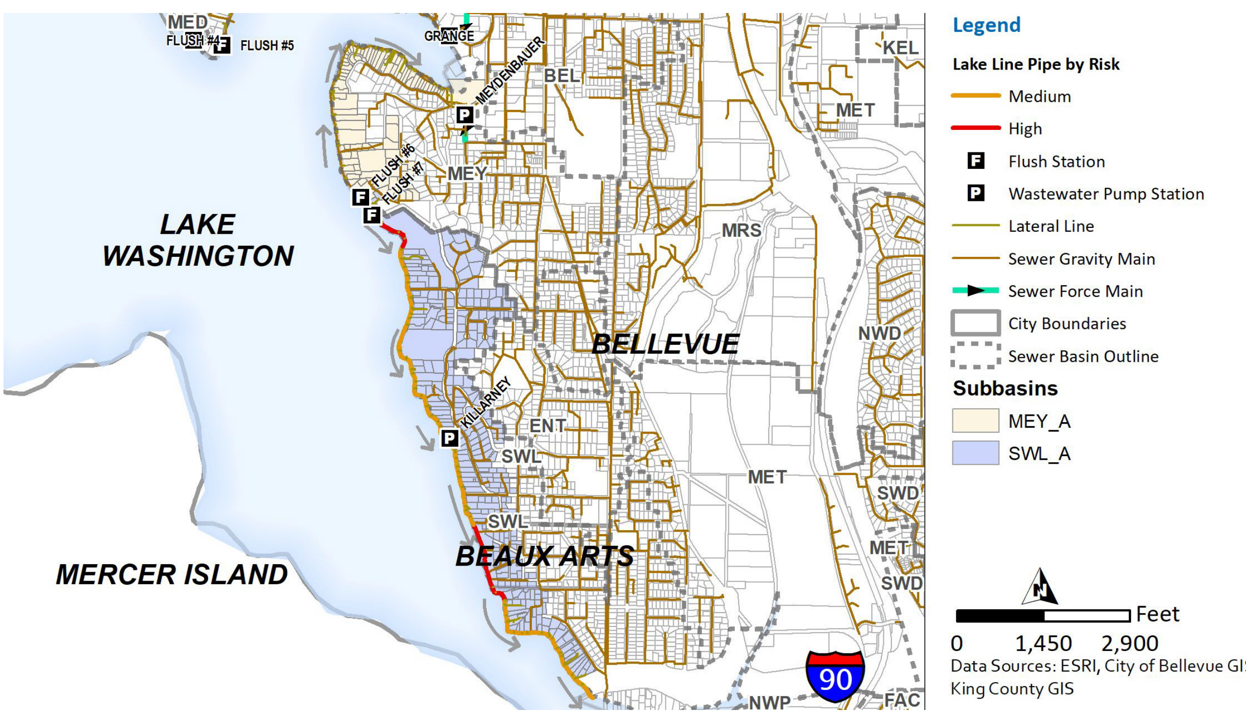


Figure 5.21 High-risk Assets - Killarney

The length of pipe considered high-risk is approximately 2,392 LF of 10,284 LF, or approximately 23 percent of the lake line main in the service area. At an average repair cost of $4,000/LF for in-water pipe, the recommended emergency repair fund for spot repair(s) in this service area is $9,568,000.

5.10.5.4 Other System Improvements

The other system improvements recommended for the Killarney Service Area are summarized in Table 5.54. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in Table 5.54). Refer to Appendix G for the detailed operational cost estimates.

Table 5.54 Other System Improvements - Killarney

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Cleaning and Inspection	Hydro-jetting and CCTV Inspection.	Near-term	$3,152,000
Access Improvements	Vegetation/Obstruction clearing at PS and FS.	Near-term	City Staff
Data Collection	Right-of-way and Easement Review.	Near-term	City Staff
	Topographic Survey.		$4,862,000
	Phase 1 Pipe Coupon Collection.		$90,000
	Phase 2 Pipe Coupon Collection.		$90,000
Emergency Repair Planning	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Total			**$8,194,000**

Notes:
(1) Approximate cost for the coupons in this service area only; coupons to be collected in five service areas in each phase.

5.10.6 Regulatory Considerations

5.10.6.1 Environmental Impacts

Construction for the Killarney service area would be within upland locations. Potential upland construction methods include installation of a gravity line via open cut-and-cover construction, installation of a gravity line via trenchless construction, installation of a vacuum sewer system, and installation of grinder pumps. Upland construction methods would avoid environmental impacts to surface water resources, fisheries, and aquatic ecosystems using appropriate BMPs. The project would prioritize installing new pipelines in locations that are already impacted (e.g., public ROW, parking lots).

Construction methods, potential impact, and the surface water resources present within the Killarney service area are summarized below in Table 5.55.

Table 5.55 Potential Environmental Impacts for Upland Construction - Killarney

Construction Method	Stormwater and Runoff	Turbidity and DO	Pollutants	Surface Water Resources Present within Service Area
Gravity line Vacuum sewer Grinder pumps	▪ Construction activities within upland areas would be isolated from surface water resources and controlled using proper BMPs.	▪ No impacts if stormwater and runoff is controlled before discharge to stormwater system.	▪ Unassessed pollutants in soil during trenching are separated from water resources. ▪ Construction equipment leaks or spills are negligible based on distance from water resources.	▪ None identified – upland areas where the pipe could be moved would avoid sensitive areas.

5.10.6.2 Permitting

Upland construction is located within the general vicinity of the public ROW farther than 200 feet from the shoreline and is thus not subject to shoreline permitting requirements. No locations were identified at the planning level that overlapped with federal- or state-regulated wetlands or surface waters. Killarney service area falls under the jurisdiction of the City of Bellevue and Beaux Arts Village. Necessary permits within the service area are identified in Table 5.56.

Table 5.56 Permit Matrix - Killarney

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
State Permits(1)			
Ecology	Construction Stormwater General Permit	6-12 months	▪ Discharge to surface waters through the stormwater system.
Ecology	Shoreline Permit or Variance Review	1 month	▪ Required if there is a shoreline permit issued.
Local Permits(1)			
City of Medina	SEPA Compliance	Issued with a land use/ shoreline permit	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process.
	Land Use Permit(s)	6-18 months	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Grading and Drainage Permit(s)	6-12 months	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course.
	Right-of-Way Use Permit(s)	3-6 months	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department.

Notes:
(1) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.

5.10.6.3 Mitigation

Upland locations are heavily developed or degraded within the Killarney service area, but there are locations that would require mitigation measures. Mitigation measures include the general provisions described in Chapter 3. These measures are primarily construction BMPs to avoid and minimize temporary impacts. The main enhancement measure in upland areas is to restore/enhance disturbed riparian vegetation areas.

5.11 Service Area Plan - Newport South

5.11.1 Overview

The Newport South Service Area begins at the southern portion of Newcastle Beach Park, follows the lake line system in the southern portion of the City of Bellevue into unincorporated King County, parallels I-405 to the east, and ends approximately 500 feet north of the Virginia Mason Athletic Center in Renton. The Newport South Service Area serves approximately 149 parcels. Parcels within Bellevue are zoned as single-family residential, and parcels in King County are zoned as residential. The lake line system in the Newport South service area consists of two reaches with approximately 1.9 miles of lake line, with two pump stations and one flush station.

The risk score for the Newport South Service Area resulting in its ranking as **priority number two** of six service areas. The implementation period for the Newport South Service Area is **medium-term**.

Based on the alternatives analysis, the preferred system alternative identified for the basis of planning and budgeting for the Newport South Service Area is the **upland shore alternative**.

A cost summary of the system alternative, pump and flush station improvements, emergency repair fund, and other system improvements is provided in Table 5.57. All costs are presented in 2023 dollars. Only costs prior to and including the implementation of the system alternative are included.

The total implementation cost for this service area plan is **$214M**.

Table 5.57 Service Area Plan Implementation Costs - Newport South

Service Area Plan Components	Estimated Cost
System Alternative	$205,700,000
Pump and Flush Station Improvements	$1,753,000
Emergency Repair Fund	$116,000
Other System Improvements	$6,425,000
Total	**$213,994,000**

5.11.2 Lake Line System

The lake line system in the Newport South Service Area consists of two reaches approximately 1.9 miles of lake line, two pump stations, and one flush station, as shown in Figure 5.22. Flow is conveyed from Flush Station No. 8 at the southern limit of the service area north to the Pleasure Point intermediate pump station. Lake line flow is further pumped to the Bagley pump station in Newcastle Beach Park, where it is then pumped to a gravity system further upland in the park. Table 5.59 summarizes the lake line system components in the Newport South Service Area.

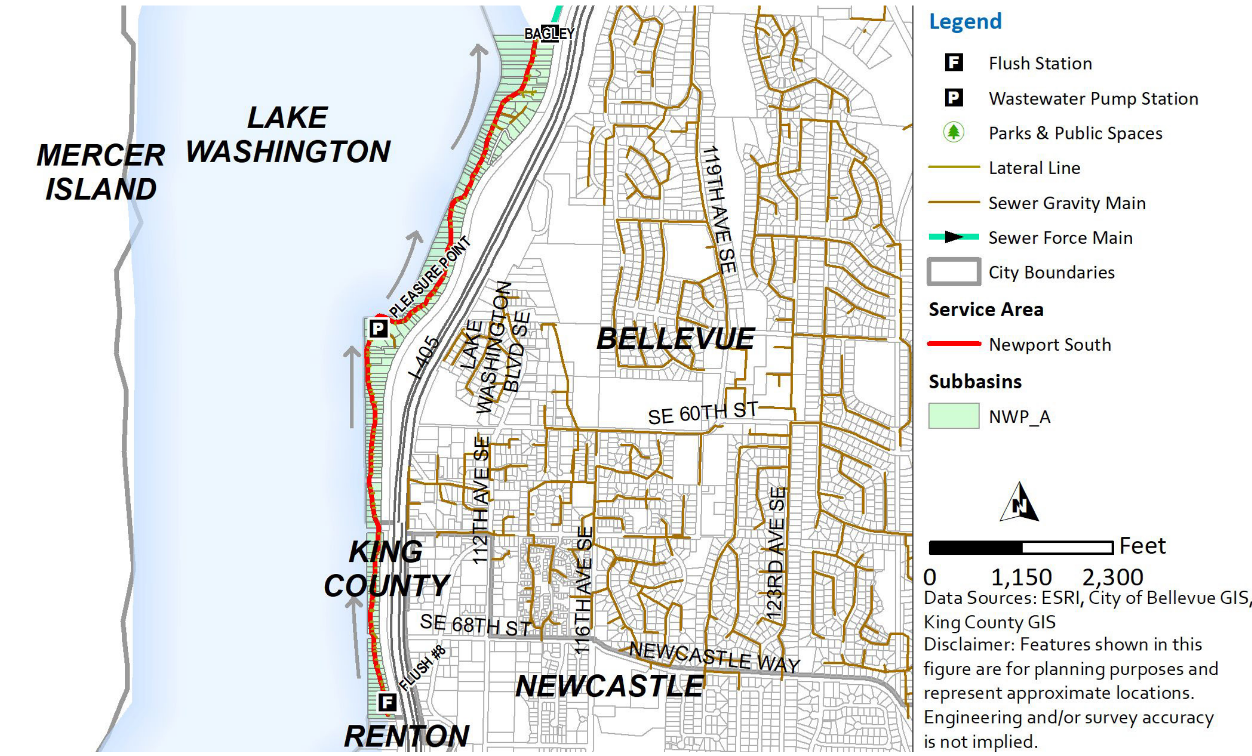


Figure 5.22 Lake Line System - Newport South

Table 5.58 Lake Line System Components – Newport South

Component	Description
Reaches	▪ Reach 17 - Pleasure Point PS to Bagley PS. ▪ Reach 18 - Flush No. 8 to Pleasure Point PS.
Pump Stations	▪ Pleasure Point PS: 2 pumps, 240-250 gpm station firm capacity. ▪ Bagley PS: 2 pumps, 175-185 gpm station firm capacity.
Flush Stations	▪ Flush No. 8: 240 gpm
Pipe	▪ 10,175 linear feet of pipe: » 10,175 feet in-water.
Parcels Served	▪ 149 parcels served (131 parcels adjacent to lake line)

5.11.3 Area Characteristics

The northern terminus of the Newport South Service Area is approximately 1.5 miles south of the southern terminus of the Killarney Service Area. The connecting pipeline between the Killarney Service Area and the Newport South Service is located upland (i.e., the pipeline is not located in the lake in this segment). Beginning at the southern portion of Newcastle Beach Park, the Newport South Service Area extends following the lake line system in the southern portion of the City of Bellevue into unincorporated King County, parallels I-405 to the east, and ends approximately 500 feet north of the Virginia Mason Athletic Center in Renton, as shown in Figure 5.25.

The Newport South Service Area serves approximately 149 parcels and within Bellevue is zoned as single-family residential and in King County as residential, with 6 dwelling units per acre (R-6) and contains approximately 98 private docks (City of Bellevue 2015 Comprehensive Plan and King County 2018 iMap). The land cover in the Service Area is mostly low to medium-intensity development, which includes the I-405 roadway with some open space developed areas.

Similar to the other service areas, the shoreline of the Newport South Service Area is located within a moderate to high liquefaction hazard area and contains the following critical areas: landslide deposits along Lake Washington Boulevard SE and Hazelwood Lane SE, location atop the Seattle Fault Zone putting area at risk for shallow crustal earthquake and surface rupture, and steep slopes adjacent to I-405.

Characteristics of the service area are summarized in Table 5.59. Refer to the EIS for a more detailed discussion of the affected environment, including land and shoreline use, earth resources, air quality, surface water resources, fisheries and aquatic ecosystems, vegetation and wildlife, noise, transportation, cultural resources, and public utilities.

Table 5.59 Area Characteristics - Newport South

Characteristic	Description
Jurisdictions	▪ City of Bellevue. ▪ Unincorporated King County.
Zoning and Land Use	▪ Single family. ▪ R-6 (Residential).
Parks and Public Spaces	▪ Newcastle Beach Park.
Geologic Hazards or Limitations	▪ Landslide deposits along Lake Washington Blvd SE and Hazelwood Lane SE. ▪ Steep slopes adjacent to I-405. ▪ Moderate to high liquefaction hazard area. ▪ Seattle Fault Zone.
Surface Water Resources	▪ Lake Washington. ▪ Lakehurst Creek. ▪ 0281B. ▪ 0281C. ▪ Additional unnamed tributaries.

5.11.4 Area Prioritization

This section provides a summary of the service area prioritization including the risk score and the implementation period in the Newport South Service Area.

5.11.4.1 Risk Score

The likelihood of failure, consequence of failure, and risk scores for the four reaches in the Newport South Service Area are presented in Table 5.60.

The average risk score for the Newport South Service Area is 4.43, resulting in its ranking as **priority number two** of the six service areas.

5.11.4.2 Implementation Period

The implementation period for the Newport South service area is **medium-term**.

Table 5.60 Risk Scores - Newport South

	Reach 17 - Pleasure Point PS to Bagley PS	Reach 18 - Flush No. 8 to Pleasure Point PS
Likelihood of Failure Components		
EUL	1	1
Pipe Material	2	2
Couponing	1	1
Pump and Flush Station Condition	3	3
Outside Influences	3	3
Overflow History	2	2
Weighted LOF Score	**2.21**	**2.21**
Consequence of Failure Components		
Environmental Impact	3	3
Land Use	2	1
Parcels Served	2	2
Flow	2	1
Location	3	3
Operational Access	2	3
Weighted COF Score	**2.30**	**2.15**
Weighted Total Risk Score	**4.47**	**4.38**
Service Area Average Risk Score	**4.43**	

5.11.5 Service Area Plan

5.11.5.1 System Alternative

The preferred system alternative for the Newport South Service Area is the **upland alternative**. Table 5.61 summarizes the factors for consideration for each alternative, with red shading representing a higher level of complexity for that factor and a green shading representing a lower level of complexity, and therefore the preferred alternative for that factor.

Table 5.61 System Alternatives Analysis Summary - Newport South

	Permitting	Environmental Impact	ROW	Performance O&M	Technical/ Constructability	Cost	Local Community
In-water							
Onshore							
Upland							

Upland was the preferred alternative because it had the least number of red cells, therefore representing the lowest level of complexity/difficulty for this Service Area. Newport South has only one row of properties between the shore and the main road, reducing the length of new grinder pump sewer lateral connections back to the street. Permitting for the upland work was considered to be less challenging due to the higher number of likely needed permits, higher effort with permitting agencies, and more complex permits for in-water work. Environmental impact is also less significant for the upland alternative when compared to the in-water alternative, due to the sensitivity of water ecosystems. Performance and O&M are both improved with the upland alternative as operations staff can easily access sewer infrastructure from the street. Technical/Constructability was also more complex for the in-water alternative.

In-water was not identified as the preferred alternative because of difficulties permitting this work, a substantially higher impact on the environment, more complex constructability challenges, and difficulties with operations and maintenance of sewer infrastructure within Lake Washington. However, both right of way and local community scored slightly higher for the in-water approach, but do not make up for the other more challenging factors.

Onshore was not identified as the preferred alternative because there is not enough space on the existing shoreline to construct the new sewer lines. It was considered an infeasible solution for this Service Area and consequently scoring was not considered for any of the seven factors.

The preferred alternative of upland would consist of constructing a new 10,000-foot-long sewer main along Pleasure Point Lane, Hazelwood Lane SE, and Ripley Lane SE. Pleasure Point Pump Station would be abandoned as the individual grinder pumps would be sufficient for pumping wastewater flows up into the new sewer main. All flows would be conveyed to Bagley Pump station, similar to the existing conditions. Flush Station No. 8 would be abandoned as part of abandoning the existing lake line system.

The cost of implementing the upland alternative in the Newport South Service Area is summarized in Table 5.62. Refer to Appendix E - Alternatives Analysis TM for detailed cost information.

Table 5.62 System Alternative Cost (Onshore) - Newport South

	Upland Cost
Total Bid Amount(1)	$91,281,000
Construction Hard Cost(2)	$127,801,000
Soft Cost(3)	$77,830,000
Total Project Cost(4,5)	**$205,631,000**
Low Range (-19 percent)	$167,000,000
High Range (+62 percent)	$333,000,000

Notes:
(1) Construction bid amount including AFI and Washington State sales tax.
(2) Includes additional construction contingency for risk-based management reserve due to complex nature of projects.
(3) Engineering design, construction administration, City labor, permit administration, and soft cost contingency.
(4) Total estimated project cost including hard and soft costs; with 19 percent reduction for low range, and 62 percent increase for high range estimates.
(5) Costs are in 2023 dollars, and do not include inflation/escalation, real property or easement acquisition, permit fees, or mitigation.

5.11.5.2 Pump and Flush Station Improvements

Table 5.63 identifies the pump and flush station locations, original project ID and implementation period per the 2015 assessment, and associated project costs.

Table 5.63 Pump and Flush Station Improvements – Newport South

Pump/Flush Station	PS Location	Project ID	Timing	Planning Level Cost(1)	Escalated Cost in 2023 dollars(2)
Flush No. 8	Parcel number: 3343302740	F8-1	2018-2022	$5,000	$7,000
	Address: 7011 Ripley Lane SE Bellevue, WA 98056(3)	F8-2	2020-2025	$75,000	$103,000
		F8-3	2023-2026	$480,000	$654,000
Pleasure Point PS	Parcel number: 2024059073	PP-1	2015-2018	$150,00	$205,000
	Address: 5600 Pleasure Point Lane SE Bellevue 98006	PP-2	2023-2027	$210,000	$287,000
Bagley PS	Parcel number: N/A (Newcastle Beach Park)	B-1	2015-2018	$154,000	$210,000
	Address: Approximately 4400 Lake Washington Blvd SE Bellevue 98004	B-2	2023-2027	$210,000	$287,000
Total				**$1,284,000**	**$1,753,000**

Notes:
(1) In 2014 dollars from the Wastewater Pump Station Evaluation Final Report by Murray, Smith & Associates (May 2015), 20-City ENR CCI: 9806.5.
(2) The 20-City ENR CCI used for 2023 was 13358.17.
(3) Unincorporated King County.

5.11.5.3 High-risk Assets

One pipe segment of the lake line (asset ID: 214068) has a high-risk of failure rating (greater than 6 on a scale of 3 to 9). This pipe is immediately adjacent to Flush No. 8 as shown in enlarged detail within Figure 5.23.

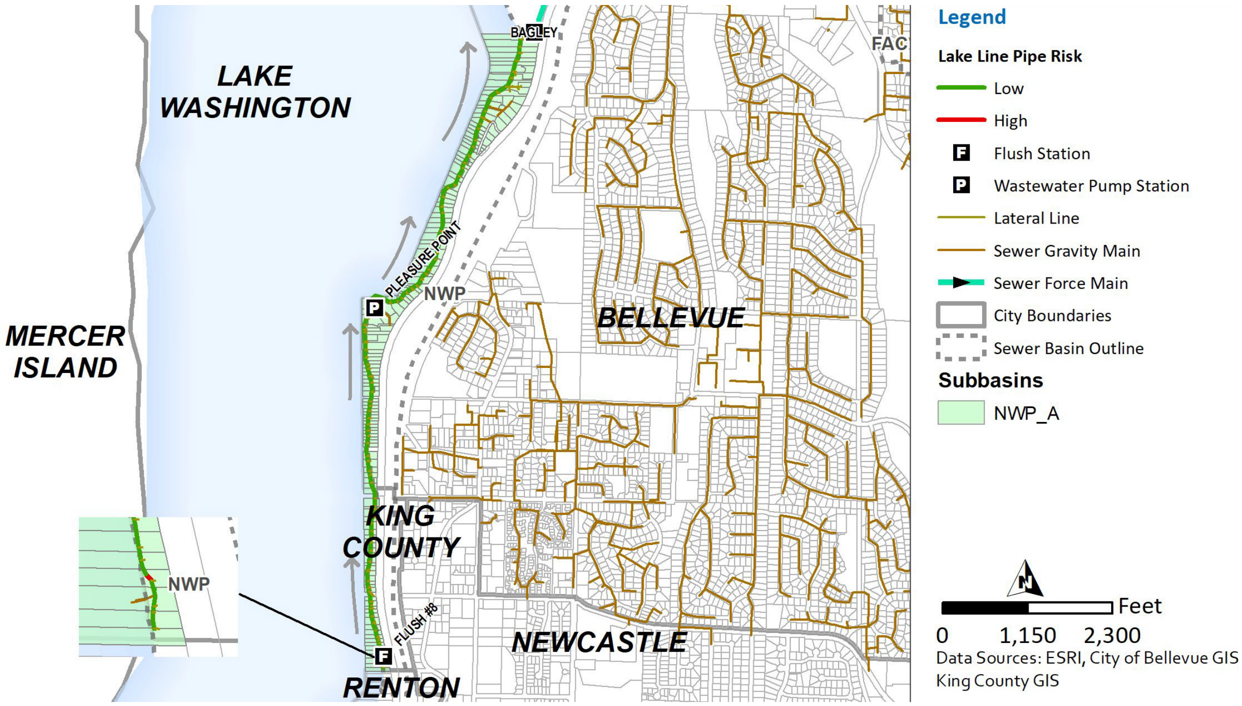


Figure 5.23 Newport South High-Risk Assets

The length of pipe considered high-risk is approximately 29 LF of 10,175 LF, or approximately 0.3 percent of the lake line main in the service area. At an average repair cost of $4,000/LF for in-water pipe, the recommended emergency repair fund for spot repair(s) in this service area is $116,000.

5.11.5.4 Other System Improvements

The other system improvements recommended for the Newport South Service Area are summarized in Table 5.64. Operational or internal tasks that are anticipated by City staff are not included in the planning level costs (indicated "City Staff" in Table 5.65). Refer to Appendix G for the detailed operational cost estimates.

Table 5.64 Other System Improvements - Newport South

Type	System Improvement	Timing	Planning Level Cost (2023 dollars)
Operations Procedure Review	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Cleaning and Inspection	Hydro-jetting and CCTV Inspection.	Near-term	$2,474,000
Access Improvements	Vegetation/Obstruction clearing at PS and FS.	Near-term	City Staff
Data Collection	Right-of-way and Easement Review.	Near-term	City Staff
	Topographic Survey.		$3,816,000
	Phase 1 Pipe Coupon Collection.		$45,000
	Phase 2 Pipe Coupon Collection.		$90,000
Emergency Repair Planning	See Chapter 3 for System-Wide Recommendations.	Near-term	City Staff
Total			**$6,425,000**

Notes:
(1) Approximate cost for the coupons in this service area only; coupons to be collected in five service areas in each phase.

5.11.6 Regulatory Considerations

5.11.6.1 Environmental Impacts

Construction for the Newport South service area would be within upland locations. Potential upland construction methods include installation of a gravity line via open cut-and-cover construction, installation of a gravity line via trenchless construction, installation of a vacuum sewer system, and installation of grinder pumps. Upland construction methods would avoid environmental impacts to surface water resources, fisheries, and aquatic ecosystems using appropriate BMPs. The project would prioritize installing new pipelines in locations that are already impacted (e.g., public ROW, parking lots).

Construction methods, potential impact, and the surface water resources present within the Newport South service area are summarized below in Table 5.65.

Table 5.65 Potential Environmental Impacts for Upland Construction - Newport South

<table>
<tr><th>Construction Method</th><th>Stormwater and Runoff</th><th>Turbidity and DO</th><th>Pollutants</th><th>Surface Water Resources Present within Service Area</th></tr>
<tr><td>Gravity line</td><td rowspan="3">▪ Construction activities within upland areas would be isolated from surface water resources and controlled using proper BMPs.</td><td rowspan="3">▪ No impacts if stormwater and runoff is controlled before discharge to stormwater system.</td><td rowspan="3">▪ Unassessed pollutants in soil during trenching are separated from water resources.
▪ Construction equipment leaks or spills are negligible based on distance from water resources.</td><td rowspan="3">▪ None identified – upland areas where the pipe could be moved would avoid sensitive areas.</td></tr>
<tr><td>Vacuum sewer</td></tr>
<tr><td>Grinder pumps</td></tr>
</table>

5.11.6.2 Permitting

Upland construction is located within the general vicinity of the public ROW farther than 200 feet from the shoreline and is thus not subject to shoreline permitting requirements. No locations were identified at the planning level that overlapped with federal- or state-regulated wetlands or surface waters. Newport South Service Area falls under the jurisdiction of the City of Bellevue. Necessary permits within the service area are identified in Table 5.66.

Table 5.66 Permit Matrix - Newport South

Authority	Type of Permit/Authorization	Permit Timeline Estimate	Trigger
State Permits[(1)]			
Ecology	Construction Stormwater General Permit	6-12 months	▪ Discharge to surface waters through the stormwater system.
Ecology	Shoreline Permit or Variance Review	1 month	▪ Required if there is a shoreline permit issued.
Local Permits[(1)]			
City of Medina	SEPA Compliance	Issued with a land use/ shoreline permit	▪ Proposed activities that are not considered exempt from SEPA (per Chapter 43.21C RCW and WAC 197-11). ▪ Includes 14-day appeal process.
	Land Use Permit(s)	6-18 months	▪ Activities proposed near or within critical areas or their buffer(s).
	Shoreline Permit(s)	6-18 months	▪ Activities proposed near or within shoreline areas or within 200 feet of the shoreline.
	Grading and Drainage Permit(s)	6-12 months	▪ Land disturbing activities, including excavating, boring, or changing the natural drainage course.
	ROW Use Permit(s)	3-6 months	▪ Projects that require traffic or pedestrian diversions. ▪ Project may just require a haul route permit issued through the ROW department.

Notes:
(1) Potential permits may include, but are not limited to, those listed. When individual projects are carried forward under the Management Plan, all applicable permits will be determined as required and will comply with the requirements of those permits.

5.11.6.3 Mitigation

Upland locations are heavily developed or degraded within the Newport South service area, but there are locations that would require mitigation measures. Mitigation measures include the general provisions described in Chapter 3. These measures are primarily construction BMPs to avoid and minimize temporary impacts. The main enhancement measure in upland areas is to restore/enhance disturbed riparian vegetation areas.

CHAPTER 6 FINANCIAL CONSIDERATIONS

6.1 Introduction

The size and the scope of the LWWLLMP will impact the City's finances and will require the City to evaluate its existing financial policies to identify what potential funding approaches, financial strategies, and other considerations should be considered in the development of the project's Financial Plan. Policies to be considered include differential cost recovery by area, cash funding with renewal and replacement, and use of various types of debt. Funding alternatives were developed to illustrate the range of funding scenarios for the project and the potential impacts on customers.

6.2 Scope of Financial Analysis

The financial strategy alternatives developed as part of this study did not evaluate potential rate increases. Also, the financial analysis does not provide a financing strategy recommendation because the project design and cost estimates are still in the planning phase; estimates prepared for this LWWLLMP are Class 5, which are considered order-of-magnitude estimates with a considerable range in expected accuracy (-19 percent to +62 percent).

The financial analysis estimated the potential impacts to the capital requirements of different funding strategies to pay for the lake line system alternative. The City used this information to estimate the potential impact on the utility's overall revenue requirements and rates based on the different funding mechanisms. Several lake line system alternatives were considered for each service area, as described in Chapter 5. The preferred system alternative was selected based on several criteria including permitting, environmental impact, ROW/easements, operations, constructability, cost, and impacts to the local community. For each service area, Table 6.1 summarizes the estimated project cost for the preferred lake line system alternative, number of properties served, and corresponding estimated total project cost. Estimated total project costs for each service area range from approximately $127 million to nearly $235 million. Total project costs include construction cost, contingency, and soft costs. Figure 6.1 presents a map of the six service areas served by the projects.

The City considered whether the costs of other components of the Plan, including pump and flush station improvements, emergency repair fund, and other system improvements (data collection, cleaning, emergency planning) should be included in addition to the system alternative costs. Some components of the plan have already been factored into City financial forecasts (i.e., separate renewal and replacement forecasts for pump and flush station improvements) or were not categorized as an expense (emergency repair fund). Other system improvement costs such as data collection, inspection, topographic survey and coupon collection are included in the revenue requirement impact analysis in Section 6.4.

Table 6.1 Preferred System Alternative Cost by Service Area

Service Area	Preferred System Alternative	Estimated Cost	Number of Parcels Served
Meydenbauer Bay	Upland	$197,100,000	448
Newport South	Upland	$205,600,000	149
Hunts Point and Yarrow Point	On Shore, Trenchless	$234,700,000	587
Killarney	Upland	$174,700,000	336
Evergreen Point	On Shore, Trenchless	$127,400,000	172
Medina South	Upland	$199,700,000	213
Total		**$1,139,200,000**	**1,905**

Notes:
(1) Preferred system alternative estimated costs is the calculated value between that low and high range presented in the service area plans in Chapter 5, and includes construction hard costs and soft costs.
(2) System alternative costs does not allow for other system improvement cost such as data collection, inspection, topographic survey and coupon collection.

6.3 Financial Strategy for Implementation of System Alternatives

6.3.1 Purpose

The purpose of the financial strategy for the LWWLLMP is to provide a high-level financial analysis to help understand the impacts on the City's overall revenue requirements. The analysis summarized herein does not include a detailed analysis of the revenue requirements. Rather, the analysis estimates the capital requirements for the lake line improvements based on reasonable assumptions. Other system improvement costs such as surveying, inspection, data collection, and coupon collection are included in the impact analysis but are not included in the system capital costs. The results of the financial analysis are used by the City to evaluate the impact on revenue requirements. The financial analysis compares a 30-year and 50-year study period options. The four funding strategy alternatives included in the analysis are listed below and only include capital costs for the preferred system alternative:

- Alternative 1: 100 percent cash funded over a 30-year construction period. The 30-year construction period is an assumption that each implementation periods (near-term, medium-term, and long-term) are 10 years each. The actual implementation period duration is likely to vary; this assumption was made only for the financial analysis presented in this chapter.
- Alternative 2: 30 percent cash funded, and 70 percent debt financed over a 30-year construction period. The split between cash and debt financing was an estimate and can be evaluated in future analyses. The 30-year construction period is consistent with the implementation periods of plan.
- Alternative 3: 100 percent cash funded over a 50-year construction period. The 50-year analysis period spreads out the cost of the project and allows for completion of other needed projects over an extended timeline. The implementation duration may be extended as assets are maintained and renewed, and condition assessments are completed that inform schedule.
- Alternative 4: 30 percent cash funded and 70 percent debt financed over a 50-year construction period. The split between cash and debt financing was an estimate and can be evaluated in future analyses. The 50-year analysis period spreads out the cost of the project and allows for completion of other needed projects over an extended timeline.

6.3.2 Key Findings

Table 6.2 summarizes for each financial strategy alternative the project costs, funding sources, capital requirements, net present value (NPV), and equivalent annual cost (EAC). The preferred system capital costs are the same for each financial strategy alternative. The total capital requirements are different for Alternatives 2 and 4 because of debt service, but the amount of the debt service is the same for Alternatives 2 and 4. Debt service is the annual payment of principal and interest to repay the loan. Because spend patterns are different for each alternative, the NPV and EAC are different in each funding alternative.

Table 6.2 Summary of Preferred System Alternative Capital Costs, Funding Sources, and Capital Requirements

Funding Source	Alternative 1 Cash, 30 years	Alternative 2 Cash + Debt Service, 30 years	Alternative 3 Cash, 50 years	Alternative 4 Cash + Debt Service, 50 years
Project Costs				
Cash Funded	$1,139,200,000	$341,760,000	$1,139,200,000	$341,760,000
Debt Funded	$ -	$797,440,000	$ -	$797,440,000
Total Project Costs	**$1,139,200,000**	**$1,139,200,000**	**$1,139,200,000**	**$1,139,200,000**
Capital Requirements(1)				
Cash	$1,139,200,000	$341,760,000	$1,139,200,000	$341,760,000
Debt Service	$ -	$1,843,500,000	$ -	$1,843,500,000
Total	**$1,139,200,000**	**$2,185,260,000**	**$1,139,200,000**	**$2,185,260,000**
Net Present Value	$707,000,000	$941,800,000	$549,100,000	$734,300,000
Equivalent Annual Cost	$39,700,000	$40,100,000	$24,500,000	$29,200,000

Notes:
(1) Capital costs do not include allowance for other system improvement cost such as data collection, inspection, topographic survey and coupon collection.

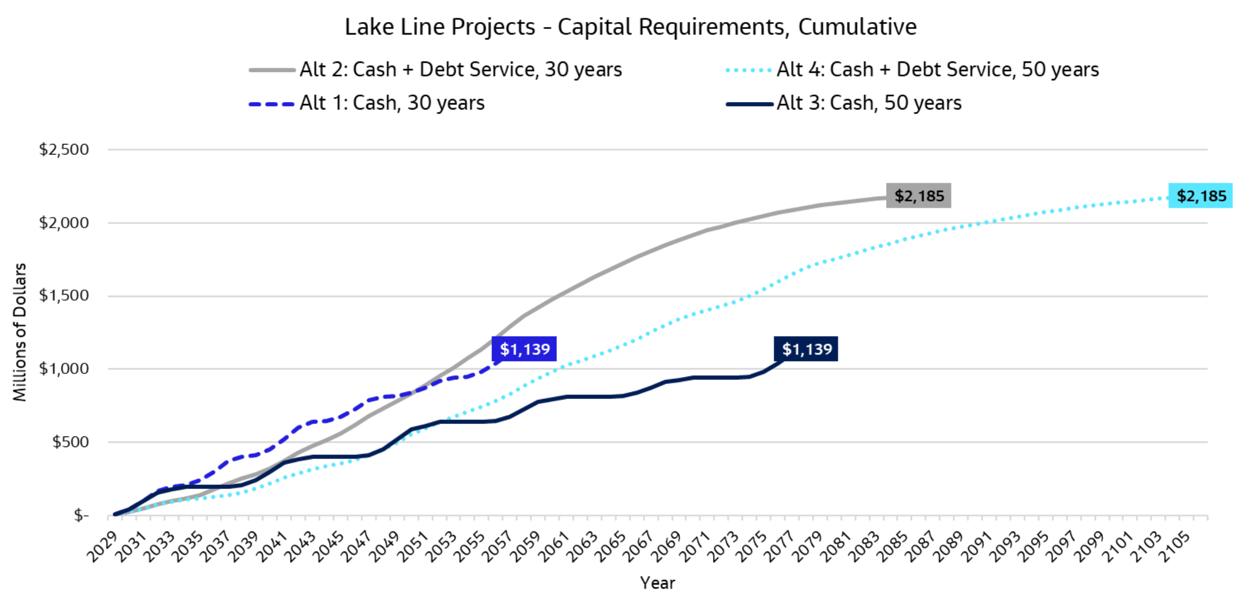


Figure 6.1 Cumulative Capital Requirements for Lake Line Projects

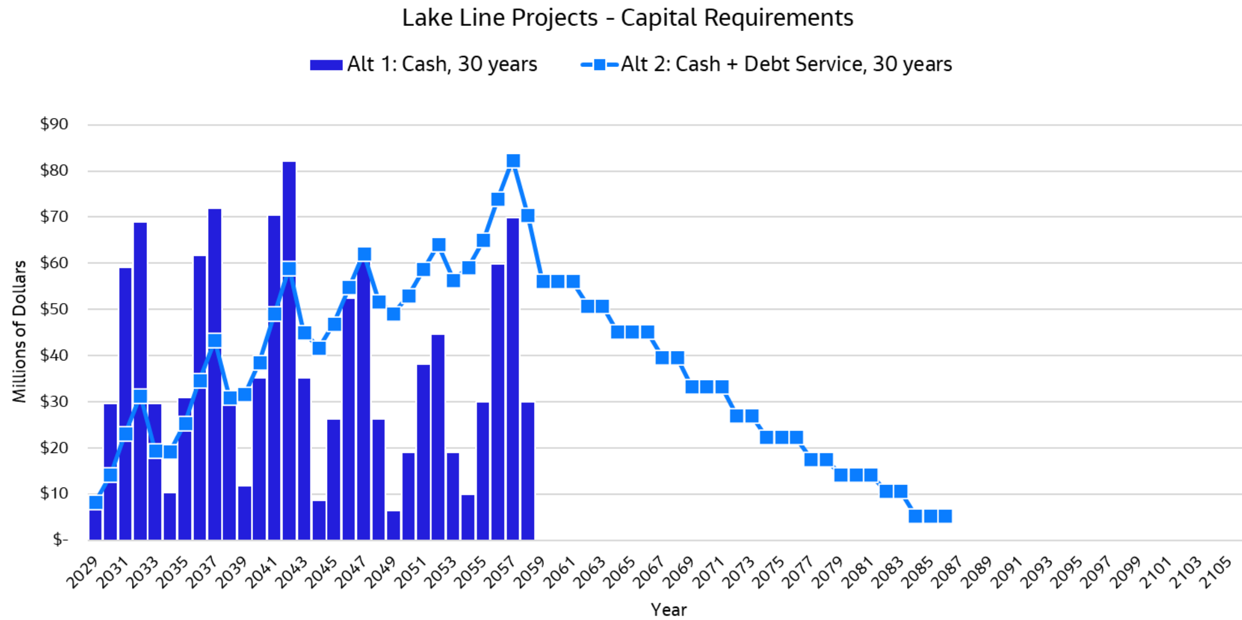


Figure 6.2 Annual Capital Requirements for Lake Line Projects - Alternatives 1 and 2

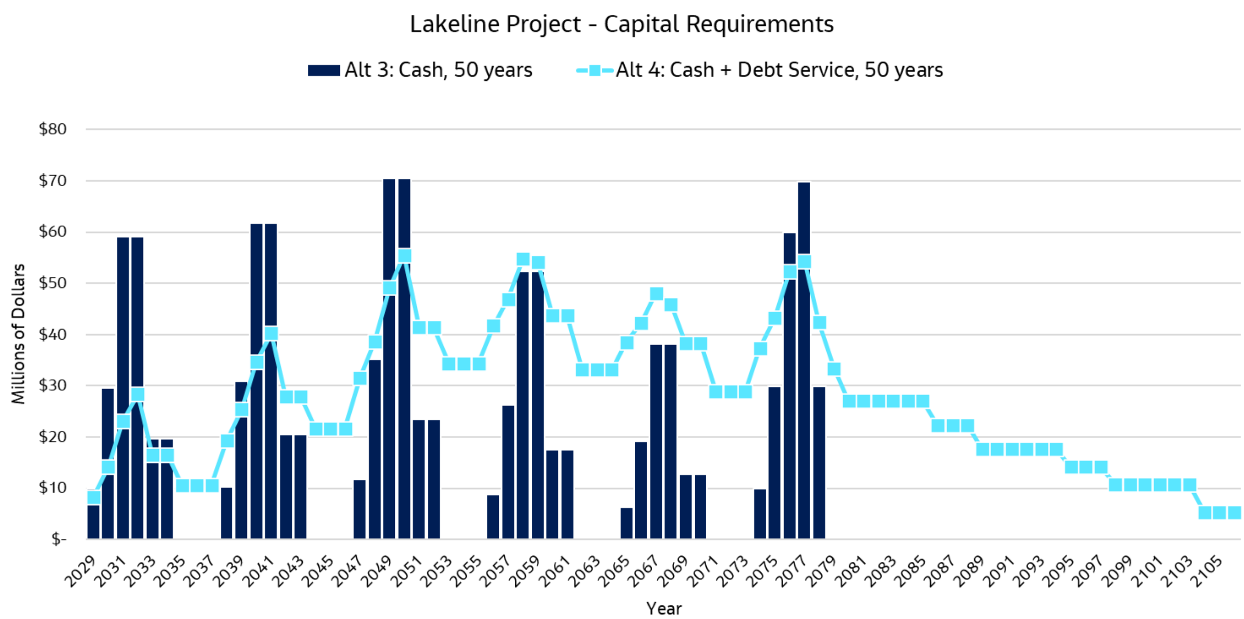


Figure 6.3 Annual Capital Requirements for Lake Line Projects - Alternatives 3 and 4

6.3.3 Methodology and Assumptions

The financial strategy analysis is limited to the initial construction costs of the preferred system alternatives and does not include operating expenditures. The impact to revenue requirements presented in Section 6.4 includes the capital cost as well as an allowance for some operational expenses such as surveying, cleaning, and CCTV inspection (see Section 6.4). The analysis evaluates costs in real dollars and does not consider inflation because that is addressed in the City's rate model. The financial strategy alternatives evaluate two primary time frames for project constructions, 30-years and 50-years. The sequencing of projects for a 30-year study period assumes a 5-year construction period with no gap between service area projects. The 50-year study period assumes a 6-year construction period with a three year gap between service area projects. This assumption of time period and delivery capability was made solely for the purposes of analyzing the scale of financial impacts presented in this chapter. Financing of the capital projects compares two options: cash only and cash plus debt funding. The financial strategy analysis focuses on the preferred technical alternative for each of the six service areas. Table 6.3 provides a matrix of assumptions for financial strategy alternatives.

Table 6.3 Matrix of Assumptions for Financial Strategy for Constructing Alternatives

Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Financial Strategy Alternative	Cash, 30 years	Cash + Debt Service, 30 years	Cash, 50 years	Cash + Debt Service, 50 years
Cash funded	100%	30%	100%	30%
Debt funded	N/A	70%	N/A	70%
Start Year	2029	2029	2029	2029
Study Period	30-years	30-years	50-years	50-years
Service Area Project Duration	5-years	5-years	6-years	6-years
Gap between Service Area Projects	none	none	3-years	3-years
Debt Issuance	none	Every 2-3 years	none	Every 2-3 years
Term of debt (years)	N/A	30	N/A	30
Interest Rate	N/A	5.5%	N/A	5.5%
Cost of Issuance (% of project costs)	N/A	2%	N/A	2%
Debt Reserve (% of project costs)	N/A	10%	N/A	10%
Number of debt issuances	N/A	12	N/A	12
Year Debt Matures	N/A	2086	N/A	2106
Discount Rate	3.75%	3.75%	3.75%	3.75%

While the construction schedules are unknown at this time, the assumptions for the financial analysis are presented in Figure 6.4 for Alternatives 1 and 2, and Figure 6.6 for Alternatives 3 and 4. The relative spending by year on a percentage basis is identified and then the dollar amount is determined based on the estimated costs by area. The schedule of estimated costs were developed based on the assumed start year.

Alternatives 1 and 2, 30 years		**Relative Spending by Year (% of total)**				
Area	**Technology**	**1**	**2**	**3**	**4**	**5**
Meydenbauer Bay	Upland	5%	15%	30%	35%	15%
Newport South	Upland	5%	15%	30%	35%	15%
Hunts Point, Yarrow Point	On Shore, Trenchless	5%	15%	30%	35%	15%
Killarney	Upland	5%	15%	30%	35%	15%
Evergreen Point	On Shore, Trenchless	5%	15%	30%	35%	15%
Medina South	Upland	5%	15%	30%	35%	15%

Alternatives 1 and 2, 30 years			**Relative Spending by Year**				
Area	**Cost (2023$)**	**Start Year**	**1**	**2**	**3**	**4**	**5**
Meydenbauer Bay	$ 197,100,000	2029	$ 9,855,000	$ 29,565,000	$ 59,130,000	$ 68,985,000	$ 29,565,000
Newport South	205,600,000	2034	10,280,000	30,840,000	61,680,000	71,960,000	30,840,000
Hunts Point, Yarrow Point	234,700,000	2039	11,735,000	35,205,000	70,410,000	82,145,000	35,205,000
Killarney	174,700,000	2044	8,735,000	26,205,000	52,410,000	61,145,000	26,205,000
Evergreen Point	127,400,000	2049	6,370,000	19,110,000	38,220,000	44,590,000	19,110,000
Medina South	$ 199,700,000	2054	$ 9,985,000	$ 29,955,000	$ 59,910,000	$ 69,895,000	$ 29,955,000
Total	$ 1,139,200,000						

Figure 6.4 Spend Patterns and Start Year Assumptions - Alternatives 1 and 2

Alternatives 3 and 4, 50 years		**Relative Spending by Year (% of total)**					
Area	**Technology**	**1**	**2**	**3**	**4**	**5**	**6**
Meydenbauer Bay	Upland	5%	15%	30%	30%	10%	10%
Newport South	Upland	5%	15%	30%	30%	10%	10%
Hunts Point, Yarrow Point	On Shore, Trenchless	5%	15%	30%	30%	10%	10%
Killarney	Upland	5%	15%	30%	30%	10%	10%
Evergreen Point	On Shore, Trenchless	5%	15%	30%	30%	10%	10%
Medina South	Upland	5%	15%	30%	35%	15%	0%

Alternatives 3 and 4, 50 years			**Relative Spending by Year**					
Area	**Cost (2023$)**	**Start Year**	**1**	**2**	**3**	**4**	**5**	**6**
Meydenbauer Bay	$ 197,100,000	2029	$ 9,855,000	$ 29,565,000	$ 59,130,000	$ 59,130,000	$ 19,710,000	$ 19,710,000
Newport South	$ 205,600,000	2038	$ 10,280,000	$ 30,840,000	$ 61,680,000	$ 61,680,000	$ 20,560,000	$ 20,560,000
Hunts Point, Yarrow Point	$ 234,700,000	2047	$ 11,735,000	$ 35,205,000	$ 70,410,000	$ 70,410,000	$ 23,470,000	$ 23,470,000
Killarney	$ 174,700,000	2056	$ 8,735,000	$ 26,205,000	$ 52,410,000	$ 52,410,000	$ 17,470,000	$ 17,470,000
Evergreen Point	$ 127,400,000	2065	$ 6,370,000	$ 19,110,000	$ 38,220,000	$ 38,220,000	$ 12,740,000	$ 12,740,000
Medina South	$ 199,700,000	2074	$ 9,985,000	$ 29,955,000	$ 59,910,000	$ 69,895,000	$ 29,955,000	$ -
Total	$ 1,139,200,000							

Figure 6.5 Spend Pattern and Start Year Assumptions - Alternatives 3 and 4

Note: Capital costs in Figures 6.5 and 6.6 do not include allowance for other system improvement costs such as data collection, inspection, topographic survey and coupon collection.

6.3.4 Financial Strategy Alternatives Analysis

Based on the assumptions identified in Section 6.3.3, information is summarized for each financial strategy for the preferred system alternative capital costs, including the following:

- Project costs.
- Debt financing.
- Capital requirements.
- NPV.
- EAC.

6.3.4.1 Alternative 1 - 30-year schedule Cash Funding

Financial Strategy Alternative 1 assumes a 30-year study period and Table 6.4 summarizes the amount cash funded, the NPV, and EAC. Figure 6.7 summarizes the annual capital requirements from 2029 to 2058. As shown, there is a 5-year construction period for each service area and projects occur sequentially with no gap. The actual schedule, duration, and distribution of costs for each project will be refined as these capital projects are developed and implemented by the City.

Table 6.4 Alternative 1 Fundings Sources, Capital Requirements, NPV, and EAC

Funding Source	Total
Cash Funded	$1,139,200,000
Debt Funded	N/A
Total	$1,139,200,000
Net Present Value	$707,000,000
Equivalent Annual Cost	$39,700,000

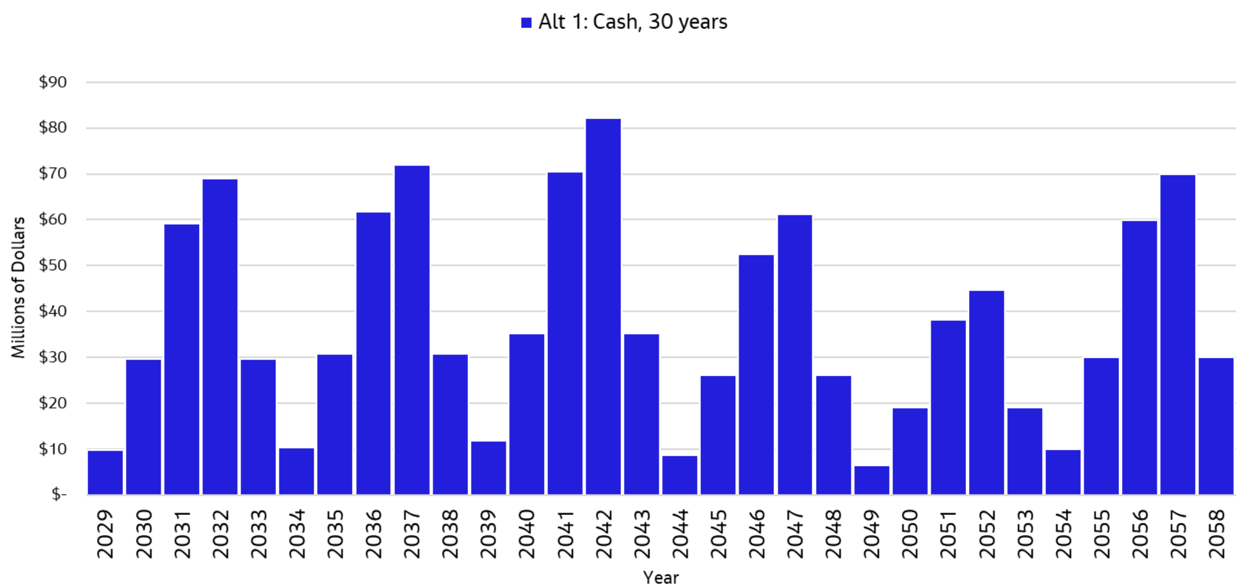


Figure 6.6 Annual Capital Requirements - Alternative 1

6.3.4.2 Alternative 2 - 30-year schedule Cash and Revenue Bonds

Financial Strategy Alternative 2 assumes a 30-year study period and Table 6.5 summarizes the amount cash funded versus debt funded, the NPV, and EAC. Figure 6.7 summarizes the annual capital requirements 2029 – 2058 for both cash and debt service components. As shown, there is a 5-year construction period for each service area and projects occur sequentially with no gap. The actual schedule, duration, and distribution of costs for each project will be refined as these capital projects are developed and implemented by the City.

Based on the stated assumptions, 30 percent of the costs are cash funded and would span the 30-year study period. Because debt financing is assumed for the other 70 percent, debt service payments extend beyond the 30-year study period and the debt issuances mature in 2086. Key differences compared to Alternative 1 are the timing and extent of cash outlays as debt service payments extend beyond the 30-year construction timeline. While both funding sources are cash outlays, they are presented separately for comparison between cash only alternatives.

Table 6.5 Alternative 2 Fundings Sources, Capital Requirements, NPV, and EAC

Funding Source	Total
Project Costs	
Cash Funded	$341,760,000
Debt Funded	$797,440,000
Total Project Costs	$1,139,200,000
Debt - Revenue Bonds	
Project Costs	$797,440,000
Issuance Costs	$15,948,800
Debt Reserve	$79,744,000
Estimated Principal	$893,132,800
Estimated Interest Costs	$950,367,200
Estimated Debt Service	$1,843,500,000
Capital Requirements	
Cash	$341,760,000
Debt Service	$1,843,500,000
Total	$2,185,260,000
Net Present Value	$941,800,000
Equivalent Annual Cost	$40,100,000

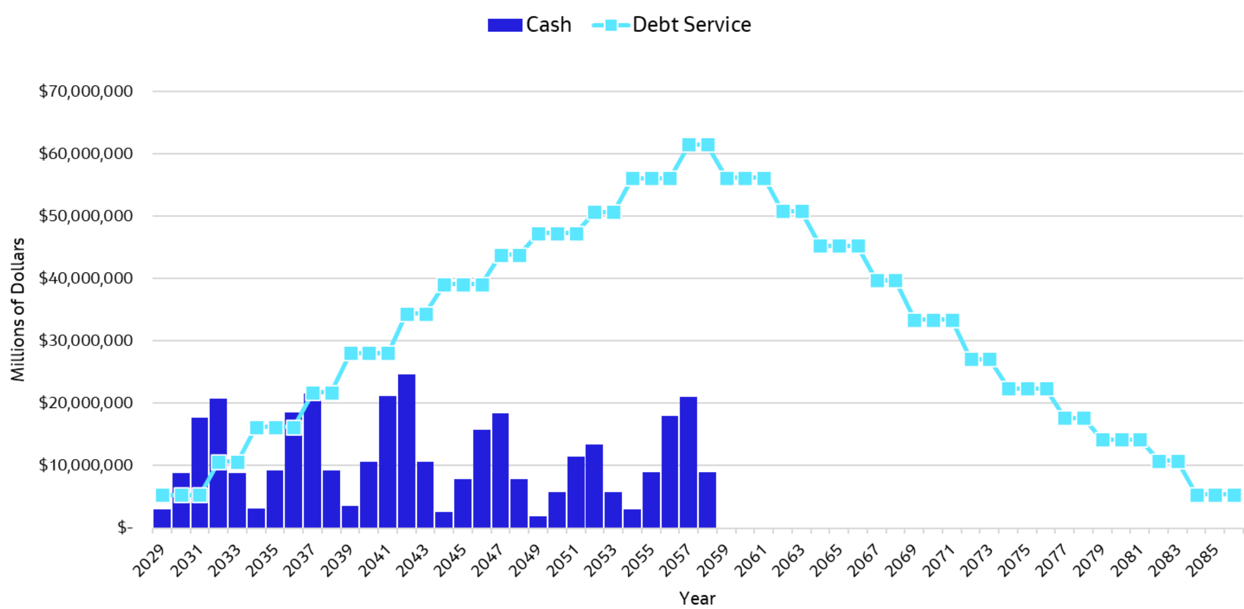


Figure 6.7 Annual Capital Requirements - Alternative 2

6.3.4.3 Alternative 3 - 50-year schedule Cash Funding

Financial Strategy Alternative 3 is similar to Alternative 1, except a 50-year study period is assumed with a 6-year construction period and 3-year gap between service areas. Table 6.6 summarizes the amount cash funded, the NPV, and EAC. Figure 6.9 summarizes the annual capital requirements from 2029 to 2078. The actual schedule, duration, and distribution of costs for each project will be refined as these capital projects are developed and implemented by the City.

Table 6.6 Alternative 3 Fundings Sources, Capital Requirements, NPV, and EAC

Funding Source	Total
Cash Funded	$1,139,200,000
Debt Funded	N/A
Total	$1,139,200,000
Net Present Value	$549,100,000
Equivalent Annual Cost	$24,500,000

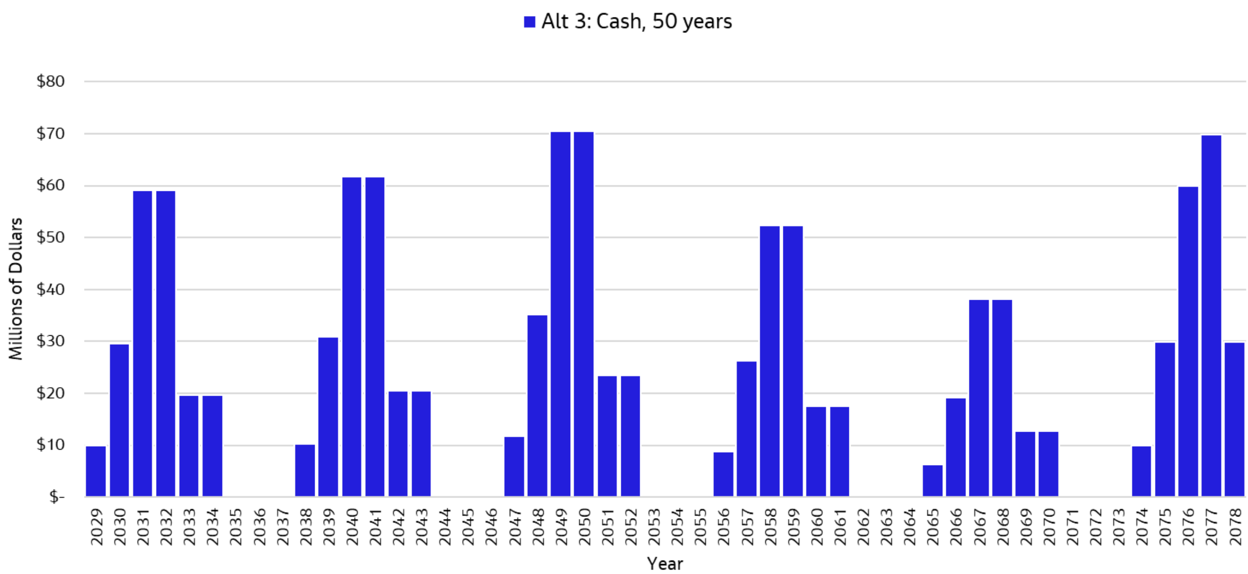


Figure 6.8 Annual Capital Requirements - Alternative 3

6.3.4.4 Alternative 4 - 50-year schedule Cash and Revenue Bonds

Financial Strategy Alternative 4 is similar to Alternative 2, except it assumes a 50-year study period. Table 6.7 summarizes the amount cash funded versus debt funded, the NPV, and EAC. Figure 6.9 summarizes the annual capital requirements 2029-2078 for both cash and debt service components. As shown, there is a 6-year construction period for each service area and a 3-year gap between service area projects. The actual schedule, duration, and distribution of costs for each project will be refined as these capital projects are developed and implemented by the City.

Table 6.7 Alternative 4 Fundings Sources, Capital Requirements, NPV, and EAC

Funding Source	Total
Project Costs	
Cash Funded	$341,760,000
Debt Funded	$797,440,000
Total Project Costs	$1,139,200,000
Debt - Revenue Bonds	
Project Costs	$ 797,440,000
Issuance Costs	$15,948,800
Debt Reserve	$79,744,000
Estimated Principal	$893,132,800
Estimated Interest Costs	$950,367,200
Estimated Debt Service	$1,843,500,000
Capital Requirements	
Cash	$341,760,000
Debt Service	$1,843,500,000
Total	$2,185,260,000
Net Present Value	$734,300,000
Equivalent Annual Cost	$29,200,000

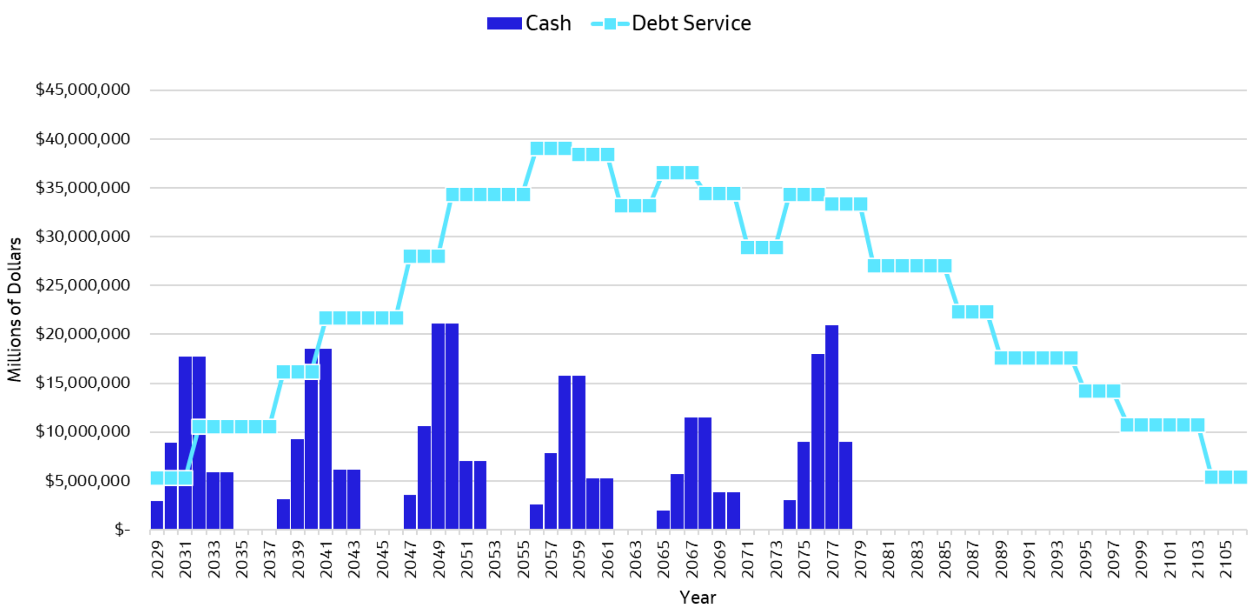


Figure 6.9 Annual Capital Requirements - Alternative 4

6.3.5 Other Considerations

The financial analysis makes high level assumptions regarding the schedule of project costs. Once design and construction for the projects begins, the duration of projects could be longer and spending pattern could be more levelized as project costs are spread out. In some cases, the projects for different service areas may overlap. It is anticipated that as individual assets are renewed, spot repairs are completed, and additional data is collected, that the area priority, timing, and sequence may be modified over time.

6.4 Potential Impacts to Revenue Requirements

Based on the evaluation of four financial strategies for the lake line improvements, the estimated capital requirements developed by the consulting team were provided to the City's Utility Department for consideration of impact on the overall revenue requirements and customer rates. The City also included additional operational costs in the impact analysis to address topographic surveys, pipeline cleaning and CCTV inspection, and phased coupon collection. Pump and flush station improvement costs are already included in the City's renewal and replacement schedule and were not added to this analysis.

The impact on sewer rates was evaluated by the City using their rate model. The City provided the consultant team output from the City's rate model for comparison purposes in this Report. The consultant team was not tasked to evaluate the impact that the lake line improvements would have on sewer rates, hence rate impacts developed by the City have not been validated and summarized in this Chapter. Based on discussion and feedback from City, the sewer fund has cash reserves that will be used to help buffer the rate impacts and be available for establishing an emergency repair fund. Based on output from the City's rate model, Figure 6.11 summarizes the rate impacts from the lake line improvements. The cumulative rate increases for the period 2025 to 2054 (30-years) by Alternative are as follows:

- Alternative 1 – 132 percent: with the shorter construction period, increases are larger initially and need to be high enough to cover the additional cash outlay required. Once the increases are high enough and are generating enough additional rate revenue, no further increases are needed.
- Alternative 2 – 175 percent: the increases are needed over a longer period of time to meet the annual cash funded portion of the project as well as the annual debt service. Once the increases are high enough and are generating enough additional rate revenue, no further increases are needed.
- Alternative 3 – 75 percent: the project costs are spread out over a longer period of time allowing for smaller increases than Alternative 1. Minor increases are needed beyond 2040.
- Alternative 4 – 100 percent: the project costs are spread out over a longer period of time allowing for smaller increases than Alternative 2. Minor increases are needed beyond 2050.

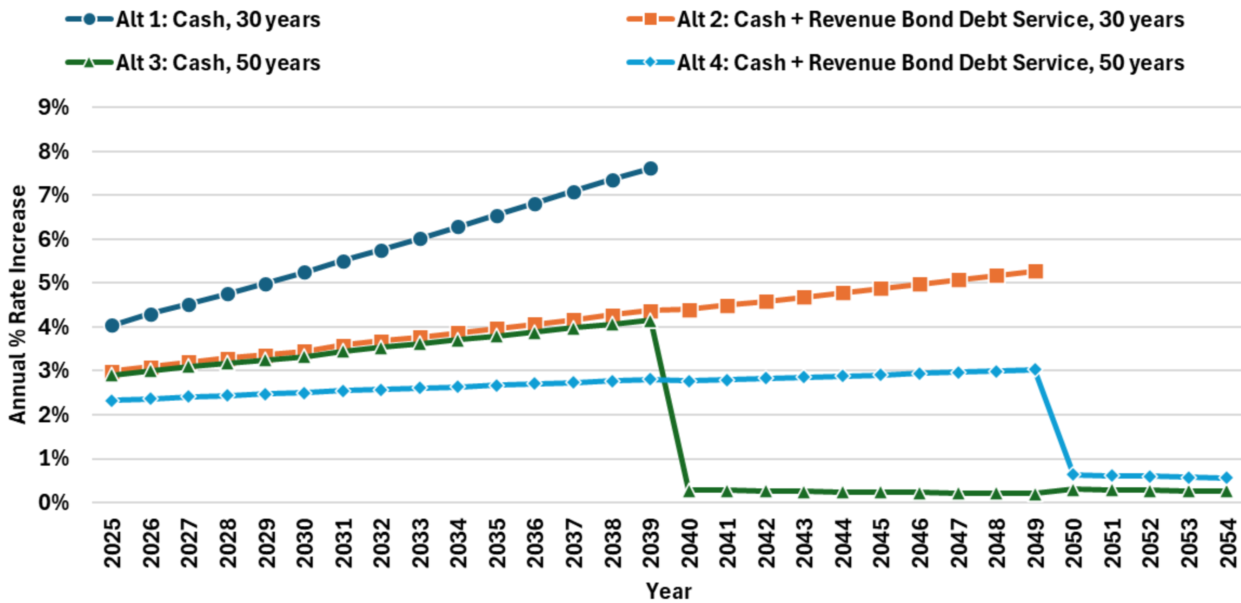


Figure 6.10 Estimated Percent Rate Increases Associated With Lake Line Projects

Note: Rate increase includes preferred system alternative capital costs and an allowance for other system improvement costs such as data collection, inspection, topographic survey and coupon collection.

6.5 Consideration of Financial Policies

The City has documented their financial policies regarding the waterworks utilities in the guidance document "City of Bellevue Utilities Financial Policies (2023-2024 Budget Waterworks Utility Financial Policies)." Policies for utility management, renewal and replacement of sewer assets, utility impacts to the environment, neighborhoods, and rate payers, and issuing of debt are examples of the topics discussed in the policy document. Chapter 4 of this document provides a summary of financial and other policy issues the City will need to consider when implementing the LWWLLMP. This section summarizes some of the existing financial policies relevant to the lake line improvements and provides discussion on how the policy may need to be reviewed to accommodate the implementation of the LWWLLMP.

6.5.1 Financial Policies

6.5.1.1 Use of Debt

Per the City of Bellevue Utilities Financial Policies, the following policies related to the use of debt are presented:

- "The Utilities should fund capital investment from rates and other revenue sources and should not plan to use debt except to provide rate stability in the event of significantly changed circumstances, such as disasters or external mandates."
- "Use of low interest rate debt such as the Public Works Trust Fund loans, by offering repayment terms below market rates, investment earnings or even inflation, should be viewed as a form of grant funding. When available or approved, such sources should be preferred over other forms of rate or debt funding, including use of available resources. Since such reserves would generate more interest earnings than the cost of the loan, the City's customers would be assured to benefit from incurring such debt."

Use of Debt Considerations

In order to fund a program the size of the LWWLLMP and to maintain levelized rate increase, the City will likely need to consider issuing debt. As discussed previously, potential financing strategies may include traditional revenue bonds, where annual rate revenue is pledged to pay the annual debt service payments, or state of federal programs that have the ability to fund a project of this size, such as the State Revolving Fund (SRF) and Water Infrastructure Finance and Innovation Act (WIFIA) programs.

6.5.1.2 Debt Coverage Requirements

Per the City of Bellevue Utilities Financial Policies, the following policies related to the targeted debt service coverage requirements are presented:

- "Resolution No. 5759 (Attachment B) states that the City Council will establish utility rates/charges and appropriations in a manner intended to achieve a debt service coverage ratio (adjusted by including City taxes as an expense item) of approximately 2.00. Having long-term rate stability also assures inter-generational equity without the use of debt because the rate pattern is similar to that achieved by debt service."
- "Utility rates shall be maintained at a level necessary to meet minimum debt coverage levels established in the bond covenants and to comply with Resolution No. 5759 which establishes a target coverage ratio of 2.00. In 1994, Council adopted Resolution No. 5759 that established a policy, which mandates the Utilities to maintain a target combined debt coverage ratio of approximately 2.00, to further protect the City's historically favorable Utility revenue bond ratings."

Debt Coverage Requirements Considerations

The utility's current target coverage ratio of 2.00 may not be required to maintain favorable terms from the rating agencies. The higher the debt coverage ratio, the more revenue required from rates. The target ratio is one of many things considered during the bond rating review process. A municipal advisor would assist the utility in navigating the bond rating process and may be able to secure favorable terms with a debt coverage ratio lower than 2.00, which could be more favorable for rate payers.

6.5.1.3 Rate Uniformity

Per the City's Utilities Financial Policies, the following policies related to rate uniformity are presented:

- "Rates shall be uniform for all utility customers of the same class and level of service throughout the service area. However, special rates or surcharges may be established for specific areas, which require extraordinary capital investments and/or maintenance costs. Revenues from such special rates or surcharges and expenses from capital investments and/or extraordinary maintenance shall be accounted for in a manner to assure that they are used for the intended purposes."
- "However, RCW 35.92.010 authorizes utilities to consider differences in the cost of service to various customers, location of customers within the service area, and other such factors that present a reasonable basis for distinction. When conditions in particular service areas require extraordinary capital improvement or maintenance costs to be incurred, special rates or surcharges may be adopted to recover those costs directly from properties contributing to the specific service demand, instead of assigning that cost burden to the general Utility rate base. This will only apply for costs above and beyond normal operations, maintenance and capital improvements."

Rate Uniformity Considerations

The City could elect to establish a surcharge or other fee structure that would be assessed to those customers that will be served by the lake line improvements. The City should consider how it charges other customers for sewer line replacement projects to ensure all customers are being treated equitably. Because the lake line improvements require specialized construction techniques that will increase the cost above and beyond a typical sewer line replacement project, the City could consider applying a surcharge to lake line customers for the portion of the project that is higher cost than a typical sewer line replacement project.

6.5.1.4 Rate Assistance

Per the City's Utilities Financial Policies, the following policies related to rate assistance programs are presented:

- "Rate assistance programs shall be provided for specific low-income customers as permitted by State law. The cost of these programs is absorbed in the overall Utility expenses and is recovered through the rate base."

Rate Assistance Considerations

When future lake line capital projects are further along the design process and the accuracy of the cost estimate improves, the utility should review the potential rate impacts of the LWWLLMP on the customers and consider if the rate assistance program needs to be expanded to help assist low-income families.

6.5.2 Utility Debt Funding Competencies

Because the utility hasn't issued debt in over 30 years, it will need to develop the internal processes and resources to track the potential programs available to support funding the project. While the WIFIA program accepts rolling applications throughout the year, other funding programs will have specific dates for which the application is due. It is also important for City staff to understand the different requirements of each funding program and any specific programs the funding agency may be targeting so the City can tailor its application to meet those requirements.

If the City were to receive WIFIA credit assistance, they would be required to comply with all relevant federal regulations. The City would need to build internal competencies to meet the reporting and compliance requirements or outsource the services to a third party. The following four topics are examples of compliance requirements of particular importance to the WIFIA program:

- **Build America, Buy America Act (BABA) Requirement**: All borrowers must use iron, steel manufactured products, and construction materials produced within the United States. For projects that initiated project design planning prior to May 14, 2022, the USEPA issued a program waiver of the requirements. Examples included master plans, preliminary engineering reports, and alternatives analysis. The WIFIA program will determine if a project meets the criteria for a waiver after an application is submitted.
- **American Iron and Steel (AIS) Requirement**: All borrowers must use iron and steel products produced in the United States. Waivers are possible if the USEPA finds that applying the requirements could be inconsistent with the public interest, if there is insufficient quantity or quality of the iron or steel product produced in the US, or if the inclusion of US iron and steel will increase the cost of the

project by over 25 percent. Prospective borrowers should consult with the WIFIA program regarding the AIS requirement.

- **Davis Bacon Wage Requirements**: All borrowers must pay all laborers employed by contractors or subcontractors wages not less than the prevailing wage in the immediate locality.
- **NEPA of 1969**: The project must comply with the NEPA of 1969. Each proposed project must be assessed for its impact on the environment and a loan will not be closed until the NEPA review is complete.

In the competition to secure affordable financing, the ability to demonstrate that the City will be ready to proceed with design and/or construction immediately upon execution of a financing agreement is critical. For example, the WIFIA program expects the contracting process for construction of the project to commence within 90 days after the date on which a federal credit instrument is obligated for the project. Readiness to proceed is important across all state and federal programs and can make or break the success of an assistance application and is often used as a tiebreaker when evaluating and scoring application submissions.

6.6 Summary

Based on management planning activities, preferred project alternatives for each of the six service areas were used to estimate capital requirements for the study area. In total, the estimated lake line system alternative costs are $1.14 billion. The assumed timeframe for completing the projects ranges from 30-50 years. The analysis also includes an allowance for other system improvement costs such as data collection, inspection, topographic survey and coupon collection.

The mix of funding sources can have impact on the lake line capital requirements and the overall revenue requirements for the utility. If the projects are entirely funded with cash, this would require the need to generate additional capital through rate increases. While not historically used as a financing vehicle by the City, debt funding could help provide capital to accomplish the projects while buffering the impacts on rates.

The source of funding can have significant impact on rates. If the lake line improvements are cash funded, the cumulative rate increases from 2025 to 2054 (30-years) could range from 74 percent to 132 percent. If projects assume a mix of cash and debt funding, the cumulative rate increases for the same period could range from 100 percent to 175 percent.

If debt funding is a consideration, the City would likely need to update their financial policies regarding the use of debt, debt service requirements, rate uniformity, and rate assistance. If credit assistance is pursued from either SRF or WIFIA programs, then there are compliance requirements for all relevant federal and state regulations that will need to be followed to secure funding.

CHAPTER 7 IMPLEMENTATION PLAN

7.1 Introduction

This chapter provides a roadmap for implementing the service area plans described in Chapter 5, including major milestones and recommended implementation activities.

Before any system alternatives for lake line system replacement are designed or constructed, the City needs to adopt policies to support the upland, onshore, and in-water alternatives. The City will also need to develop a strategy to fund the improvements for each service area. This chapter outlines the recommended administrative actions to implement the LWWLLMP.

Service area plan implementation is identified for near-term, medium-term, and long-term planning periods based on the overall risk score for each service area. The cost estimates for implementing each service area plan are summarized for the planning periods. The recommended actions, activities and improvements in the near-term planning period were sequenced into two-year periods to assist the City in implementing the LWWLLMP. A typical process for implementing a system alternative is summarized into four milestones and applicable activities for each. In addition to system alternatives, other operationally-focused system improvements such as cleaning and inspection are necessary to keep the lake line system functioning until the system alternative for each service area is implemented.

Development of a robust emergency response plan and applicable resources is critical to future success of the system and prolonging the estimated useful life.

As the City implements the LWWLLMP, outreach and education will continue to be a critical element for successful projects.

7.2 LWWLLMP Adoption

Areas of the lake line system have been repaired and studied in the past. However, the development of this LWWLLMP is the first comprehensive planning-level evaluation of the lake line system in Lake Washington. The lake line system is a critical component of the City's wastewater system infrastructure that serves approximately 1,900 parcels in the City and adjacent communities. This plan is intended to be a living document that will be updated at least every ten years as projects are completed, lessons learned from construction and maintenance are incorporated, additional data is collected, and condition assessments are performed.

7.2.1 Wastewater System Plan

The LWWLLMP will be incorporated as an appendix to the City's Wastewater System Plan at the time the System Plan is next updated. The current version of the system plan is the 2014 Wastewater System Plan, adopted by City Council via Resolution 8771 in July 2014; the King County Council adopted the plan via Ordinance 17968 in February 2015. The plan was approved by the Washington State Department of Ecology in May 2015.

7.2.2 Programmatic Environmental Impact Statement

As part of the LWWLLMP development process, the City prepared a non-project, or "programmatic" EIS. The programmatic EIS evaluated the environmental impacts associated with the four system alternatives to replace or repair the lake line system.

A non-project EIS was prepared because the LWWLLMP is not a specific project, but rather a series of potential future improvement strategies to proactively manage the lake line system. The EIS examined the broad plan-level issues related to the general location of alternatives and how combinations of improvements may collectively impact the environment. The programmatic EIS:

- Streamlines future environmental review process for individual project(s) through outlined potential impacts and considerations for effective project implementation.
- Ensures uniform mitigation strategies across LWWLLMP projects and predictable approval processes.
- Provides consistent guidance on permit requirements and upfront regulatory expectations.

The Draft EIS was published in April 2023. A public hearing on the Draft EIS was held on April 18, 2023, and the public comment period was open through May 8, 2023.

Public feedback collected through this process was used to refine criteria and weighting used for the selection of preferred system alternatives. The EIS was used as a basis for the environmental impacts and permitting factors, and applicable mitigation measures associated with each alternative. Refer to Section 7.6 for additional details about the public outreach process throughout the development of the LWWLLMP.

The Final EIS was published in June 2024 and is included as Appendix B.

7.3 City Administrative Actions

Before the City begins implementation of the service area plans, the City will need to modify and adopt policies to support the system alternatives and finalize a funding strategy for constructing the new systems in each service area.

7.3.1 Policy

As discussed in Chapter 4, the City needs to adopt policies to support the implementation of the upland, onshore, and in-water service area alternatives, as applicable. Much of the existing lake line system is a legacy system that was installed before the current adopted policies. Policy modifications or additions are required to support significant improvements or replacement of the lake line system with the preferred alternatives.

By having the foundational policies in place, the City can work towards systematically implementing the service area alternatives to transform the lake line system. A failure or delay in enacting the required supporting legal framework associated with the lake line alternatives, emergency repairs, and continued operation and maintenance makes the City more vulnerable to infrastructure failures over time.

7.3.1.1 Future Policy Project

The City is planning to conduct a follow-on project with a specific focus on implementing the necessary policy changed identified as part of the Plan development. It is anticipated that this project will begin in 2024.

7.3.2 Fiscal

Due to its inherent complexity, the lake line system represents a disproportionally higher construction, operation, and maintenance cost relative to a typical conveyance system.

Bellevue Utilities is currently entirely supported by rates and fees paid by Utilities customers. The cost estimates developed as part of the LWWLLMP are a significant step to plan and prepare for long term infrastructure renewal and replacement accurately and proactively. Due to the magnitude of the costs associated with the LWWLLMP, the City may need to consider alternate funding sources (grants, debt financing, non-rate revenues) to fully fund implementation.

The City can reasonably anticipate that costs of operation, maintenance, and emergency repairs of the lake line system are likely to increase over time. While the current strategy of spot-repairs and limited improvements has been manageable to date, the entire lake line system is of a relatively similar age, and a significant portion of the lake line system may reach the end of its functional lifespan in a relatively concentrated period if not systematically rehabilitated, replaced, or eliminated.

7.3.2.1 Future Financial Project

The City is also planning to conduct a follow-on project that will include a more detailed financial analysis, including potential special service districts, rate impacts, revisions to debt policies, and alternate funding strategies as described in Chapter 6. It is anticipated that this project will begin in 2024.

7.4 Service Area Plan Implementation

This section summarizes recommended improvements across the service areas in the near-term, medium term, and long-term planning periods. The sequence and timing of the improvements is likely to change as additional system condition data is collected and service area risk scores are reassessed. The section provides more details for near-term improvements and operational strategies to provide the City with a roadmap for implementations. Project milestones and general project activities are also outlined in this section.

7.4.1 Service Area System Alternative Implementation

The Plan recommends the City implement the system alternative for the lake line system in each service area in order of risk-based priority, as outlined in Chapter 5, where the highest risk service areas will be improved first for efficiency in system function, design, permitting, and outreach. Table 7.1 summarizes the capital alternative and implementation period, based on prioritization, for each service area.

Table 7.1 Service Area System Alternative and Priority

Priority	Service Area	System Alternative	Implementation Period
1	Meydenbauer Bay	Upland	Near-term
2	Newport South	Upland	Medium-term
3	Hunts Point and Yarrow Point	Onshore	
4	Killarney	Upland	
5	Evergreen Point	Onshore	
6	Medina South	Upland	Long-term

7.4.2 Service Area Plan Implementation by Planning Period

Only one service area, Meydenbauer Bay, has an implementation period for the capital alternative within the near-term; however, pump and flush station improvements, designation of emergency repair funds, and other system improvements, are recommended in the same term across all service areas. Table 7.2 summarizes the estimated costs by planning period for all projects in all service areas. Refer to Chapter 5 for a detailed breakdown of the costs. Note, all costs are shown in 2023 dollars and have not been escalated for future years.

Table 7.2 Summary of Implementation Costs by Planning Period

Project	Planning Period		
	Near-Term	Medium-Term	Long-Term
Pump and Flush Station Improvements(1)	$11,065,000	--	--
Emergency Repair Fund(1)	$37,768,000	--	--
Other System Improvements(1)			
Cleaning and CCTV Inspection	$14,742,000	--	--
Topographic Survey	--	$14,973,000	$4,620,000
Phased Coupon Collection	$990,000		
Meydenbauer Bay System Alternative (Upland)(2)	$197,200,000	--	--
Newport South System Alternative (Upland)(2)	--	$205,700,000	--
Hunts Point and Yarrow Point System Alternative (Onshore)(2)	--	$234,700,00	--
Killarney System Alternative (Upland)(2)	--	$174,800,000	--
Evergreen Point System Alternative (Onshore)(2)	--	$127,500,000	--
Medina South System Alternative (Upland)(2)	--	--	$199,800,000
Total	**$261,765,000**	**$757,673,000**	**$204,420,000**

Notes:
(1) Includes all service areas except Meydenbauer Bay, where the system alternative will be first implemented, and other immediate improvements are not proposed.
(2) Total Project Cost for system alternative; see Chapter 5 for detailed estimates, including low and high range.

7.4.3 Near-Term Implementation

To aid the City in implementing the recommended improvements in the LWWLLMP, Table 3 provides a detailed breakdown of activities in the near-term implementation, throughout a series of five steps. The implementation timing will be dependent on City resources, funding availability, and supporting policies. It is anticipated that these improvements are initiated within the next 10-year budget cycle. Table 7.3 includes general activities for implementing the Meydenbauer Bay system alternative since this service area is prioritized first as the highest risk.

Note the recommended timing for the proposed pump and flush station improvements in a service area does not follow the proposed implementation period for the service area that was based on the risk ranking of the overall service area. Per the 2015 MSA report, all pump and flush station improvements were due to be implemented by 2026; all remaining recommended improvements have been distributed across the near-term planning period. The proposed sequence for pump and flush station improvement is provided in order of the magnitude of recommended improvements, deficiencies occurring during the modeled 25-year storm, in addition to input from City Operations and Maintenance staff for stations with a history of performance deficiencies. These pump and flush station improvements are necessary to continue operation of the lake line system until the preferred system alternative for each service area is implemented.

Similarly, cleaning, inspection and pipe couponing projects have been split into phases so the City can complete these activities over the near-term planning period. Cleaning and inspection (hydro-jetting and CCTV inspection) is split into three phases; for the entire lake line system, this would consist of approximately 25,000 LF per phase, with associated access improvements required to facilitate cleaning. The City may wish to complete Phase 1 in a smaller section as a trial run, and implement any lessons learned into subsequent phases. For the pipe couponing, Phase 1 includes a total of 8 coupons at pipes that have been identified as high-risk; Phase 2 includes a total of 14 coupons, within all remaining reaches not included in Phase 1. Refer to Chapter 5 for additional details.

Table 7.3 Near-Term Implementation Plan

Category	Step 1	Step 2	Step 3	Step 4	Step 5
Meydenbauer Bay System Alternative (Upland)	▪ ROW, King County, Easement research. ▪ Public outreach.	▪ Scope and Qualifications.	▪ Alternatives and Conveyance System Analysis.	▪ Permitting, Preliminary and Final Design.	▪ Bidding and Construction.(1)
PS and FS Improvements(1)	▪ Evergreen Point PS and FS.	▪ Hunts Point and Yarrow Point PS and FS.	▪ Medina South PS and FS.	▪ Killarney PS and FS.	▪ Newport South PS and FS.
Cleaning and Inspection(1)	▪ Scope and Advertisement for Cleaning Project.	▪ Cleaning Project – Phase 1.	▪ Cleaning Project – Phase 2.	▪ Cleaning Project – Phase 3.	
Emergency Planning	▪ Develop Emergency Response Plan. ▪ Standard Details for Repair. ▪ Create Roster of Contractors for Repair. ▪ Procurement of Emergency Repair Materials.				
Data Collection		▪ Phase 1 Coupon.(1) ▪ Topographic and Utility Survey (Meydenbauer Bay).(1)(2)		▪ Phase 2 Coupon.(1)	
Management Plan	▪ Policy Project. ▪ Funding Project.				▪ Update LWWLLMP Including Area Priority.(3)
Ongoing Activities	▪ Routine PS and FS inspections. ▪ Overflow monitoring. ▪ Drainage complaint logging. ▪ Emergency repairs. ▪ Public outreach and education.				

Notes:
(1) Cost included in service area plan cost; see Chapter 5. All other activities in the implementation plan are assumed to be completed by City staff.
(2) Survey is identified as a separate activity as a critical first step for pre-design; however, the cost of this effort is included in the total project cost for the system alternative.
(3) LWWLLMP updates recommended every 10 years, minimum (or as significant new information becomes available).

7.4.4 Typical System Alternative Implementation

This section summarizes a suggested typical process to assist the City in implementing a system alternative in a given service area. It is anticipated that the implementation of a system alternative would occur by multiple projects or phases. Figure 7.1 illustrates the four typical major implementation milestones for an individual project:

Figure 7.1 Typical System Alternative Implementation Milestones

Table 7.4 outlines the typical actions associated with each milestone. In the initiation step, the project is defined, and the necessary data is collected. The pre-design milestone includes assessments, analyses, field data collection, and cost estimates to help refine the system alternative and project definition. The new system is designed, agreements are developed, property is acquired, and permitting is completed during the design step. Construction is the final milestone, where the system is built, the existing lake line system is abandoned, and lessons learned are documented for future lake line projects.

Table 7.4 Typical System Alternative Implementation Process

Milestone	Actions
Initiation	▪ Definition of initial project extents. ▪ Internal (City) data collection. ▪ Preparation of the RFQ or identification of on-call/roster contract suitability for pre-design and design. ▪ Business Case Analysis.[(1)] » Confirmation or re-selection of preferred system alternative(s), including construction method, using the City's MODA approach.
Pre-Design[1]	▪ Condition assessment. ▪ Field data collection (topographic survey, environmental assessments, geotechnical explorations, hydraulic grade line verification). ▪ Conveyance system/basin analysis and delineation of future system alternative projects within the service area. ▪ Hydraulic modeling. ▪ Evaluation for potential combination with other City Capital Investment Program Plan projects. ▪ Planning-level cost estimating. ▪ Public outreach.

Milestone	Actions
Design	▪ In-water, onshore, or upland system design. ▪ Franchise utility agreements. ▪ Inter-community agreements (Yarrow Point, Hunts Point, Medina). ▪ KCWTD agreements. ▪ Inter-departmental agreements (Bellevue Parks and Community Services). ▪ Temporary and permanent easement identification and acquisition. ▪ Property acquisition. ▪ Permitting. ▪ Project-level cost estimating. ▪ Public outreach.
Construction	▪ Advertisement, bid evaluation and award. ▪ Purchasing and procurement. ▪ Permit compliance and reporting. ▪ Operational testing. ▪ Training of City staff. ▪ SCADA integration. ▪ Start-up and transition to City staff. ▪ Record drawings and GIS updates. ▪ Abandonment of the existing lake line system, as applicable. ▪ Documentation of lessons learned for future lake line projects.

Notes:
(1) Pre-design action(s) may be required to inform MODA, to be completed by the City or an external consultant depending on qualifications and availability.
MODA - Multi-Objective Decision Analysis; RFQ - Request for Qualifications.

This is intended to provide a guide for implementation; the City can refine this process as necessary to comply with the City Utilities Project Management Manual and standards.

7.4.5 Coordination with Other Projects

The service areas comprise relatively large portions of the City. It is recommended that the City identify other planned improvements (transportation, other City utilities, major franchise utility projects) in the area to coordinate construction, permitting and restoration where feasible. In addition to potential cost savings for the City, this can help prevent construction fatigue for residents, workers, and the traveling public in project areas.

7.4.6 Advantages of Implementation

Implementation of the LWWLLMP will allow the City to:

- To be prepared for unexpected failures, by developing an emergency response plan and having a dedicated emergency repair fund;
- Gather additional data and renew individual assets to provide a more accurate remaining useful life, which could allow for a more gradual fundraising strategy and realistic project delivery approach;
- Use a programmatic approach, starting with the highest-risk area of Meydenbauer Bay, to develop a repeatable framework that can be applied to subsequent service areas.

7.5 Emergency Planning

Regular maintenance and monitoring of the existing lake line system is critical to ensure continued operation prior to implementation of the service area alternative. However, implementation of the service area plans may be constrained by the delivery capacity and funding availability of the City. Additionally, it is impossible to predict future failures of the lake line with certainty; the City should continue to prioritize resources and planning efforts for emergency repairs and continued operations.

This section includes recommendations to mitigate the impacts and burden of an emergency response, much of which can be completed in-house by City staff.

7.5.1 Emergency Repairs

There is significant risk associated with the delay of lake line system improvements. The City has experienced failures in the past and is likely to experience failures in the future due to the inherent risk and inaccessibility of the system. Mitigation requirements associated with expedited and emergency actions can be significantly higher than a planned action.

The threshold between what is considered repair or replacement is largely project-specific, and different regulatory agencies may have differing interpretations of these definitions. Regulatory agencies may consider the following when evaluating whether a proposed project is considered a repair or replacement to a section of lake line:

- Determining the percentage of the system being replaced, and setting a percentage threshold over which is considered replacement instead of maintenance.
- Examining the location of the system; repair if it remains in the same location (minor deviations may be permitted), replacement if not.
- Examining the purpose of the system; repair if it serves the same purpose (minor upgrades may be permitted), replacement if not.

The distinction between repair and replacement is likely to be the basis of the determination whether regulatory agencies allow replacement in-kind or require the implementation of a different system alternative (onshore or upland, if the existing is in-water).

7.5.2 Emergency Response Plan

The City recognizes the importance of a detailed emergency lake line repair response plan to mitigate the potential environmental and public health impacts associated with such incidents. The ability to swiftly address and rectify sewer overflows is key to maintaining the public's trust of the City as a public utility provider. Components of an emergency response plan should include:

- Roster of on-call contractors to perform repairs without delay of advertisement process, if unable to be performed by City crews.
  - May include specialty contractors such as certified divers and marine construction.
- Agency notification requirements and protocol.
- Resident notification text/materials and protocol.

- Procurement of common materials to perform repairs.
  - Specialty/custom repair clamps specific to lake line pipe.
  - Containment equipment.
- Adequate supply of temporary generators and replacement pumps/parts for power and pump failures.

Having a robust emergency lake line repair plan in place is essential to minimize potential loss of service and environmental damage. This plan should be prepared by the City, or by a qualified consultant.

7.5.3 Standard Details

The City currently has three standard details for the lake line, included in the 2023 Sewer Engineering Standards:

- S-23: Lake Line Cleanout and Check Valve Assembly Installation.
- S-24: Lake Line Cleanout and Check valve Assembly Installation at or Below Hydraulic Gradient.
- S-25: Cleanout to Grade for Lake Line Connection.

These details are applicable to the continued function or construction of a replacement in-kind system. It is recommended that the City develop additional standard details applicable to the abandonment, emergency repair/replacement, and construction of the replacement system. Development of standard details, particularly if done in collaboration with applicable regulatory agencies, could increase efficiency of planned and unplanned repairs or replacement. Recommended standard details or procedures include:

- Abandonment:
  - Abandonment of flush station intake.
  - Abandonment of in-water lake line pipe.
  - Removal of in-water lake line pipe (if abandonment presents hazard) and associated restoration.
- In-Water (existing, or system alternative):
  - Typical in-water lake line repair.
  - Typical in-water trenching detail.
- Onshore (existing, or system alternative):
  - Typical onshore lake line repair.
  - Typical onshore trenching detail.
- Upland (system alternative)
  - Typical grinder pump installation.

7.5.4 Standard Operating Procedures

It is recommended that the City complete a review of all existing Standard Operating Procedures (SOP) associated with the lake line system and update to current practices. Any procedures that are currently undocumented should be formalized to ensure continuity throughout Operations and Maintenance staffing transitions.

7.6 Outreach and Education

Community input is a critical part of Bellevue Utilities' commitment to Informed Consent. The goals and guidelines of Informed Consent were implemented throughout the development of the LWWLLMP to provide clear communication about the project and to solicit public input through a variety of outreach channels.

7.6.1 Community Outreach During LWWLLMP Development

Community outreach was an important component of the LWWLLMP development. Outreach activities included project briefings, a virtual public meeting, in-person pop-up events, mailed postcards, online open houses, a community survey, newsletter articles, social media posts, website updates, and project posters distributed in the community. Goals of community engagement were to:

- Build and maintain public support by sharing how the project will benefit the community.
- Raise awareness of the importance of Lake Washington lake line, as well as the needs, challenges and impacts for lake line rehabilitation and/or replacement.
- Communicate the repercussions to the community and Lake Washington if no action is taken to rehabilitate and/or replace the aging lake line.
- Lay a groundwork and develop strong community relationships for future improvement projects that could include planning, design, and construction phases.
- Identify the needs of audiences directly affected by lake line rehabilitation or replacement.
- Share information early and often to ensure transparency and prevent surprises.
- Provide opportunities for public input during key steps of the project and incorporate audience feedback into project decisions.

Key themes of the community feedback from the above outreach activities were:

- When asked about the most important consequences to consider in the event of a lake line failure, community members ranked the consequences (from most to least important) as 1) the risk to the environment, 2) the difficulty of repair or replacement of a lake line, and 3) the number of customers impacted. These themes were repeated in comments received throughout the project.
- When asked about the most important evaluation factors for alternative selection, community members ranked impacts to land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important. This echoes the themes mentioned above.
- Some people shared a desire to maintain Lake Washington's water quality and to protect native habitat. Additionally, people expressed a desire to implement a long-term and sustainable solution so that service can continue to be provided for years to come without further impacts to Lake Washington. Lastly, people expressed concerns over the cost of the maintenance of the lake lines, but consistently encouraged the project team to prioritize the impacts to the community members over the cost of the project.
- Bellevue Utilities learned that most people engaging with this project lived, worked, or played in the Meydenbauer Bay or Medina South service areas. The team also learned that most people preferred

that Bellevue Utilities keeps them informed about this project via emails, postcards, and It's Your City articles.

- Many customers of the lake line system, including those with City infrastructure on or adjacent to their property, are unaware of the extents, ownership, and associated potential impacts associated with maintenance, repair, or replacement of the system. The foundational educational materials used in Lake line 101 will be important to reiterate throughout the implementation of the subsequent projects.

7.6.2 Future Outreach Opportunities

As Bellevue Utilities begins implementation of the LWWLLMP, there are opportunities for continued community outreach to provide transparent communication about the project's next steps ahead of construction. Ongoing engagement and information sharing throughout the implementation of the policy changes, data collection, project design, and construction, is critical to its success. Opportunities for continued community outreach include those summarized in Table 7.5.

Table 7.5 Potential Outreach Tools for Implementation Activities

Implementation Activity	Potential Outreach Tools
Policy Evaluations or Modifications	▪ Email update about next steps. ▪ Engage neighborhood organizations and CBOs. ▪ Website update on completed plan and next steps. ▪ Briefings to local jurisdictions about completed plan and next steps.
Data Collection	▪ Email update to keep community informed on project progress.
Funding	▪ Email update. ▪ Print notifications to ratepayers on expected project funding sources (IYC articles, postcards, etc.)
Pre-Design and Design	▪ Email updates about pre-design and design. ▪ Website update to share anticipated project timeline(s) for pre-design, design, and construction. ▪ Social media posts. ▪ Engage schools, neighborhood organizations, and CBOs. ▪ Briefings to local jurisdictions. ▪ Tabling at local events. ▪ Community and stakeholder surveys and requests for input.
Construction	▪ Email update about the start of construction. ▪ Website update. ▪ Online open house to share construction details. ▪ Pre-construction open house and/or "meet the contractor" events. ▪ Social media posts. ▪ Engage schools, neighborhood associations, and CBOs. ▪ Postcard (and other print notifications) to inform residents of major construction impacts. ▪ Continue tabling at local events throughout construction to keep the public informed on project progress.

Notes:
CBO - Community Based Organization; IYC - "It's Your City" Bellevue Newsletter.

7.6.3 Other Stakeholders

In addition to the public and local community members and groups, implementation of the plan should be communicated and coordinated with other stakeholders and public agencies. This includes (but is not limited to):

- Towns of Beaux Arts Village, Hunts Point.
- Cities of Clyde Hill, Medina, Newcastle, Yarrow Point.
- King County.
- USACE.
- Washington State Departments of Ecology, Archaeology and Historical Preservation, Natural Resources, Fish and Wildlife, Transportation.
- Muckleshoot Indian Tribe, Tulalip Tribes of Washington, Suquamish Tribes, Stillaguamish Tribe of Indians, Squaxin Island Tribe, and Snoqualmie Indian Tribe.

7.7 Applicability to Lake Sammamish

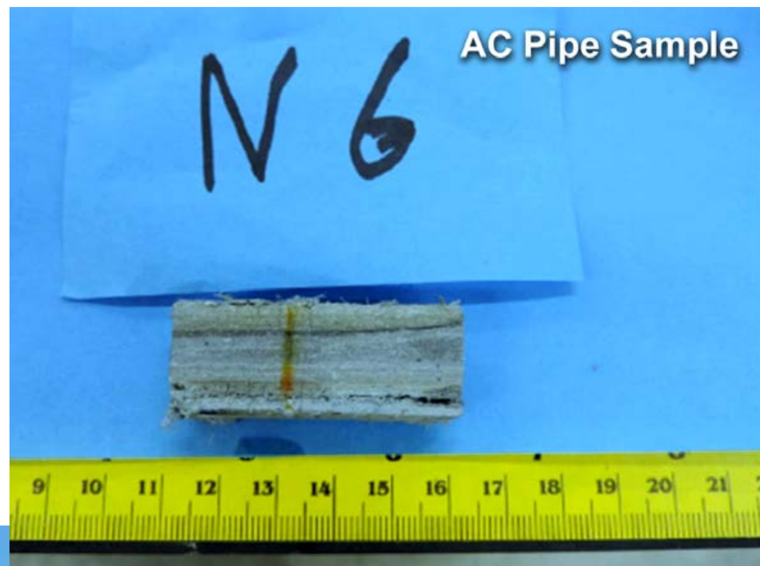
The development of the LWWLLMP is specific to the Lake Washington system, which was prioritized due to the age and material of the lake lines. The City also has approximately 4.1 miles of lake line in or along Lake Sammamish. The Lake Washington lake lines were mostly installed in the 1950s, and primarily include asbestos cement and cast-iron pipe; whereas the Lake Sammamish lake lines were installed in the 1960s and are primarily cast and ductile iron. Given that the Lake Sammamish system is of roughly similar age and material to the Lake Washington system, many of the conclusions of this LWWLLMP should be considered and implemented for the Lake Sammamish system.

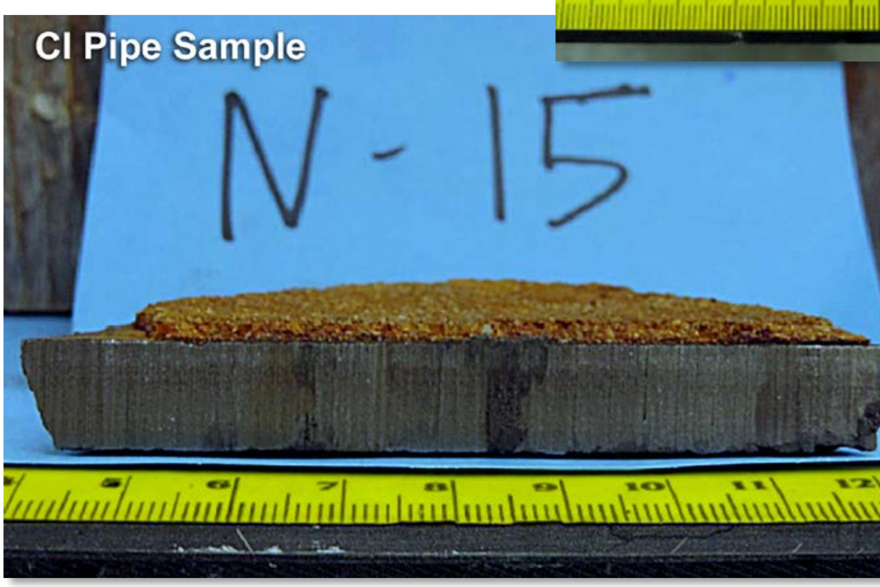
7.8 Future of the Plan

The purpose of the LWWLLMP is to provide an overarching guiding document for managing the lake line system, similar to the Wastewater System Plan, Water System Plan, or Emergency Water Supply Master Plan. It is intended to be a living document that will change as additional data is collected, future studies and analysis are completed, City budget priorities evolve, and changing permitting regulations. As such, the implementation of a typical service area plan will require future analysis at a more project-focused level. It is recommended that the LWWLLMP is updated at a minimum of every 10 years (or as significant new information becomes available), in conjunction with the Wastewater System Plan as described in Section 7.2.

APPENDIX A PREVIOUS LAKE LINE SYSTEM STUDIES

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington





TETRA TECH

December 2016

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

December 2016

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DEFINITION OF TERMS

Term	Definition
AC	Asbestos cement
CI	Cast iron
City	City of Bellevue
Project team	Consultant team consisting of Tetra Tech, BHC Consultants, The Watershed Company, Confluence Environmental Company, Buno Construction, Ballard Marine Construction, and Norton Corrosion Limited.
DI	Ductile iron
GIS	Geographic information system
GPS	Global positioning system

EXECUTIVE SUMMARY

The City of Bellevue is evaluating the condition of a 14.4-mile-long sewer system along the Lake Washington shoreline that serves lakefront properties and upstream tributary areas in Yarrow Point, Hunts Point, Beaux Arts, Bellevue, Medina, and a portion of unincorporated King County (see Figure ES-1).

Figure ES-1. Lake Line Sewer System

This lake line sewer, built in the 1950s and 1960s, is predominantly 8-inch-diameter pipe constructed of asbestos cement (AC) or cast iron (CI) with a cement-mortar lining. It is shallow-buried and generally runs along the shoreline in shallow water (typically less than 5 feet deep) or on-shore outside the lake. Some portions of the pipe in the lake have become exposed on the lake bottom. Over the years, homeowners have constructed docks, bulkheads, walls, patios and other improvements over the pipe in some places. This has made the sewer line more difficult to access and maintain. Concerns about age of the pipe, difficulty in accessing the pipe for maintenance and regular cleaning, and recent failures have prompted the City to evaluate the current condition of the pipe.

Tetra Tech and associated firms worked with the City to complete Phase 1 of a lake line condition assessment in 2013. The work included collecting samples of the pipeline (called “coupons”) for analysis of their condition. Phase 2, completed in 2016, collected an additional 19 coupons from the pipe in five upland and 14 in-water locations. The coupons were analyzed to determine the pipe’s condition and set priorities for replacement. Approximate locations are shown on Figure ES-1.

A report has been prepared summarizing the findings of both phases. It presents findings and offers recommendations for a future alternatives evaluation and lake line improvement plan. The report describes the test methods used and the existing pipe conditions and deficiencies found. A ranking system is presented for organizing the lake line system and prioritizing pipe replacement or rehabilitation projects.

PROCEDURES FOR COLLECTING AND ANALYZING COUPONS

Coupon Collection

For each Phase 2 in-water sample location, a turbidity curtain was set up around the work area to contain silt. The lake bottom sediment was then hydraulically jetted off the pipe. For the upland sample locations, the sewer line was excavated primarily by machine, with some hand excavation. For all sample locations, upon accessing the top of pipe, an initial physical evaluation was made to ensure that the pipe was fit to be core-drilled. The City then temporarily shut down upstream stations, as necessary, to reduce flow in the pipe. The pipe sample coupon was cut from the top of the pipe with a 4-inch-diameter hole saw. Once the coupon was removed, a pipe repair sleeve was slid over the hole and bolted to seal the pipe. Property restoration for the upland locations consisted of backfill with native soils, and then restoration of surface conditions to match pre-work conditions. Restoration for the in-water locations consisted of grading soils in the vicinity of the repair band with native materials to approximately match pre-work conditions.

Pipe Coupon Analysis

Phase 2 laboratory analysis of the pipe coupons determined the condition of the pipe in each reach and allowed projections of the pipeline's remaining service life. The analyses performed included the following:

- Asbestos cement pipe coupons:
  - Microscopic visual examination
  - Wall thickness measurement
  - Measurement of surface hardness and scratch hardness
  - Chemical analysis
  - pH indicator staining
  - Estimate of remaining pipe service life

- Cast iron pipe coupons:
  - Microscopic visual examination
  - Wall thickness measurement
  - Impact test
  - Hardness test
  - Chemical testing
  - Examination of interior cement mortar lining
  - Estimate of remaining pipe service life.

The Phase 1 analyses and collected data differ somewhat from those performed for Phase 2, but there are sufficient similarities to allow a comparison and prioritization across the entire lake line system.

PIPE CONDITION FINDINGS

AC Pipe

AC pipe contains calcium, which makes it hard. This type of pipe deteriorates over time as contact with acidic wastewater or soil causes the calcium to leach from the material, leaving behind a layer of softer, weaker asbestos. The amount of deterioration is measured by a test in which a chemical called phenolphthalein is applied to the collected pipe wall sample. The chemical stains the middle layer of the pipe wall, where calcium remains. The unstained interior and exterior layers of the sample indicate where contact with acid in the wastewater or in the soil has resulted in the loss of calcium. The thickness of each layer is measured to determine the overall amount of deterioration. Based on the Phase 2 measurements, AC pipe generally showed both interior and exterior acid attack, leading to a total deterioration of 34 to 66 percent of the pipe wall thickness. The seven samples tested represent a small percentage of the piping system overall, and the condition of the remaining AC pipe is unknown.

Sample N6, collected along the northeastern shore of Medina, was the most severely impacted sample, with deterioration of 66 percent of the wall thickness. The inside layer of the pipe at this sample appeared to be in worse shape than the outside layer, although both showed deterioration. The interior surface had experienced delamination. This portion of the pipe wall can be expected to have a significantly reduced strength.

The AC pipe ranges from 51 to 57 years in age. Its remaining useful service life is dependent on the loading and the environment the pipe is exposed to. According to an article in Public Works magazine and other publications, the typical service life of AC pipe is 40 to 60 years for wastewater service. Research undertaken by the Alameda County Water District in California's San Francisco Bay Area projects a service life of 70 to 80 years for AC pipe used for water distribution. Water pipes are usually subject to less internal corrosion than wastewater pipes but much higher pressures. The Alameda County Water District considers six to 10 leaks per mile over the life of the pipe to be acceptable, but this is not a suitable standard for a wastewater collection system.

Since the AC pipe is approaching its normal service life, and testing has documented significant deterioration, near-term planning for systematic replacement should be conducted before failures occur. Normal operating pressures in the lake line are minimal, so failure may not be imminent, but the deterioration seen represents a significant decrease in the factor of safety.

CI Pipe

For the CI pipe, the condition of the cement mortar lining was examined as well as that of the metal. The cement mortar lining protects the cast iron until its pH is degraded to less than 7, which indicates an acidic condition. At that point, the liner no longer provides effective protection, and corrosion of the cast iron begins. The lower the pH at the metal surface, the more aggressive the rate of corrosion. Interior corrosion also initiates when the interior liner is compromised, and as the liner continues to deteriorate, the corrosion rate increases toward that of bare metal. The point at which the liner will become compromised cannot be predicted in advance.

The samples tested show all phases of liner deterioration, from intact with a high pH, to intact with a low pH, to cracked, deteriorated or removed from the metal surface. The liner continues to be effective in only 8 percent of the coupons examined, so the liner may be reaching its expected service life for this application. Coupons N16 and N17 near the south end of the system had no liner, yet the rate of corrosion over their 50-year lifespan has not been enough to compromise the integrity of the pipe. On samples where the liner was intact and had a pH of 7 or higher, there was essentially no corrosion on the inside of the pipe. Corrosion rates are not linear over time, and it is likely that future rates of interior corrosion will increase from those measured in this study.

Sample N15, collected along the Bellevue shoreline north of Beaux Arts, had an exterior pit 0.098 inches deep. This is the deepest pit found in the coupons analyzed and represents a 23.5-percent wall loss. Some coupons had no wall loss. However, the quantity of samples is small and the possibility that there is more extensive external pitting and corrosion exists. In addition, this estimate does not account for the interior corrosion occurring at the same time as the exterior corrosion. The pipe can be considered to have lost its factor of safety against rupture at 50-percent wall loss, although embrittlement and loss of metal toughness can also compromise its strength.

Cast iron pipe normally has a service life of 100 to 150 years. It will last longest where flowing full, so that there is no air in the headspace. At this time, none of the CI pipes have lost enough wall thickness to indicate likely failure in the near term. A long-term planning horizon with monitoring of pipes with the highest levels of corrosion is appropriate for these pipes.

PRIORITIZATION

The City of Bellevue wants to maintain the integrity of its lake line sewer by timely replacement of portions that may be in danger of failing. As part of this study, individual reaches of the lake line system represented by each sampled coupon were prioritized based on the consequence of failure and the probability of failure. The consequence of failure was rated with a numerical score based on the length and location of the reach, the number of services connected to it, its accessibility for maintenance, its suitability for bypass pumping during repair, and its proximity to public places where failure of the pipe would expose people to the spilled wastewater. Probability of failure was rated with a numerical score based on location, burial depth, material, remaining life and history of failures or repairs.

“Risk” was defined as the consequence-of-failure score times the probability-of-failure score. Reaches with the highest risk were assigned the highest priority for replacement or repair. Reaches with the same score received the same priority. The final ranking is shown in Table ES-1. Generally, the AC pipe received a higher priority than the CI pipe.

Table ES-1. Priority Ranking

Priority Rank	Coupon Associated with Reach	Pipe Material
1	N12	AC
2	N11	AC
3	EC19	AC
4	EC17	AC
5	N15	CI
6	EC101, N5	AC
7	EC6	CI
8	N6, N14	AC
9	N1	AC
10	EC21	DI
11	N17, N18	CI
12	N16	CI
13	N9, N4	CI
14	N8 N2, N3, N21	AC CI
15	EC16, EC8 EC20	CI DI
16	N19	CI
17	EC12, EC14	CI
18	N10, N13	CI

Note: AC = asbestos cement; CI = cast iron; DI = ductile iron

RECOMMENDATIONS FOR FUTURE WORK

One way to address the identified priorities is to begin to develop a replacement strategy for the AC pipe. The two CI pipes with a higher level of deterioration can be scheduled for another assessment in 10 years to see if their deterioration has accelerated. Depending on the results, the remaining pipes can be further evaluated at that time or put on hold pending further developments. By continuing to track any failures or repairs on these lines, it may be possible to identify reaches that are deteriorating faster than others. The City plans to start reviewing replacement strategies in 2017.

1. INTRODUCTION

The City of Bellevue has initiated an evaluation of the sewer system in and directly adjacent to the Lake Washington shoreline. This lake line system provides service to lakefront properties and upstream tributary basins in the towns of Yarrow Point, Hunts Point and Beaux Arts, the cities of Bellevue and Medina, and a portion of unincorporated King County south Bellevue. Figure 1-1 shows the approximate location of the lake line.

The 14.4-mile-long lake line sewer was built in the 1950s and 1960s. It is predominantly 8-inch-diameter piping constructed of asbestos cement (AC) or cast iron (CI) with a cement mortar lining. A few short sections consist of ductile iron (DI) pipe, PVC, concrete pipe, vitrified clay pipe, or pipe of an unknown material. The shallow buried pipe generally runs along the shoreline in shallow water or on-shore outside the lake. Pipes in the lake are entirely submerged, typically in water less than 5 feet deep. Some portions of the piping system have become exposed on the lake bottom. Over the years, homeowners have constructed docks, bulkheads, walls, patios and other improvements over the pipe and cleanouts in some places. This has made the sewer line difficult to access and maintain. Concerns about age of the pipe, difficulty in accessing the pipe for maintenance and regular cleaning, and recent failures have prompted the City to evaluate the current condition of the pipe.

Tetra Tech, BHC Consultants, and others worked with the City to complete a Sewer Lake Line Condition Assessment, Phase 1 in 2013. Phase 2 of the assessment, completed in 2016, collected an additional 20 samples (called coupons) from the pipe in upland and in-water locations. The coupons were analyzed to determine the pipe's condition and to set priorities for replacement. Work elements for Phase 2 included the following:

- **Pipe Sample Coupon Location Exhibits—**Project team members, in collaboration with the City, identified coupon collection locations that would provide a representative sampling throughout the lake line system. These included upland and in-water sites for each type of pipe, distributed along the length of the lake line. The project team then produced geographic information system (GIS) maps of the lake line, indicating pipe material and proposed coupon collection sites. Team members reviewed individual aerial photos of each site, with the pipe location shown from the City's GIS system, to help determine the best collection sites.
- **Permitting—**The project team used the pipe sample location exhibits, work plans, critical area maps, and environmental information to support the City-led environmental review process and obtain all needed permits from local jurisdictions and state and federal agencies.
- **Pipe Coupon Collection—**The City staked and photographed each collection site and took global positioning system (GPS) coordinates to help locate the sites, particularly from the water. City staff obtained rights of entry from the owners of upland properties with collection sites. The project team collected coupons from the upland and in-water sites and analyzed the coupons to assess condition.
- **Documentation—**A report was prepared to summarize the condition assessment work.

This report is the documentation of the work completed by the Tetra Tech project team for the Phase 2 condition assessment. It presents findings and prioritization rankings from Phase 1 and Phase 2 work. The report also offers recommendations for a future alternatives evaluation and lake line improvement plan. The report describes the test methods used and the existing pipe conditions and deficiencies found. A ranking system is presented for organizing the lake line system and prioritizing pipe replacement or rehabilitation projects. The results of the Phase 1 and Phase 2 condition assessments provide valuable data for the City's ongoing management of the assets that make up the lake line system.

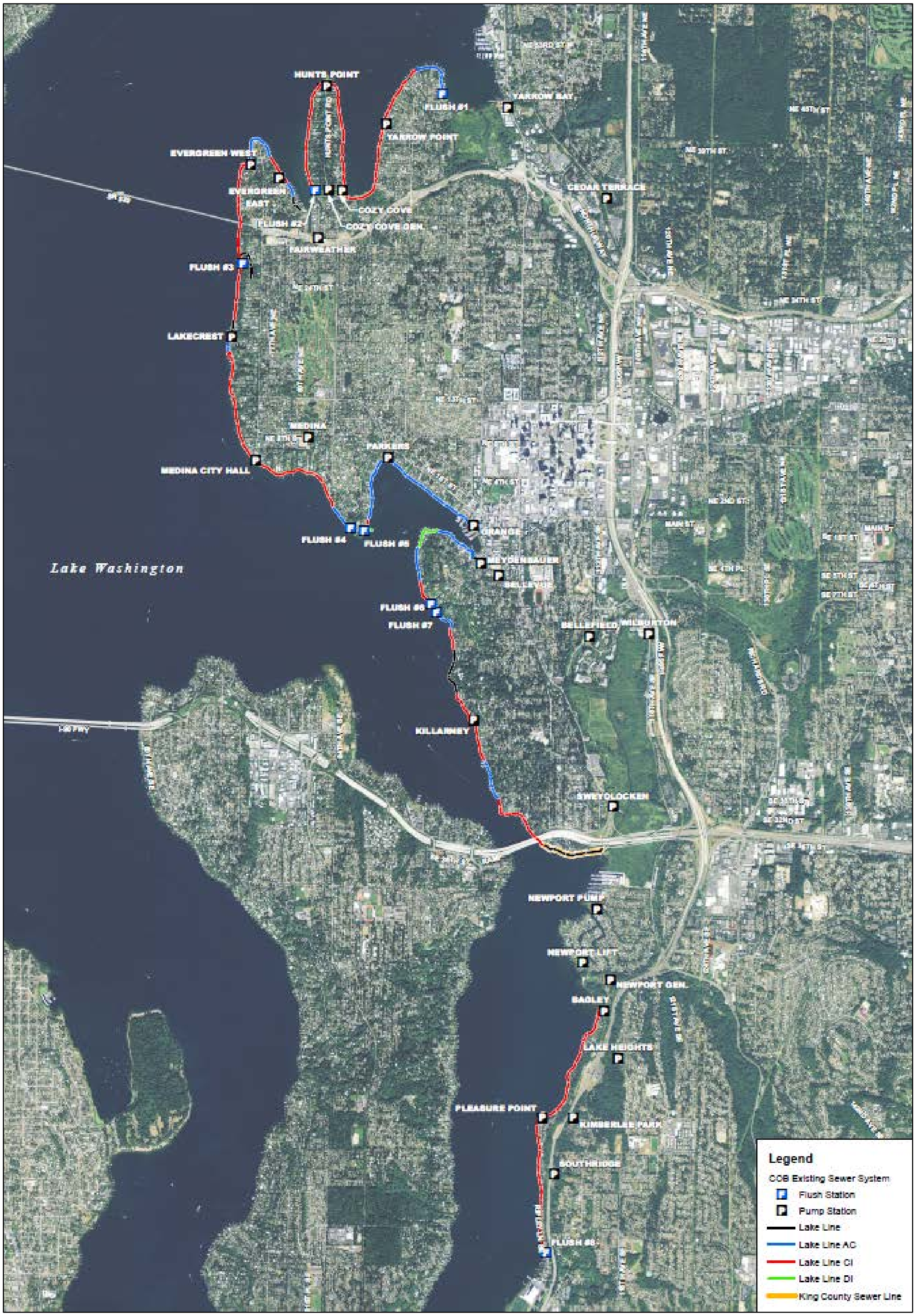


Figure 1-1. Lake Line Sewer System

2. Description of Work Performed

COUPON COLLECTION LOCATION SELECTION AND MAPPING

The project team used GIS mapping developed during Phase 1 of the condition assessment to divide the lake line into reaches between flush stations and/or pump stations. The mapping identified Phase 1 coupon collection locations, jurisdictions, parcel boundaries, and lake line pipe material as follows:

- Asbestos cement (AC)
- Cast iron (CI)
- Ductile iron (DI)
- Concrete
- Polyvinyl chloride
- Vitrified clay
- Unknown.

The project team proposed coupon collection locations for Phase 2 that would provide representative sampling throughout the lake line piping system. Proposed locations included in-water and upland pipe sections. Only AC and CI pipes were considered for sampling; other pipe materials make up a very small portion of the lake line and are assumed to be in better condition because they were installed as part of more recent repairs. The reaches from which 10 coupons were collected during Phase 1 were not considered for further sampling in Phase 2. City staff and consultants reviewed the mapping and proposed locations at a workshop and identified five upland and 14 in-water locations for Phase 2 coupon collection.

The project team prepared a pipe coupon location exhibit mapping the selected collection sites. The exhibit consisted of GIS mapping and aerial photos. Individual aerial photos of each location were marked to show an outline of the parcel at the collection site, the location and material of the lake line based on GIS data, and the proposed collection spot. The exhibit was then used as an attachment for permit applications, in field verification of the proposed locations prior to the coupon collection effort, and for City public relations efforts related to the project.

After completion of the coupon collection, the exhibit was revised to reflect the actual collection locations based on GPS coordinates. At each site, the difference between the GPS-measured location of the lake line and the location shown on the City's GIS mapping is apparent. The pipe coupon location exhibit is in Appendix A.

PERMITTING

The project team prepared permit applications and coordinated with the regulatory agencies for the required upland and in-water permits. Coupon sampling occurred in the City of Medina, the Town of Hunts Point, and the Town of Yarrow Point, in addition to the City of Bellevue. Local permits included critical areas land use permits, shoreline exemption permits, clearing and grading permits, and a construction stormwater pollution prevention plan.

State and federal permit requirements included a Joint Aquatic Resource Permit Application, a Biological Evaluation, a Hydraulic Project Approval from the Washington Department of Fish and Wildlife, a Clean Water Act Section 404 Nationwide Permit 12 from the U.S. Army Corps of Engineers, a Rivers and Harbors Act Section 10 Letter of Permission from the U.S. Army Corps of Engineers, a Clean Water Act Section 401 Nationwide Permit 12, an Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, and Coastal Zone Management Act compliance from Washington's Department of Ecology.

The project team developed a permit submittal package and associated exhibits for each jurisdiction. The City of Bellevue Utilities was the permit applicant and wrote the State Environmental Policy Act checklist, and the City's Development Services conducted an environmental review process, including review and coordination for all jurisdictions.

COUPON COLLECTION COORDINATION

City of Bellevue staff used the pipe coupon location exhibit and as-built drawings to field-locate and stake every collection site. They took GPS coordinates and photographs to aid in finding the collection sites later. The project team visited each site to document conditions as part of the permit application process. During this process, some upland locations were found to be inaccessible, and one location that GIS mapping showed to be in-water was found to be on land.

The City conducted public relations and obtained rights-of-entry for work on upland locations. Some property owners declined to allow work on their property. In some cases, the pipe could not be found or was too close to a rock wall for safe excavation. In these cases, the collection site was moved to a different property. In a few cases, the pipe material was found to be different from that shown on the GIS map. In one case, the pipe was found to be a different diameter (10-inch instead of 8-inch). All changes were recorded in a summary coupon data table, which is included in Appendix B. Daily reports of coupon collection activities are included in Appendix C. The pipe coupon location exhibit was updated at the completion of the upland collection work and again at the completion of the in-water collection work.

Mobilization scheduling and coordination were planned during meetings held while waiting for the permits to be approved. The coupon collection contractors provided two weeks' notice to the City to notify homeowners and then two days' notice for a final contact prior to collecting coupons. They also provided the City with daily status reports.

The project team assembled a contact list for coordination between the work crew and City staff. A damaged pipe contingency plan was also developed to integrate project team and City responses in case of a pipeline emergency. This included advance purchase of pipe repair clamps, transition couplings, pipe, and other supplies to be on hand when the coupons were being collected. To minimize the risk of leaked sewage and interference with the City's conveyance facilities, communication was maintained between City personnel and the project team's on-site observer for temporary shutdown of pumping systems during the cutting of pipe coupons.

COUPON COLLECTION

Upland Pipe

Buno Construction mobilized by land to the upland addresses and coordinates provided in the summary coupon data table and pipe coupon location exhibit. The sewer line was excavated by machine and hand as required to avoid damaging the pipeline. Upon reaching the top of pipe, an initial physical evaluation was made to ensure that the pipe was sound and fit to be core-drilled. Once the existing pipe was fully accessible, the outside diameter was hand measured so the proper size pipe repair clamp could be prepared for use. The contractor installed the pipe repair sleeve over the pipe and slid it to one side to expose the area to be core-drilled. The City was then called to temporarily shut down upstream stations to reduce flow in the pipe. The pipe sample coupon was cut from the top of the pipe with a 4-inch-diameter hole saw. Once the coupon was removed, the pipe repair sleeve was immediately slid over the hole and bolted to seal the pipe. Property restoration consisted of backfill with native soils, and then restoration of surface conditions to match pre-work conditions.

The project team's on-site observer brushed any debris off the 4-inch diameter pipe sample coupon, rinsed it with distilled water, double zip-lock bagged it, and labeled it in the field. Photographs of each sample were taken in the field to establish pre-shipping condition. The double-bagged samples were then put in protective packaging and delivered to the material testing laboratory. The on-site observer recorded the longitude and latitude of the final coupon location using a hand-held GPS measurement device with a 1-meter or better accuracy. Daily reports and photographs of the field work are included in Appendix C.

In-Water Pipe

Ballard Marine Construction mobilized by boat to the in-water coordinates provided in the summary coupon data table and pipe coupon location exhibit. Upon finding each site, a turbidity silt curtain was set up and lake bottom sediment was hydraulically jetted off the pipe. Project team staff performed turbidity sampling outside the silt curtain during pipe coupon collection to monitor permit compliance. The curtains were adjusted as needed for compliance. In some locations, soil conditions required the use of two turbidity curtains, one surrounding the other. In some instances, the curtains were left up overnight to allow the turbidity to settle.

Upon accessing the top of pipe, an initial physical evaluation was made to ensure that the pipe was sound and fit to be core-drilled. Once the pipe was fully accessible, the outside diameter was hand measured so the proper size pipe repair clamp could be prepared for use. The contractor installed the pipe repair sleeve over the pipe and slid it to one side to expose the area to be core-drilled. The City was then called to temporarily shut down upstream stations to reduce flow in the pipe. The pipe sample coupon was cut from the top of the pipe with a 4-inch-diameter hole saw. Once the coupon was removed, the pipe repair sleeve was immediately slid over the hole and bolted to seal the pipe.

Restoration consisted of grading soils in the vicinity of the repair band with native materials to approximately match pre-work conditions. No material was imported for restoration or pipe covering. The on-site observer recorded the longitude and latitude of the final coupon location using a hand-held GPS measurement device with a 1-meter or better accuracy. Daily reports and photographs of the field work are included in Appendix C along with a summary of the field reports.

PIPE COUPON ANALYSIS

Norton Corrosion Limited and its laboratory, Simon Forensic, analyzed the pipe coupons to determine the condition of the pipe in each reach and to make a projection of the remaining service life in various sections of the pipeline. The analyses performed included the following:

- Asbestos Cement Pipe Coupons
    - **Visual examination aided by low power stereomicroscopy**—Documentation of pipe condition and extent of corrosion/wall loss as an indication of condition
    - **Point micrometer wall thickness dimensional measurement**—Measurement of pipe wall cross section as an indication of degradation from original thickness
    - **Measurement of surface hardness and scratch hardness tests**—Evaluation of pipe integrity as an indication of condition

  - **Cross section chemical analysis (pH, Al, Ca, Fe, Mg, S, Si)—**Documentation of apparent competent wall cross sections as baseline, compared to apparent degraded wall cross sections, as an indication of condition and extent of cement mortar leaching
  - **Phenolphthalein indicator staining**—Thickness measurement of calcium, in the form of lime, through cross section of the pipe wall as an indication of degradation due to acid attack and evaluation of gross leaching of cement mortar
  - **Estimate of remaining pipe service life—**Based on best judgment from the analysis data and calculations using pipe failure history.

- Cast Iron Pipe Coupons

  - **Visual examination aided by low power stereomicroscopy—**Documentation of pipe condition and extent of corrosion/wall loss as an Indication of condition and cast iron graphitization
  - **Point micrometer wall thickness dimensional measurement—**Measurement of pipe wall cross section as an indication of degradation from original thickness
  - **Charpy impact test—**Evaluation of pipe integrity and toughness for an indication of condition and remaining ductility
  - **Brinell hardness test—**Indication of pipe hardness
  - **Chemical testing (C, Cr, Cu, Mg, Mn, Mo, Ni, P, Si, S, Ti, V)—**Documentation of apparent competent wall cross section as baseline, compared to apparent degraded wall cross sections as an indication of condition
  - **Petrographic examination of interior cement mortar lining—**Thickness measurement and lining evaluation as an indication of degradation of mortar lining due to acid attack
  - **Estimate of remaining pipe service life**—Based on best judgment from the analysis data and calculations using pipe failure history.

The results of these analyses were provided in a report that is attached as Appendix D.

3. Final Coupon Collection Locations

Maps of the lake line with both the Phase 1 and Phase 2 coupon locations are provided in Figure 3-1 through Figure 3-8. Pipe lengths and the number of service connections in each reach are listed in Table 3-1. Table 3-2 provides information on the locations of coupons collected during Phase 2. Table 3-3 provides information on the location of coupons collected during Phase 1. In the tables and on the maps, N signifies new coupons collected during Phase 2, and EC signifies existing coupons collected during Phase 1. NR signifies a coupon location that was considered but not recommended, so no coupon was taken.

The maps include colored land areas to represent the jurisdictions of Yarrow Point, Hunts Point, Medina, and Bellevue. They include roads and sewer lines, including the lake line. The flush stations and pump stations on the lake line are indicted by a symbol as shown in the Legend.

The colored highlighting on the maps signifies each reach of pipe on the lake line, generally between flush stations and pump stations. Each reach was given a name as shown in a rectangular box with an arrow pointing to the highlighted color. Gray arrows indicate the direction of flow. The pipe material is indicated by the color of the dashed lines, as shown in the Legend.

Note that the pipe material shown on the maps is incorrect in some locations. The mapping was based on GIS data and contained some inconsistencies in material and location. Two of the coupons collected (N6 and N10) were made of different material than shown on the maps. The Summary Coupon Data Table (Appendix B) indicates the difference between the mapped pipe material and the material found in the field. The tables throughout the report use the best available information. Where there is a difference between a table and the maps, the table should take precedence. The maps were not changed based on the coupon material because the extent of the change was not known. Coupons EC20 and EC21, collected in Phase 1, were found to be CI but Figure 3-4 identifies that section of the lake line to be made of AC pipe. Table 6 from the Phase 1 Report identified the pipe material for these coupons as DI. After the sampling, they were referred to as CI.

Figure 3-9 provides information on each reach. The reach name is highlighted in the same color as on the maps. The number of parcels adjacent to each reach is listed. The total pipe length for the reach is indicated along with the length of the reach composed of each of the materials shown. Coupons collected for each reach are identified on the same row as the material the pipe was made of. The estimated number of service connections to the pipe associated with each coupon is identified.

For example, the first reach of the lake line on Figure 3-1 is highlighted in green and is identified as the Flush #1 to Yarrow Pt PS reach. On the map, you can see that it is composed of AC pipe, unknown pipe, and cast iron pipe. In Figure 3-9, you can see that the Flush #1 to Yarrow Pt SP reach, highlighted in green, serves 50 parcels, 21 along the AC pipe, which is 1,747 feet long, and 29 along the CI pipe, which is 2,130 feet long. Coupon N1 was collected from the AC pipe and coupon N2 was collected from the CI pipe. There is 296 feet of unknown pipe, which was not sampled.

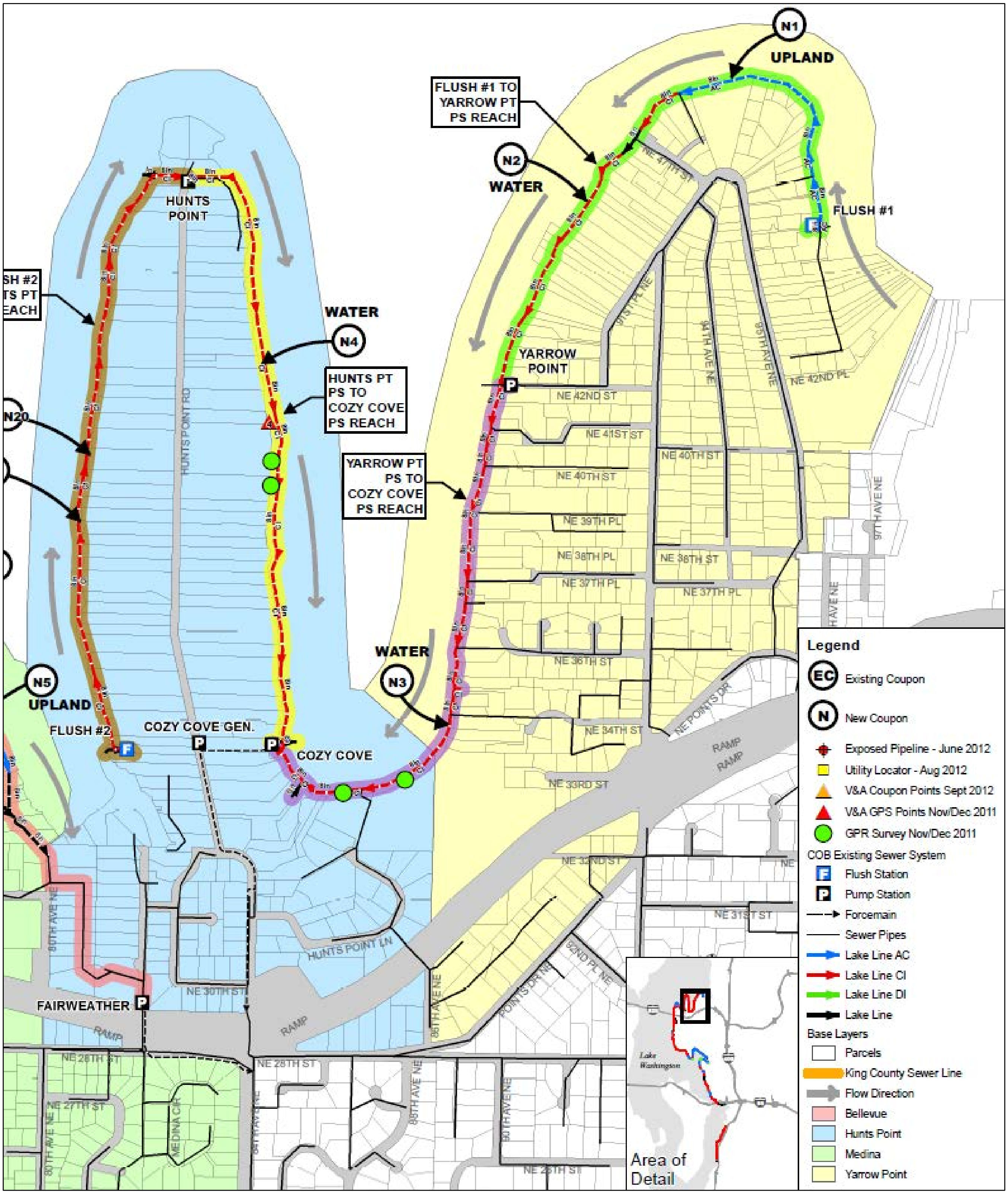


Figure 3-1. Coupon Locations, 1 of 8

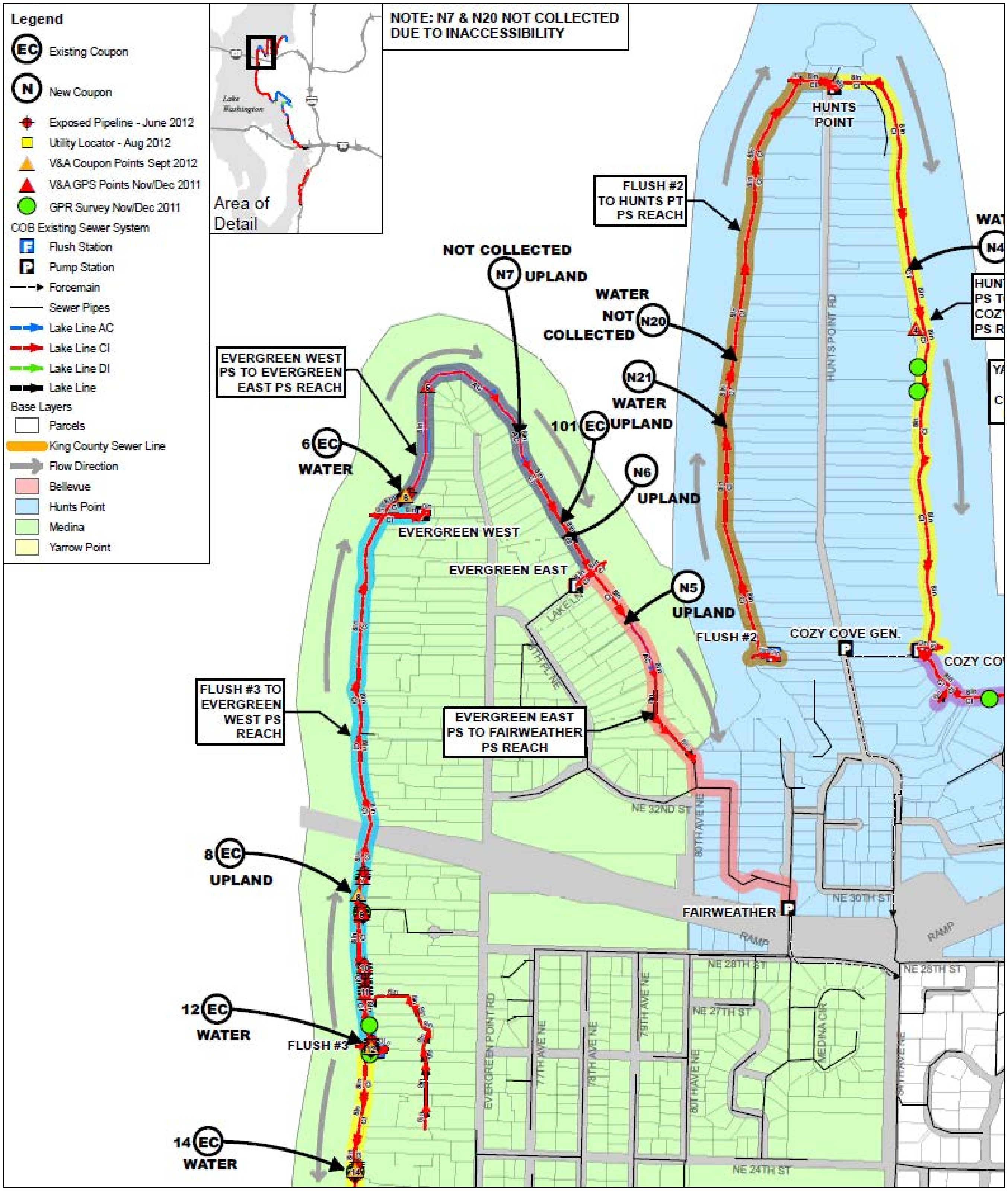


Figure 3-2. Coupon Locations, 2 of 8

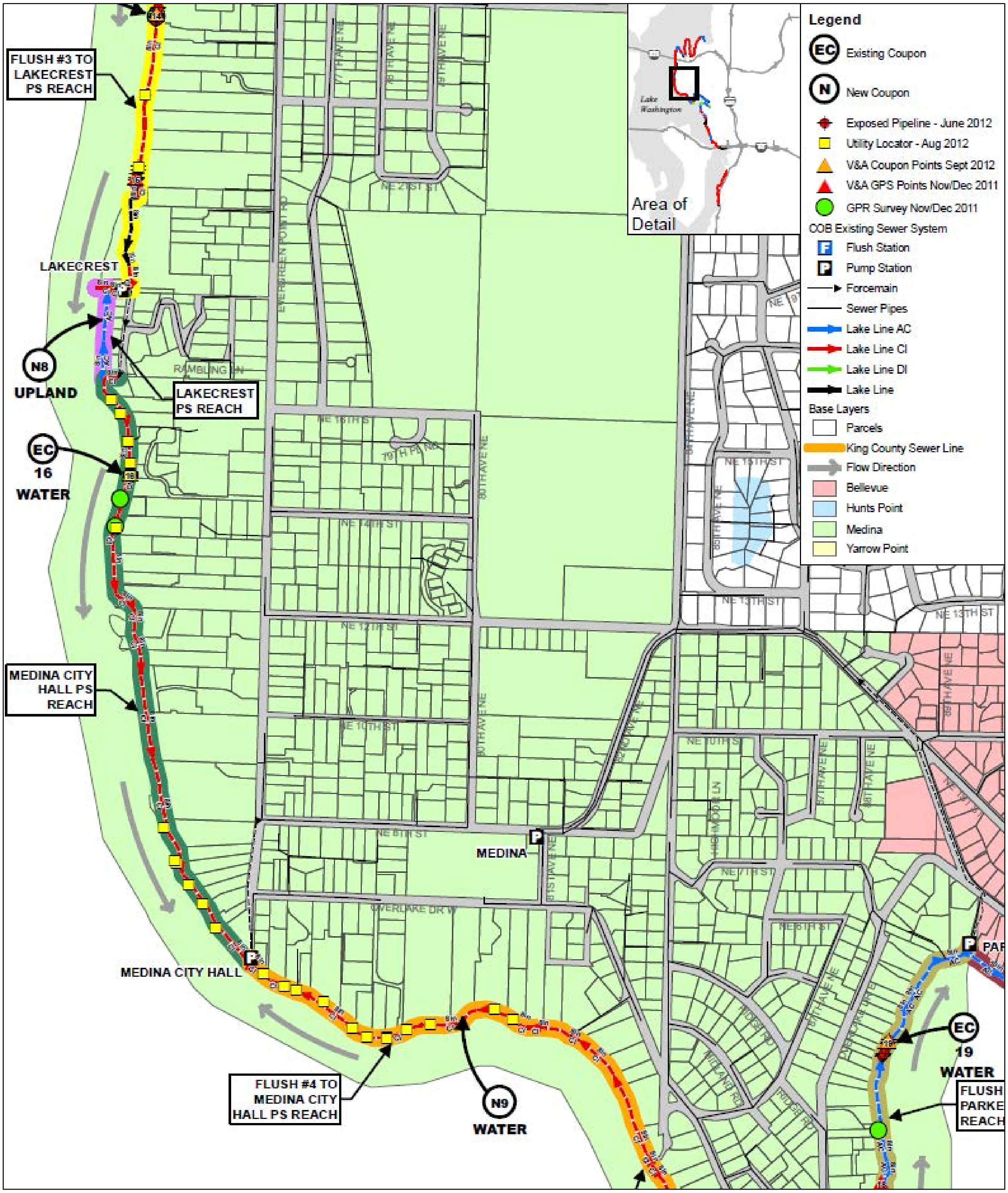


Figure 3-3. Coupon Locations, 3 of 8

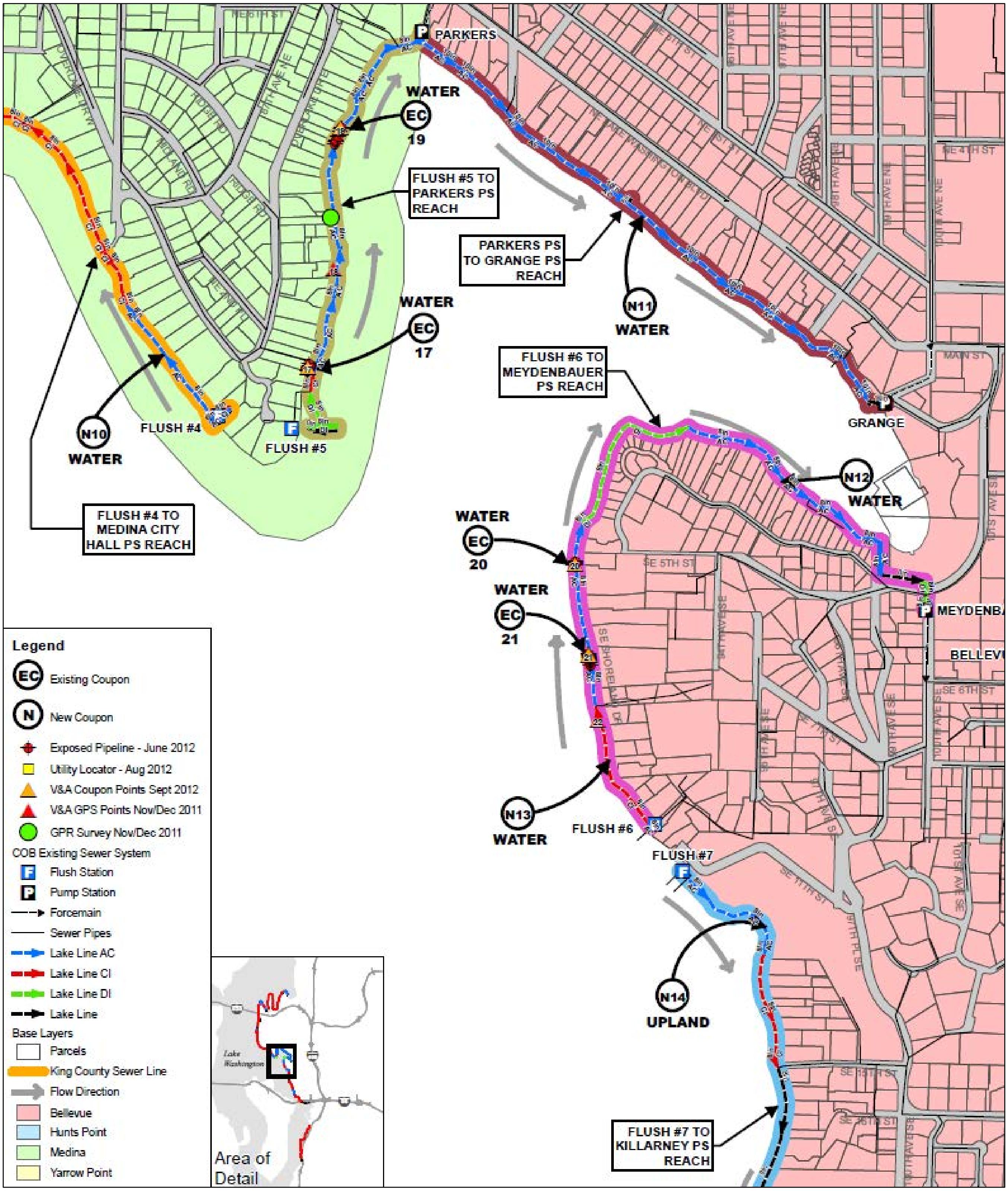


Figure 3-4. Coupon Locations, 4 of 8

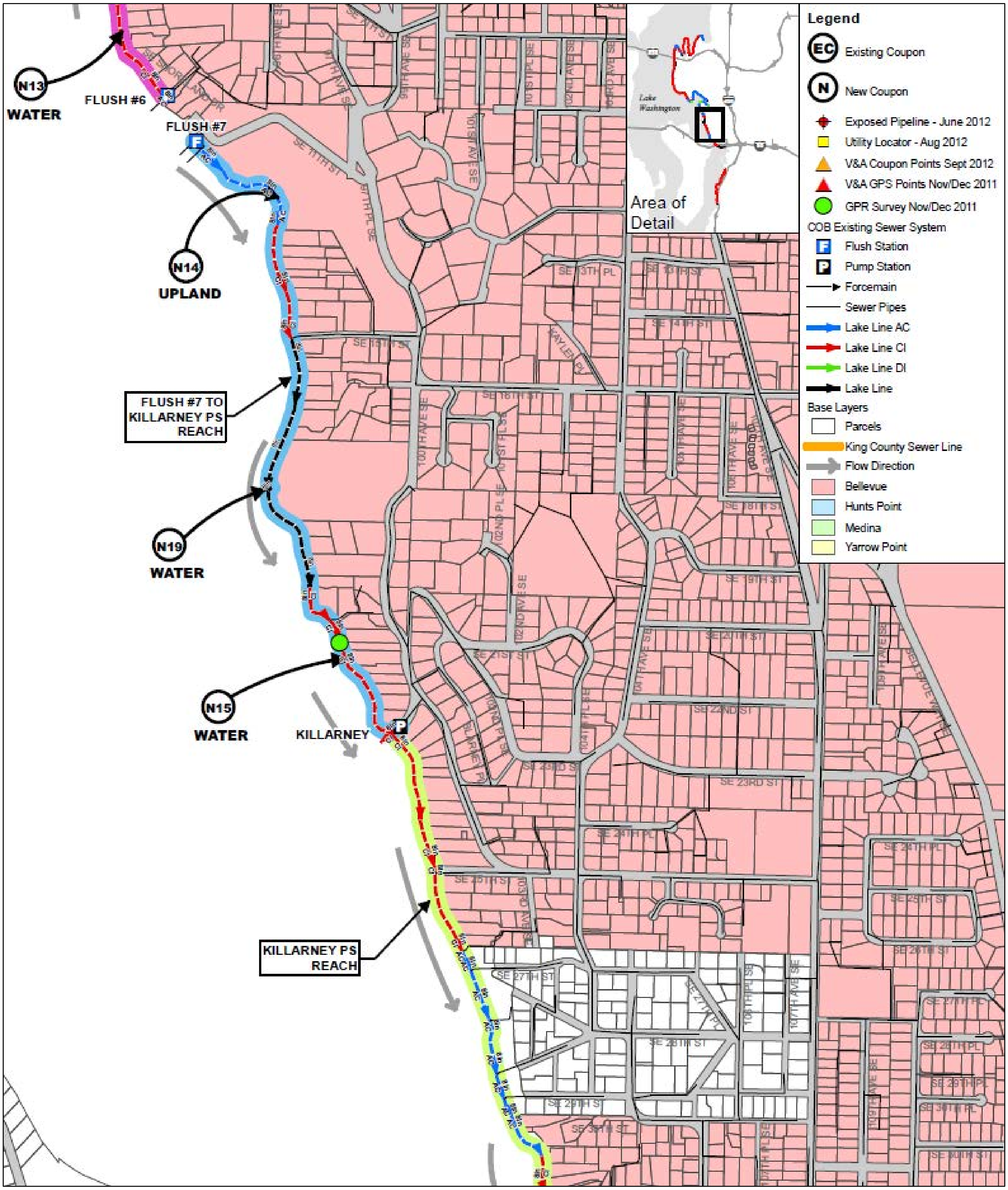


Figure 3-5. Coupon Locations, 5 of 8

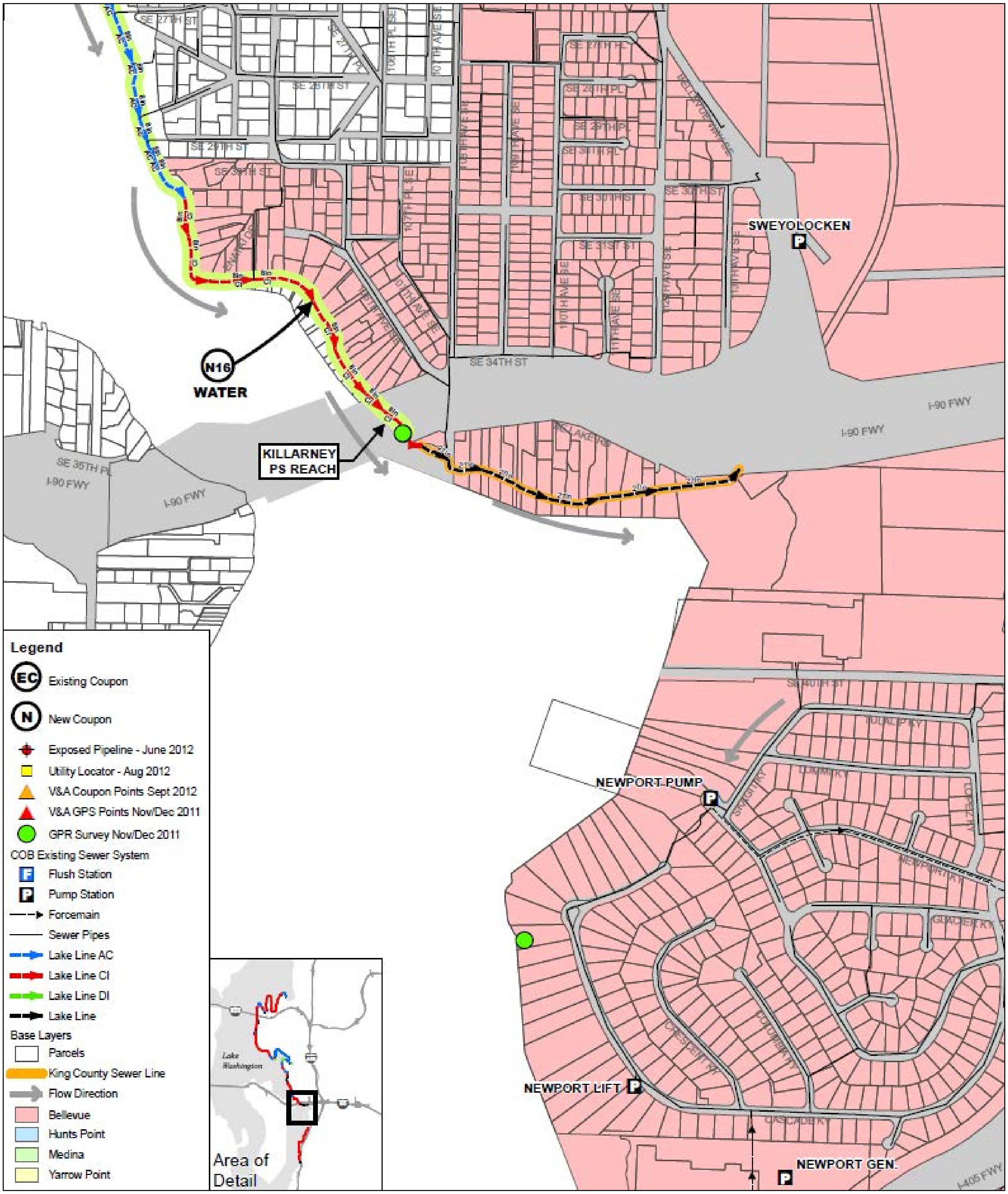


Figure 3-6. Coupon Locations, 6 of 8

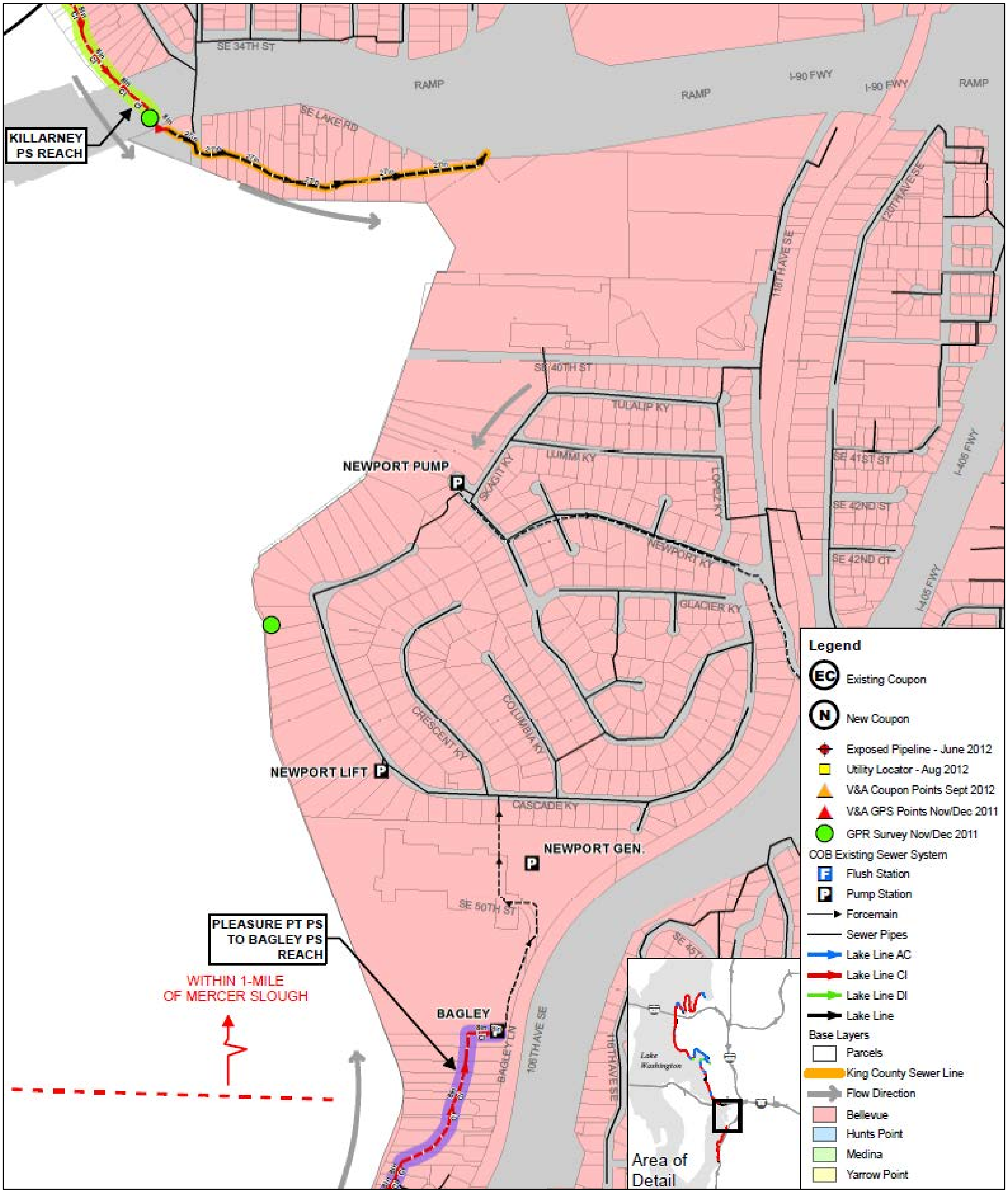


Figure 3-7. Coupon Locations, 7 of 8

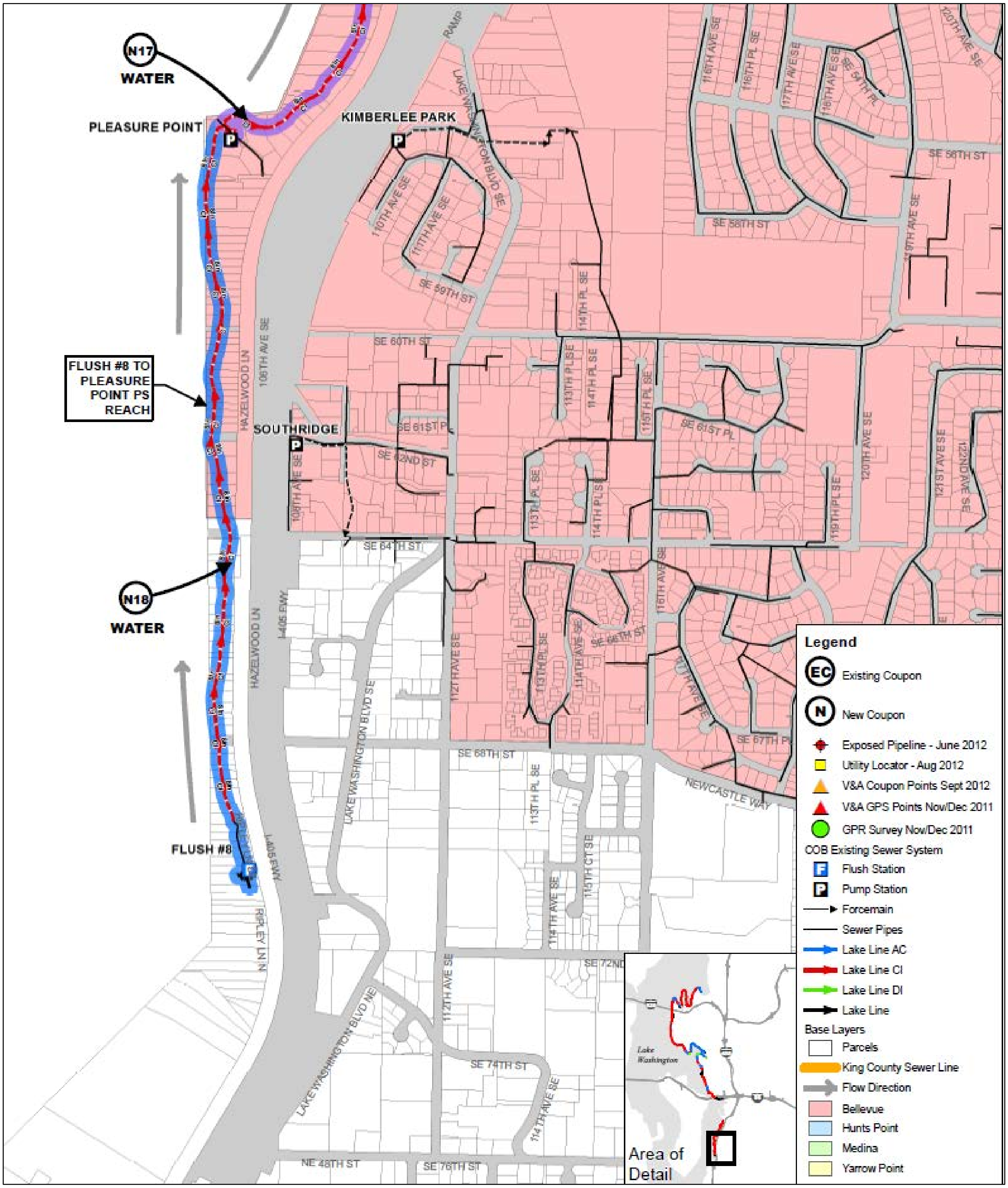


Figure 3-8. Coupon Locations, 8 of 8

Table 3-1. Reaches with Lengths and Number of Services

Reach	Parcels	Services	Coupon	Pipe Length	Material	Length	DWG Reference, Date
Flush #1 to Yarrow Pt PS	50	21 29	N1 N2	4,174	AC CI Z	1,747 2,130 296	R.W. BECK, 1960
Yarrow Point PS to Cozy Cove PS	45	45	N3	3,926	CI PVC	3,823 103	R.W. BECK, 1959
Hunts Pt PS to Cozy Cove PS	38	38	N4	4,317	CI Z	4,130 187	R.W. Beck, 1960
Flush #2 to Hunts Point PS	40	40	N20, N21	4,464	CI Z	4,122 342	R.W. Beck, 1960
Evergreen East PS to Fairweather PS	48	5	N5	3,079	AC CI CON	457 1,838 784	R.W. Beck, 1960
Evergreen West PS to Evergreen East PS	30	16 2, 12	EC101 EC6, N6	3,139	AC CI	1,717 1,422	R.W. Beck, 1960
Flush #3 to Evergreen West PS	40	40	EC8	3,803	CI	3,803	R.W. Beck, 1960
Flush #3 to Lakecrest PS	20	2, 18	EC12, EC14	2,728	CI PVC Z	2,185 495 48	R.W. Beck, 1960
Lakecrest PS	10	10	N8	776	AC CI	577 199	R.W. Beck, 1960
Medina City Hall PS	40	40	EC16	4,221	CI	4,221	R.W. Beck, 1960
Flush #4 to Medina City Hall PS	37	8 32	N10 N9	5,145	AC CI Z	1,162 3,813 170	R.W. Beck, 1960
Flush #5 to Parker PS	33	4, 29	EC17, EC19	3,322	AC CI DI Z	2,519 116 472 215	R.W. Beck, 1960
Parker PS to Grange PS	44	44	N11	3,998	AC PVC Z	3,799 114 85	R.W. Beck, 1960
Flush #6 to Meydenbauer PS	70	41 11 9, 9	N12 N13 EC20, EC21	5,409	AC CI DI VC	2,918 878 1,323 289	Carey - Kramer & Assoc, 1952
Flush #7 to Killarney PS	34	6 15 13	N14 N15 N19	4,638	AC CI Z	876 1,996 1,765	Horton Dennis & Assoc, 1965
Killarney PS	70	 37	 N16	5,596	AC CI	1,452 4,144	Horton Dennis & Assoc, 1965
Pleasure Pt PS to Bagley PS	63	62	N17	4,928	CI Z	4,905 23	Horton Dennis & Assoc, 1965
Flush #8 to Pleasure Point PS	83	 73	 N18	5,353	AC CI Z	345 4,699 309	Horton Dennis & Assoc, 1965

Table 3-2. Coupon Location Summary, Phase 2

No.	Location	Jurisdiction	Longitude	Latitude	Address	Pipe Dia.	Pipe Material	Excavation Depth	Water Depth	Date Collected	Year Installed
N1	Upland	Yarrow Point	-122.21575	47.65285	4664 95th Ave NE	8”	AC	<6’ cover	N/A	6/28/2016	1959
N2	Water	Yarrow Point	-122.21944	47.65067	4601 91st Ave NE	8”	CI	1’ cover	2’	8/02/2016	1960
N3	Water	Yarrow Point	-122.22281	47.64144	8809 NE 34th St	8”	CI	1’ cover	1.5’	8/01/2016	1959
N4	Water	Hunts Point	-122.22791	47.64770	4046 Hunts Point Rd	8”	CI	1’ cover	4.5’	8/01/2016	1960
N5	Upland	Medina	-122.23506	47.64140	3306 78th Pl NE	8”	AC	6.5’ cover	N/A	7/05/2016	1960
N6	Upland	Medina	-122.23676	47.64290	3436 Evergreen Point Rd	8”	AC	6’ cover	N/A	6/29/2016	1960
N7	Upland	Medina	No sample collected		3630 Fairweather Lane	8”	AC		N/A	N/A	
N8	Upland	Medina	-122.24307	47.62629	1651 73rd Ave NE	8”	AC	5.5’ cover	N/A	6/30/2016	1960
N9	Water	Medina	-122.23338	47.61412	7887 Overlake Dr. W	8”	CI	2’ cover	0.5’	8/03/2016	1960
N10	Water	Medina	-122.22681	47.60980	8835 Overlake Dr. W	8”	CI	<2’ cover	3 - 10’	7/26/2016	1960
N11	Water	Bellevue	-122.21439	47.61239	9567 Lake Washington Blvd NE	10”	AC	2.5’ cover	2’.	7/26/2016	1960
N12	Water	Bellevue	-122.21066	47.60776	9528 SE Shoreland Drive	8”	AC	1’ cover	1.5’	7/19/2016	Unknown
N13	Water	Bellevue	-122.21502	47.60277	817 Shoreland Drive SE	8”	CI	1’ cover	1.5’	7/20/2016	Unknown
N14	Upland	Bellevue	-122.21085	47.59990	9600 SE 11th St, Chism Beach Park	8”	AC	4’ cover	N/A	6/28/2016	1965
N15	Water	Bellevue	-122.20892	47.59181	2043 Killarney Way	8”	CI	Exposed	5’	7/22/2016	1965
N16	Water	Bellevue	-122.20022	47.58133	3203 106th Ave SE	8”	CI	2.5’ cover	3 - 10’	7/25/2016	1965
N17	Water	Bellevue	-122.19637	47.55311	5666 Pleasure Point Ln SE	8”	CI	1’ cover	2.5’	7/27/2016	1965
N18	Water	Bellevue	-122.19656	47.54532	6409 Ripley Lane SE	8”	CI	1’ cover	3.5’	7/27/2016	1965
N19	Water	Bellevue	-122.21106	47.59476	1655 Killarney Way	8”	CI	Exposed	3.5’	7/25/2016	1965
N20	Water	Hunts Point	No sample collected		3847 Hunts Point Road	8”	CI		1’	N/A	
N21	Water	Hunts Point	-122.23250	47.64487	3805 Hunts Point Road	8”	CI	1.5’ cover	2’	8/04/2016	1960

Table 3-3. Coupon Location Summary, Phase 1

No.	Location	Jurisdiction	Longitude	Latitude	Address	Pipe Diameter	Pipe Material	Date Collected	Year Installed
EC6	Water	Medina	-122.24087	47.64360	3603, 3607 Evergreen Point Road	8”	CI	9/17/2012	1960
EC8	Water	Medina	-122.24191	47.63655	2841 Evergreen Point Road	8”	CI	9/17/2012	1960
EC12	Water	Medina	-122.24150	47.63386	2441, 2453 Evergreen Point Road	8”	CI	9/17/2012	1960
EC14	Water	Medina	-122.24185	47.63169	2237, 2247 Evergreen Point Road	8”	CI	9/18/2012	1960
EC16	Water	Medina	-122.24232	47.62360	1445 Evergreen Point Road	8”	CI	9/18/2012	1960
EC17	Water	Medina	-122.22305	47.60963	118 Overlake Drive East	8”	AC	9/18/2012	1955
EC19	Water	Medina	-122.22231	47.61385	450, 484 Overlake Drive East	8”	AC	9/19/2012	1955
EC20	Water	Bellevue	-122.21599	47.60625	405 Shoreland Drive SE	8”	CI	9/19/2012	Unknown
EC21	Water	Bellevue	-122.21560	47.60464	425 Shoreland Drive SE	8”	CI	9/19/2012	Unknown
EC101	Water	Medina	Unknown	Unknown	3438 Evergreen Point Road (Collected by City of Bellevue)	8”	AC	8/28/2012	1960

4. STUDY RESULTS

This chapter presents Phase 1 and Phase 2 condition assessment results and provides conclusions to help prioritize the lake line reaches for future replacement. The Phase 1 analyses and collected data differ somewhat from those performed for Phase 2, but there are sufficient similarities to allow a comparison and prioritization across the entire lake line system, as outlined in Chapter 5.

PIPE CONDITION FINDINGS

AC Pipe

AC pipe contains calcium, which makes it hard. This type of pipe deteriorates over time as contact with acidic wastewater or soil causes the calcium to leach from the material, leaving behind a layer of softer, weaker asbestos. The amount of deterioration is measured by a test in which a chemical called phenolphthalein is applied to the collected pipe wall sample. The chemical stains the middle layer of the pipe wall, where calcium remains and the pH is neutral or alkaline (pH values of 7 or higher). As calcium is removed, the pH falls to 7 or below based on environmental conditions. The unstained interior and exterior layers of the sample indicate where the pH has been reduced to less than 7 by contact with acid in the wastewater or in the soil, with resulting loss of calcium. The thickness of each layer was measured to determine the overall amount of deterioration.

The pH of the interior, exterior and middle layers and the remaining calcium content of each layer were measured in Phase 2, but not in Phase 1. Based on the Phase 2 measurements, AC pipe generally showed both interior and exterior acid attack, leading to a total effective deterioration of 34 to 66 percent of the wall thickness. Test results obtained using a pH pen, phenolphthalein and SEM-EDS data indicate that reduction of calcium content of both the interior and exterior surfaces has occurred due to acid leaching. This results in a substantially weaker pipe wall. The middle section of the pipe wall had a calcium content ranging from 19.5 to 24.4 percent, which likely represents the original calcium content of new pipe. The pH of the middle sections ranged from 7 to 11; the original pH was likely 10.0 or above. The interior surface layer had a pH between 3 and 7, correlating with low Mohs hardness data.

Table 4-1 summarizes wall thickness of the AC pipe, along with the depth of deterioration to the interior and exterior faces. The middle region, indicated by the phenolphthalein test to have a high pH, represents the remaining wall thickness that has been minimally impacted by dissolution of the calcium content.

Table 4-1. Percent Deterioration for AC Pipe Coupons

Coupon	Wall Thickness (inches)				% Loss
	Total	Deteriorated Interior	Intact Middle	Deteriorated Exterior	((Interior + Exterior)/Total)
N1	0.70	0.27	0.36	0.07	49%
N5	0.66	0.18	0.30	0.18	55%
N6	0.65	0.21	0.22	0.22	66%
N8	0.68	0.03	0.36	0.29	47%
N11	1.07	0.22	0.71	0.14	34%
N12	0.83	0.35	0.35	0.14	58%
N14	0.70	0.10	0.45	0.10	36%

Coupon N6 was the most severely impacted sample. Its total thickness of deterioration (0.43 inches) was similar to the average of all samples, but because it was the thinnest sample to begin with (0.65 inches thick) its deterioration represented the highest percentage of all samples (66 percent). This sample had the lowest calcium content and the lowest pH in the middle layer. In general, the inside layer of the pipe at this sample appeared to be in worse shape than the outside layer, although both showed deterioration due to acid attack. The interior surface had experienced delamination, which appeared to have occurred in service and not as a result of sample collection. This portion of the pipe wall can be expected to have a significantly reduced strength. Material hardness was tested, and the lowest hardness measured, Mohs hardness of 1.0, was in this sample.

According to the testing laboratory, it did not appear that all the AC pipe samples were originally 1-inch thick and have eroded to their existing thickness. The interior layer of the AC pipe samples did not exhibit the variation in thickness that would be expected if significant corrosion had occurred, so it is reasonable to assume the current measured wall thickness closely represents the original pipe thickness. The AC pipe was likely installed under various projects for which the specified original thickness is unknown.

The seven tested samples represent a small percentage of the piping system overall, so it would not be unlikely to observe a greater depth of deterioration on the pipe in some areas. As a worst-case scenario, if a pipe with the minimum wall thickness measured (0.65 inches) were to experience the highest measured interior and exterior deterioration (0.35 inches and 0.29 inches, respectively), the remaining intact wall thickness would be only 0.01 inches; the deterioration would represent more than 98 percent of the original total thickness.

The pipe ranges from 51 to 57 years in age, based on installation dates between 1959 and 1965. The service life varies with environmental conditions and can sometimes be related to soil characteristics not evaluated under this scope of work. The remaining service life is based on the level of deterioration. At 50-percent deterioration, the factor of safety against rupture at design pressure is lost. Most of the AC pipe is at least 40-percent deteriorated, so it is likely that less than one third of the expected service life is left.

CI Pipe

For the CI pipe, the condition of the cement mortar lining was examined, as well as the metal. The cement mortar lining protects the cast iron until its pH is degraded to less than 7. At that point, the liner no longer provides effective protection, and corrosion of the cast iron begins. The lower the pH is at the metal surface, the more aggressive the rate of corrosion. Several samples have mortar that has deteriorated and cracked, which may also lead to loss of the liner. The metal below an intact liner with a low pH should experience a lower rate of corrosion than exposed metal where the liner is separated from the surface or broken away. The tested samples show all phases of liner deterioration; from intact with a high pH, to intact with a low pH, to liners that were cracked, deteriorated or removed from the metal surface.

On samples where the liner was intact and had a pH of 7 or higher, there was essentially no corrosion on the inside of the pipe. The hardness of the cement liner in these samples was about 5. In samples where the pH of the cement was less than 7, the testing crumbled the cement layer, so no value could be obtained.

Table 4-2 shows key test results for CI pipe samples. Considering the range of wall thicknesses (0.32 to 0.41 inches) and minimal extent of corrosion, it appears the pipe had various original wall thicknesses. The original wall thickness is unknown, so wall loss was estimated based on examination of a cross-section of the coupon to measure the difference between the outer edge and the depth of the corrosion. Wall loss varied from 0 percent (with liners that had a pH greater than 7) to 23.5 percent (with liners that had a pH of 3 to 4). The pitting depth in the iron varied from 0 to 0.098 inches in the lowest-pH sample.

Table 4-2. Wall Loss Due to Corrosion in CI Pipe

Sample	Pipe Wall Wall Thickness (inches)	Interior Corrosion (inches)	External Pitting (inches)	Corrosion Rate (mils/year)	Wall Loss	Liner Thickness (inches)
N2	0.319	0.000	0.000	0.000	0.0%	0.135
N3	0.390	0.000	0.000	0.000	0.0%	0.241
N4	0.339	0.000	0.000	0.314	4.8%	0.103
N9	0.333	0.000	0.000	0.000	0.0%	0.248
N10	0.335	initiated	0.021	0.412	6.2%	0.075
N13	0.377	0.000	0.028	0.549	7.4%	0.175
N15	0.414	initiated	0.098	1.902	23.5%	0.073
N16	0.405	initiated	0.063	1.235	15.6%	0.000
N17	0.397	initiated	0.026	0.510	6.4%	0.000
N18	0.364	initiated	0.018	0.353	5.1%	0.092
N19	0.378	0.000	0.062	1.216	16.3%	0.097
N21	0.339	initiated	0.000	0.000	0.0%	0.105

The laboratory estimated the average corrosion rate to date in mils per year, based on the year of construction. However, corrosion rates are not linear over time, and it is likely that future rates of interior corrosion will increase from those measured in this study. Interior corrosion initiates when the interior liner is compromised, and as the liner continues to deteriorate, the corrosion rate increases toward that of bare metal. The point at which the liner will become compromised cannot be predicted in advance. The interior corrosion has not progressed far at this time, but the liners are no longer providing effective protection in most of the locations sampled. The acidic conditions that deteriorated the liner will begin working on the metal surface of the pipe.

Another way to look at remaining life is to consider the wall loss, measured as the percentage of pitting depth to metal thickness, as shown in Table 4-3. Sample N15 had an exterior pit 0.098 inches deep, which represents a 23.5 percent wall loss. The quantity of samples is small and the possibility exists that there is more extensive external pitting corrosion. At 50-percent wall loss, the factor of safety for rupture is lost. If interior corrosion is also occurring, a pipe with 23.5-percent wall loss after 51 years, such as N15, probably has less than 50 years of remaining life as the corrosion rate increases. The terms “general corrosion” and “pitting corrosion” refer to overall corrosion of the surface and pin-point corrosion. For cast iron pipe, the rate of pitting corrosion likely would exceed that of general corrosion. The service life would be most impacted by the higher rate of pitting corrosion.

Norton Corrosion Limited has performed survey work on two other cast iron pipelines located on the bottom of Lake Washington (because of ownerships, this study is not at liberty to provide the reports or substantial details). Both were cast iron pipelines of similar size, but larger than the Bellevue line, installed in the 1960s. The extent of testing was limited. In both instances, pitting was identified by tubercles that formed on the exterior surface where submerged pipe was exposed laying on the lake bottom. The tubercles were removed and the corrosion product removed from the pits to allow for pit depth measurements.

On one of these two pipelines, the maximum pit depth measured was 370 mils, with a pit diameter of 1 inch at the pipe’s outside diameter. This line was 27 years old at the time of inspection. On the other pipeline, the greatest pit depth was 165 mils. That line was 32 years old at the time of inspection. Given the limited testing performed, it is unlikely those surveys identified the pits of greatest depth and size. This data represents more aggressive corrosion than identified on the Bellevue lines, likely because the Bellevue lines were covered.

Table 4-3. Summary Condition Assessment Results, Phase 2 CI Pipe Coupons

Coupon No.	Location	Pipe Diameter	Year Installed	pH (Mortar)	Cement Hardness (Mohs)	Metal Thickness (in)	Wall Loss	Pitting Depth (in.)	Charpy Impact Test (ft-lbs)	Brinell Hardness HRB	Condition Comments
N2	Water	8”	1960	11	4.5-5.0	0.319	0%	NR	<1.0	80.0	Good condition
N3	Water	8”	1959	8	4.5-5.0	0.390	0%	NR	<1.0	79.0	Two layers, fractured to surface
N4	Water	8”	1960	4	4.5-5.0	0.339	4.8%	0.016	<1.0	88.0	Liner is no longer effective protection
N9	Water	8”	1960	7	5.0-6.0	0.333	0%	NR	<1.0	74.5	Liner fractured, separating at metal surface
N10	Water	8”	1960	<7	Low - NA	0.335	6.2%	0.021	<1.0	77.5	Liner is no longer effective protection
N13	Water	8”	Unknown	6-7	Low - NA	0.377	7.4%	0.028	<1.0	85.5	Liner is no longer effective protection
N15	Water	8”	1965	3-4	Low - NA	0.414	23.5%	0.097	<1.0	84.0	Liner is no longer effective protection
N16	Water	8”	1965	NA	NA	0.405	15.6%	0.063	<1.0	81.5	No liner present
N17	Water	8”	1965	NA	NA	0.397	6.4%	0.026	<1.0	72.5	No liner present
N18	Water	8”	1965	6-7	Low - NA	0.364	5.1%	0.018	<1.0	72.5	Liner is no longer effective protection
N19	Water	8”	1965	5	5	0.378	16.3%	0.062	<1.0	82.0	Liner is no longer effective protection
N20	Water	8”									No coupon taken
N21	Water	8”	1960	6	4.5-5.0	0.339	0%	NR	<1.0	77.5	Liner is no longer effective protection

Phase 2 coupon analysis by Simon Forensic, LLC, Shoreline WA

For the Phase 2 coupons, the Charpy impact test was conducted at 40 ºF to simulate lake bottom temperatures. The test was performed on CI samples of 10 mm by 5 mm, and all samples broke at less than 1.0 foot-pound. The Phase 1 coupons were tested at 10 mm by 10 mm by a different lab and yielded results in the 1.3- to 4.2-foot-pound range. The samples with the highest toughness were those with the least wall loss; those with the least toughness were those with the most wall loss.

CONCLUSIONS

Results of the Phase 1 and Phase 2 coupon condition analyses are summarized in Table 4-3 through Table 4-6. The sections below present conclusions that can be drawn from the results.

AC Pipe

The remaining useful service life of AC pipe is dependent on a number of factors that are difficult to determine. Although the current state of deterioration can be measured, the deterioration rate is probably not linear with time. It is dependent on the loading and the environment to which the pipe is exposed.

The hoop stress in a pipe is inversely proportional to the pipe wall thickness, while the rupture stress is inversely proportional to the square of the pipe wall thickness. The pipe wall thickness for pressure pipe is typically designed with a safety factor of 4. This means that when 50 percent of the pipe thickness is lost, the pipe may fail due to rupture, and that when 75 percent of the pipe thickness is lost, the pipe may fail due to hoop stress when subjected to the design load.

Table 4-4. Summary Condition Assessment Results, Phase 2 AC Pipe Coupons

Coupon No.	Location	Pipe Diameter	Year Installed	pH			Ca Content			Brinell Hardness (Mohs)		Condition Comments
				Inside	Center	Outside	Inside	Center	Outside	Low	High	
N1	Upland	8”	1959	6	9	6	2.8	23.1	12.5	3.0	6.0	40% Deterioration
N5	Upland	8”	1960	7	8	7	1.8	24.4	8.2	4.0	4.0	55% Deterioration
N6	Upland	8”	1960	4	7-8	6	0.8	21.6	1.5	1.0	4.0	70% Deterioration, Delamination
N7	Upland	8”										No coupon taken
N8	Upland	8”	1960	7	8	7	23.7	23.7	5.1	3.0	5.5 - 6.0	40% Deterioration
N11	Water	10”	1960	6.5	10-11	8-9	5.6	21.5	6.1	3.0	5.5	35% Deterioration
N12	Water	8”	Unknown	7	8-9	8	6.8	19.5	13.5	3.0	4.0	40% Deterioration
N14	Upland	8”	1965	3-4	8-9	4	10.9	20	14.2	3.5	5.5	40% Deterioration

Phase 2 coupon analysis by Simon Forensic, LLC, Shoreline WA

Table 4-5. Summary Condition Assessment Results, Phase 1 AC Pipe Coupons

Coupon No.	Location	Pipe Diameter	Year Installed	Wall Thickness Affected by Calcium Leaching (in)			Hardness (in Shore D)		Condition Comments
				Inside	Center (not affected)	Outside	Outside	Core	
EC17	Water	8”	1955	0.242	0.434	0.157	76.5	85.5	48% Deterioration
EC19	Water	8”	1955	0.199	0.417	0.152	79.6	90.8	46% Deterioration
EC101	Upland	8”	1960	0.176	0.232	0.238	57	90	64% Deterioration

Phase 1 coupon analysis by MEI-Charlton, Inc., Portland, OR

Table 4-6. Summary Condition Assessment Results, Phase 1 CI and DI Pipe Coupons

Coupon No.	Location	Pipe Diameter	Pipe Material	Year Installed	Liner Thickness	Metal Thickness (in)	Wall Loss	Charpy Impact Test (ft-lbs)	Brinell Hardness HRB	Condition Comments
EC6	Water	8”	CI	1960	0.104	0.318	20.5%	1.320	61.8	Pieces of mortar debonded
EC8	Water	8”	CI	1960	0.1	0.353	11.8%	3.470	70.7	Corrosion & pitting on outside of pipe
EC12	Water	8”	CI	1960	0.135	0.399	0.3%	4.207	68.5	
EC14	Water	8”	CI	1960	0.113	0.331	17.3%	1.523	62.8	Corrosion on outside of pipe
EC16	Water	8”	CI	1960	0.156	0.397	0.8%	4.070	66.8	
EC20	Water	8”	DI	unknown	0.144	0.372	0.8%	2.188	67.6	Less corrosion than others
EC21	Water	8”	DI	unknown	0.112	0.363	3.2%	5.355	79.3	Less corrosion than others

Phase 1 coupon analysis by MEI-Charlton, Inc., Portland, OR

As seen in Table 4-3 through Table 4-6, most of the coupons indicated deterioration of 40 percent or more. Normal operating pressures in the lake line are minimal, so failure may not be imminent, but the deterioration seen does represent a significant decrease in the factor of safety.

According to an article in Public Works magazine and other sources provided in Appendix E, the typical service life of AC pipe is 40 to 60 years. Research undertaken by the Alameda County Water District in California's San Francisco Bay Area projects a service life of 70 to 80 years for AC pipe used for water distribution. Water pipes are usually subject to less internal corrosion than wastewater pipes, so their life expectancy is longer. In addition, the Alameda County Water District considers six to 10 leaks per mile over the life of the pipe to be acceptable, but this is not a suitable standard for a wastewater collection system.

For smaller diameter pipes such as these, failure is more likely to occur due to bending than pressure, so factors such as beach erosion or seismic events are a concern. Pipe that is located behind a bulkhead near the lake, but not below the lake bottom, is vulnerable to failing if the bulkhead fails. If soil leaks through the bulkhead, the lateral support for the pipe could be reduced. Where the pipe is exposed or particularly shallow, it could also be broken by direct impact from a boat or anchor.

Since the AC pipe has reached or is approaching its normal service life, and testing has documented significant deterioration, near-term planning for systematic replacement should be conducted before failures occur. Prioritization of pipe reaches is presented in Chapter 5.

CI Pipe

Although there is corrosion in CI pipes where the cement mortar liner is compromised, it is not known how long the corrosion has been taking place. The liner continues to be effective in only 8 percent of the coupons examined, so the liner may be reaching its expected service life for this application. Once the liner is no longer effective, the iron will begin to deteriorate. The rate may not be linear. Graphitization that takes place as corrosion occurs may provide some protection. Pitting that goes deeper into the metal is the biggest concern. This may lead to leaks prior to collapse of the pipe.

At this time, none of the CI pipes have lost enough wall thickness to indicate likely failure in the near term. Available records do not provide specifications for the CI pipe used for the lake line, but it appears to be heavier than normal pipe, with thickness of approximately 0.4 inches in some instances. According to the Commercial Standard CS188-66 for Cast Iron Soil Pipe and fittings, the thickness of service weight 8-inch cast iron pipe should be 0.22 inches and the thickness of extra heavy 8-inch cast iron pipe should be 0.31 inches.

However, the impact tests indicate that the toughness of the material is affected along with wall loss. The Brinell hardness tests indicate that there may be some embrittlement of the pipe as well because the pipes with more corrosion generally have higher hardness. Coupons N16 and N17 near the south end of the system had no liner. It is not known if they were installed without a liner or if the liner has failed and fallen away from the location in the pipe where the coupon was taken. In either case, the corrosion over their 50-year lifespan can be seen as not enough to compromise the integrity of the pipe.

Cast iron pipe normally has a service life of 100 to 150 years. It will last longest where flowing full, so that there is no air in the headspace. At this time, none of the CI pipes have lost enough wall thickness to indicate likely failure in the near term. A long-term planning horizon with monitoring of pipes with the highest levels of corrosion is appropriate for these pipes, based on prioritization and monitoring as discussed in Chapter 5.

5. PRIORITIZATION

The City of Bellevue wants to maintain the integrity of its lake line sewer by timely replacement of portions that may be at risk of failing. In order to do that cost-effectively in accordance with sound asset management principles, it is necessary to establish priorities among the various reaches of the 14.4-mile pipeline. The lake line system was divided for this study into 18 reaches, each represented by one or more coupons. These reaches were prioritized based on the consequence of failure of each reach combined with the probability of failure. The City and the project team met to agree on the criteria and subsequent weighting to be used for a qualitative risk-based prioritization.

CONSEQUENCE OF FAILURE

The following criteria were established for assessing the consequence of failure for each reach:

- **Cumulative length of reach**—The longer the reach, the greater the cost to replace it.
- **Location**—In-water reaches are considered to have a higher consequence of failure than upland reaches because a spill or leak would go directly into Lake Washington and in-water repairs can also be more difficult to repair.
- **Number of services**—The number of services connected to a reach determines the amount of flow in the pipe and the number of people who would be inconvenienced by a sewer break. If a line were to collapse or become surcharged, it could cause sewage to back up into houses. Residents might have to stop using water until the pipe is repaired or until a bypass system can be put in place to pump around the construction area. This measure is cumulative since some reaches are tributary to others before reaching a pump station, and a break in the lower area would drain sewage from both. This criterion was evaluated based on the number of parcels along the reach, excluding those that are likely connected to a mainline sewer in a street. It represents potential future flows from existing homes and vacant lots that could be developed.
- **Ease of maintenance access**—Ease of maintenance access affects the difficulty of repairing a segment of pipe. If the pipe is on land with access between properties, it is relatively easy. If it is on the lake bottom, it is more difficult. If it is on land and there is no access, a piece of equipment may have to be brought in by barge, so that would be the most difficult.
- **Bypass pumping difficulty**—Installing a bypass system to pump around a sewer repair construction area is relatively easy for a short distance on land. If the distance is extensive, it is more difficult, as it involves more properties and obstacles. If a bypass must be established under water, it requires a boat and divers with special equipment and methods.
- **Public health**—If a reach is near a public beach or marina, it has greater consequences associated with failure because there is more opportunity for human contact.

The scores for the consequence of failure criteria are summarized in Table 5-1. Higher scores indicate greater potential consequences in the event of pipe failure.

Table 5-1. Scores for Consequence-of-Failure Criteria

Criterion	Classification	Score
Cumulative Length of Reach	< 2,000 feet	0
	2,000 to 3,500	5
	3,500 to 4,000	10
	4,000 to 4,500	15
	>4,500 feet	20
Location	Upland	0
	In-water	20
Number of Services	0 to 20	5
	20 to 30	10
	30 to 40	15
	40 to 50	20
	> 50	25
Ease of Maintenance Access	In a yard with access	0
	In the lake	10
	In a yard without access	15
Bypass Pumping Difficulty	<1,500 feet on land	0
	>1,500 feet on land	5
	Under water	10
Public Health	No nearby beach or marina	0
	Nearby beach or marina	10

PROBABILITY OF FAILURE

The following criteria were established for assessing the probability of failure for each reach:

- **Location**—Pipe reaches located in the water are buried at shallow depth or even exposed, so the opportunity to break the pipe with a boat or anchor is high. Upland pipes are buried 6 feet underground and are less exposed to damage.
- **Exposed or buried**—Underwater pipes that are exposed are more vulnerable than buried pipes.
- **Age**—Separate scoring systems based on age were developed for AC pipe reaches and CI pipe reaches. AC pipe is considered to have reached it service life if it is more than 50 years old; CI pipe is considered to have reached it service life if it is more than 100 years old.
- **Material**—In the current lake line, most of the calcium has leached out of roughly the inner quarter of the AC pipe, so its strength is diminished, while the CI pipe still has most of its strength remaining.
- **Remaining life**—The remaining life of the pipe is based on the level of deterioration. Most of the AC pipe is at least 40-percent deteriorated, so it likely has less than a third of its expected service life left. Some of the CI pipe is more than 20-percent deteriorated, so it should have half to a third of its service life left. The rest of the CI pipe has little deterioration, so it likely has half or more of its service life left. Estimates of remaining life are presented in Appendix F.
- **Failure record**—The failure record is the best gauge of a pipe's condition and remaining life. There have been few known failures due to deterioration in the lake line system. Continued monitoring over time will tell if the pipe is beginning to reach the end of its useful life. This information is listed in Appendix G.
- **Repair record**—The repair record is a measurement of the pipe's vulnerability to damage due to external forces. The pipe may be too shallow, in shifting material, or in a location where it gets hit by boats or other objects. If the repair record becomes excessive, replacement may be warranted. This information is listed in Appendix G.

The scores for the probability of failure criteria are summarized in Table 5-2. Higher scores indicate greater probability of failure.

Table 5-2. Scores for Probability-of-Failure Criteria

Criterion	Classification	Score
Location	Upland	0
	In-water	10
Exposed or Buried	Buried	0
	Exposed	5
Age	0 to 50 years for AC pipe; 0 to 100 years for CI pipe	0
	> 50 years for AC pipe; > 100 years for CI pipe	10
Material	Cast Iron	0
	Asbestos Cement	20
Remaining Life	> 1/2	0
	1/2 to 1/3	20
	< 1/3	40
Failure Record	No failures	0
	Failures	10
Repair Record	No repairs	0
	Repairs	5

PRIORITY RANKING

For each coupon, the scores for each of the consequence-of-failure criteria were added to form the overall consequence score. Then, the scores for each of the probability-of-failure criteria were added to form the overall probability score. The consequence score was then multiplied by the probability score to form a risk score for that coupon. The risk scoring spreadsheet is included in Appendix H.

Once the risk scores for all of the coupons were established, they were sorted from highest to lowest and given a priority ranking. Some coupons had the same score, so they received the same priority. The final ranking is shown below in Table 5-3.

Generally, the AC pipe received a higher priority than the CI pipe. N1 received a low priority because the consequence of its failure is relatively low. N15 and EC6 received higher priority than the other CI coupons because of their higher level of deterioration.

Table 5-3. Priority Ranking of Coupons

Priority Rank	Coupon	Pipe Material	Address	Reach (Figure Number)
1	N12	AC	9528 SE Shoreland Drive	Flush #6 to Meydenbauer PS (Figure 3-4)
2	N11	AC	9567 Lake Washington Blvd. NE	Parker PS to Grange PS (Figure 3-4)
3	EC19	AC	450, 484 Overlake Drive East	Flush #5 to Parker PS (Figure 3-4)
4	EC17	AC	118 Overlake Drive East	Flush #5 to Parker PS (Figure 3-4)
5	N15	CI	2043 Killarney Way	Flush #7 to Killarney PS (Figure 3-5)
6	EC101	AC	3438 Evergreen Point Road	Evergreen West PS to Evergreen East PS (Figure 3-2)
6	N5	AC	3306 78th Place NE	Evergreen East PS to Fairweather PS (Figure 3-2)
7	EC6	CI	3603, 3607 Evergreen Point Road	Evergreen West PS to Evergreen East PS (Figure 3-2)
8	N6	AC	3436 Evergreen Point Road	Evergreen West PS to Evergreen East PS (Figure 3-2)
8	N14	AC	9600 SE 11th St., Chism Beach Park	Flush #7 to Killarney PS (Figure 3-4)
9	N1	AC	4664 95th Avenue NE	Flush #1 to Yarrow Pt PS (Figure 3-1)
10	EC21	DI	405 Shoreland Drive SE	Flush #6 to Meydenbauer PS (Figure 3-4)
11	N17	CI	5666 Pleasure Point Lane SE	Pleasure Pt PS to Bagley PS (Figure 3-8)
11	N18	CI	6409 Ripley Lane SE	Flush #8 to Pleasure Point PS (Figure 3-8)
12	N16	CI	3203 106th Avenue SE	Killarney PS (Figure 3-6)
13	N9	CI	7887 Overlake Drive West	Flush #4 to Medina City Hall PS (Figure 3-3)
13	N4	CI	4046 Hunts Point Road	Hunts Pt PS to Cozy Cove PS (Figure 3-1)
14	N8	AC	1651 73rd Avenue NE	Lakecrest PS (Figure 3-3)
14	N2	CI	4601 91st Avenue NE	Flush #1 to Yarrow Pt PS (Figure 3-1)
14	N3	CI	8809 NE 34th Street	Yarrow Point PS to Cozy Cove PS (Figure 3-1)
14	N21	CI	3805 Hunts Point Road	Flush #2 to Hunts Point PS (Figure 3-2)
15	EC16	CI	1445 Evergreen Point Road	Medina City Hall PS (Figure 3-3)
15	EC8	CI	2841 Evergreen Point Road	Flush #3 to Evergreen West PS (Figure 3-2)
15	EC20	DI	405 Shoreland Drive SE	Flush #6 to Meydenbauer PS (Figure 3-4)
16	N19	CI	1655 Killarney Way	Flush #7 to Killarney PS (Figure 3-5)
17	EC12	CI	2441, 2453 Evergreen Point Road	Flush #3 to Lakecrest PS (Figure 3-2)
17	EC14	CI	2237, 2247 Evergreen Point Road	Flush #3 to Lakecrest PS (Figure 3-2)
18	N10	CI	8835 Overlake Drive W	Flush #4 to Medina City Hall PS (Figure 3-4)
18	N13	CI	817 Shoreland Drive SE	Flush #6 to Meydenbauer PS (Figure 3-4)

Note: AC = asbestos cement; CI = cast iron; DI = ductile iron

6. RECOMMENDATIONS FOR FUTURE WORK

One way to address the priorities presented in Table 5-3 is to begin preparation for an alternatives analysis and the design of a replacement strategy for the AC pipe. The two CI pipes with a higher level of deterioration can be scheduled for another assessment in 10 years to see if their deterioration has accelerated. Depending on the results, the remaining pipes can be further evaluated at that time or put on hold pending further developments such as failures.

By continuing to track any failures or repairs on these lines, it may be possible to identify reaches that are deteriorating faster than others. There are also reaches that appear to require more frequent cleaning, such as near N11, N16, and N18. Frequent cleaning may damage the pipe, especially if the lining is deteriorated or if AC pipe is delaminating. In 2013, there was a break in the AC line in Beaux Arts, an area that was not sampled during this study. A pilot project to line AC pipe in Beaux Arts was scheduled for 2016 but has been placed on hold. The pilot project plans to provide a pipe sample for that reach of pipe when the work moves forward.

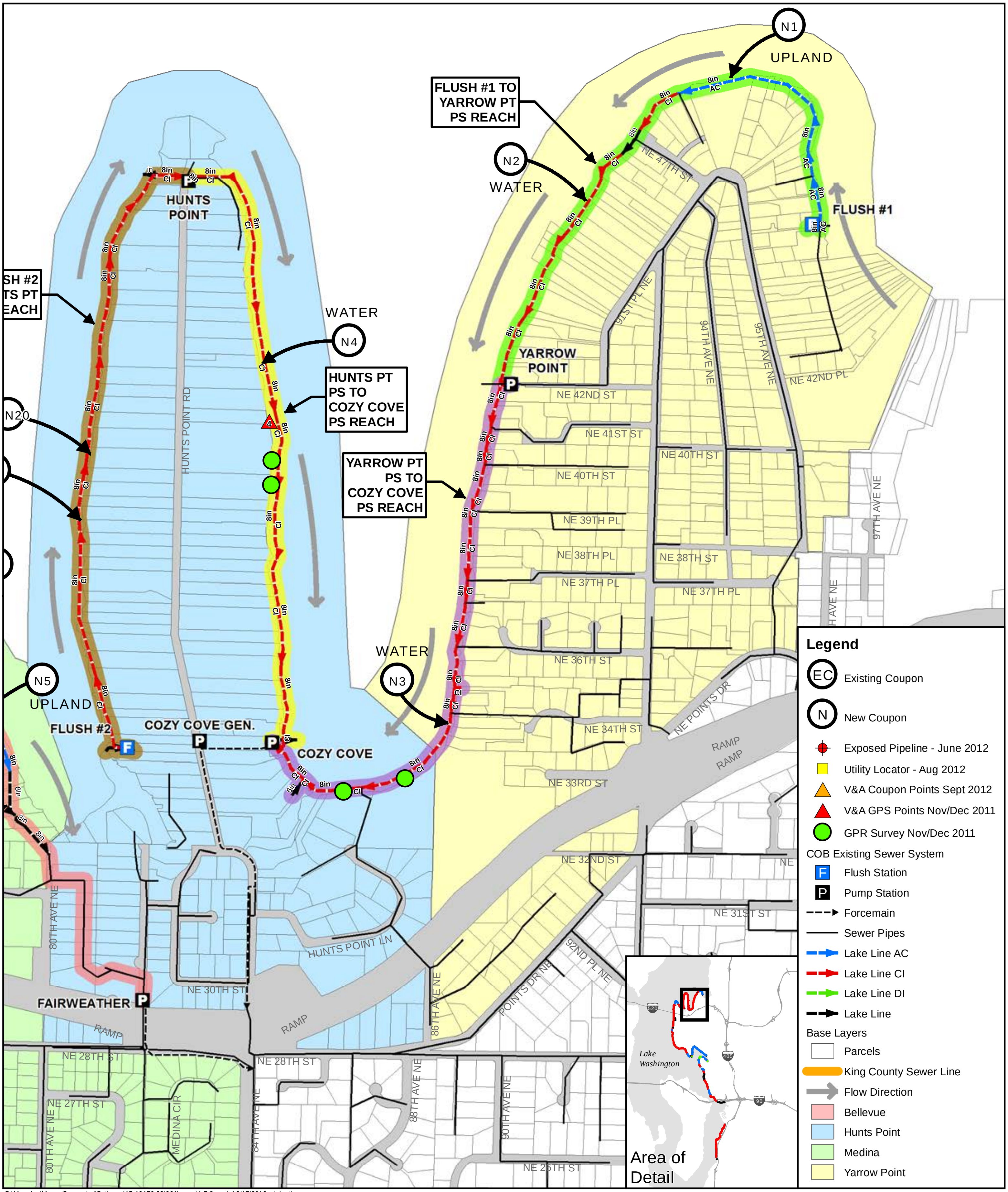
The City of Bellevue plans to start reviewing replacement strategies in 2017.

Considerations would include ownership and maintenance of the new facilities, as well as the difficulty of doing construction on so many properties with tight access, steep slopes, and mature landscaping.

Given the potential long remaining service life for most of the CI pipe, the City may want to develop a long-term plan for future condition assessment, taking into account that new technologies may emerge for conducting these studies.

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix A. Pipe Coupon Location Exhibit



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

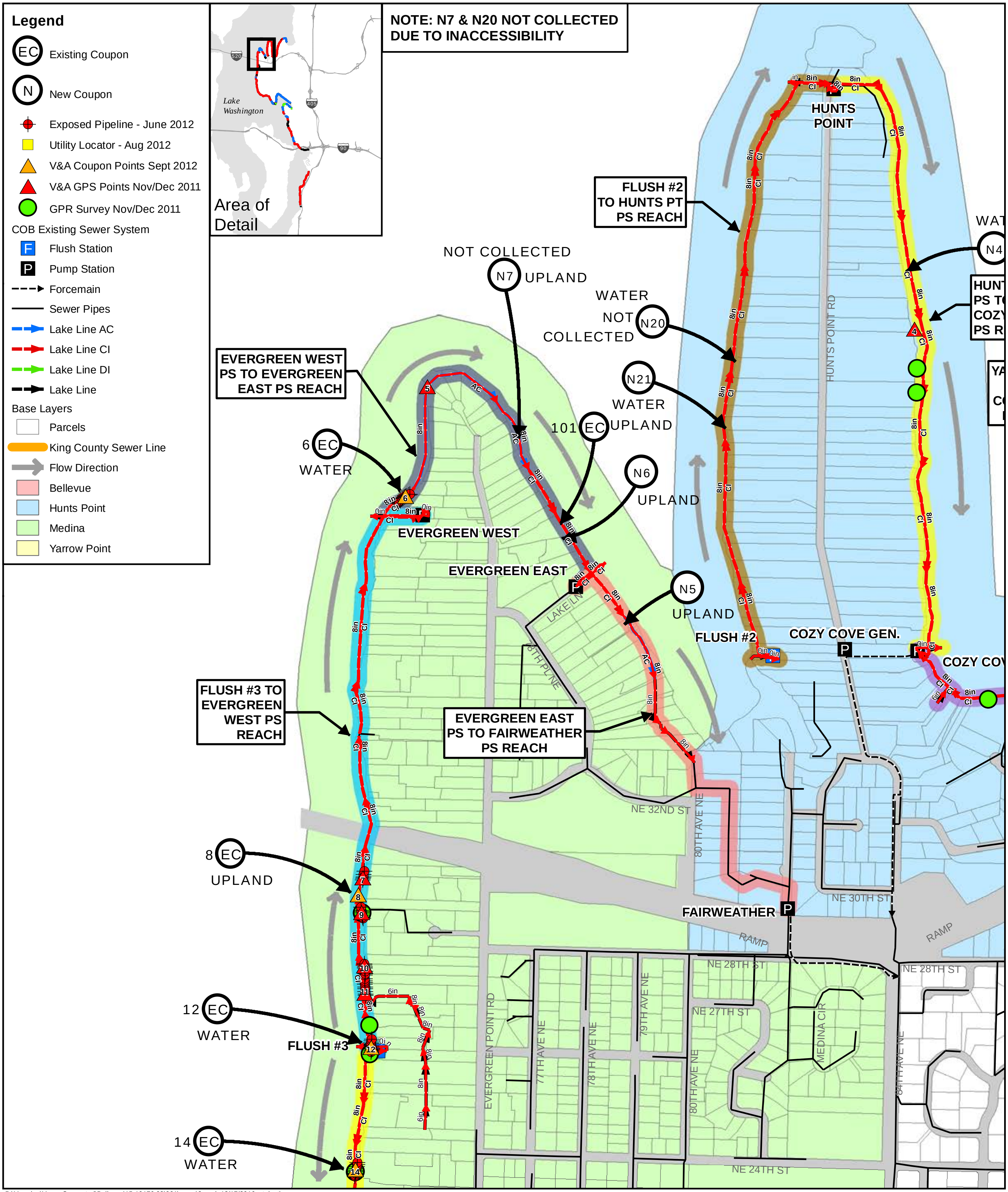
N W E S

Feet
0 400 800

CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS

Figure 1
October 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
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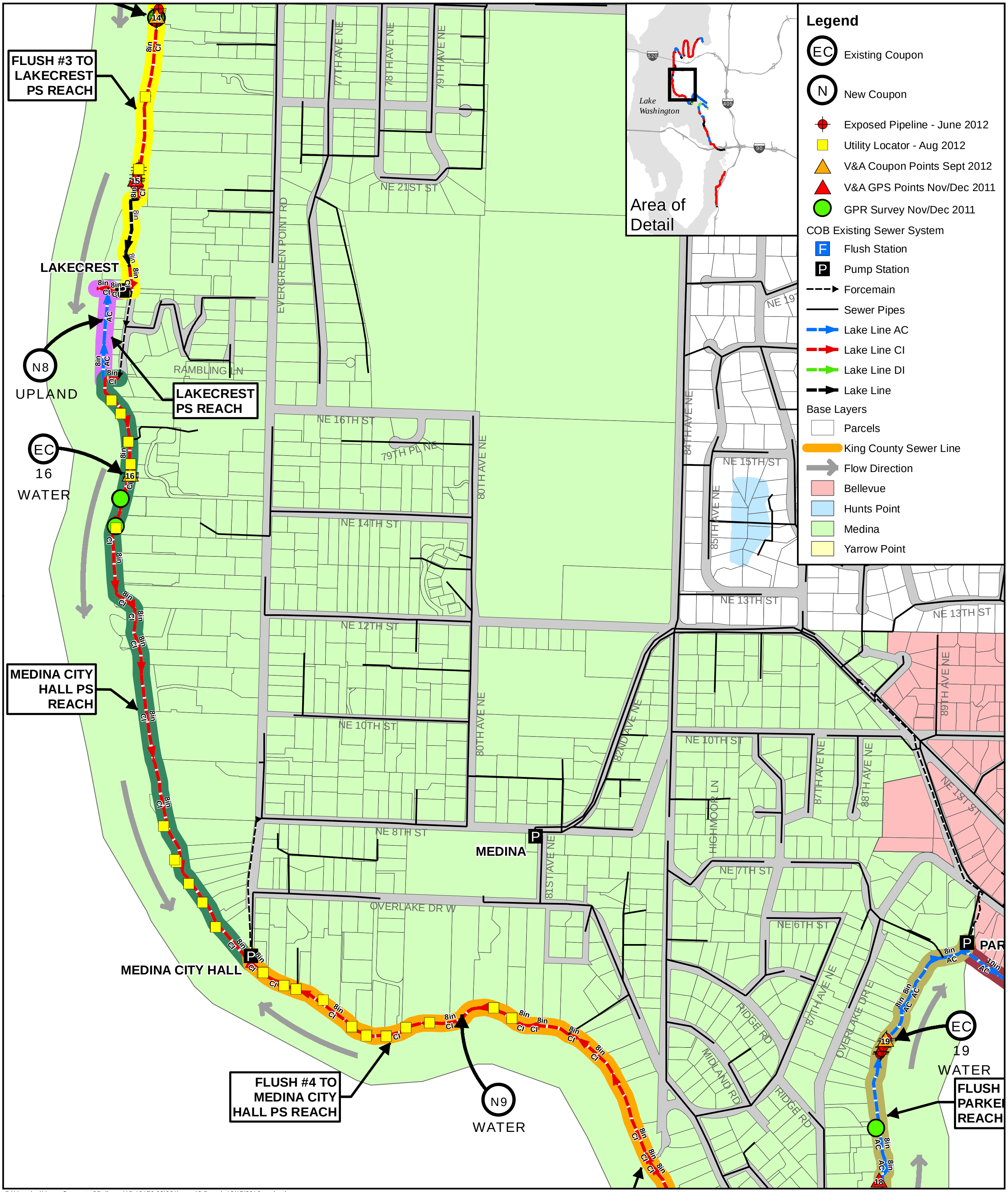
N W E S

0 400 800 Feet

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS

Figure 2
October 2016



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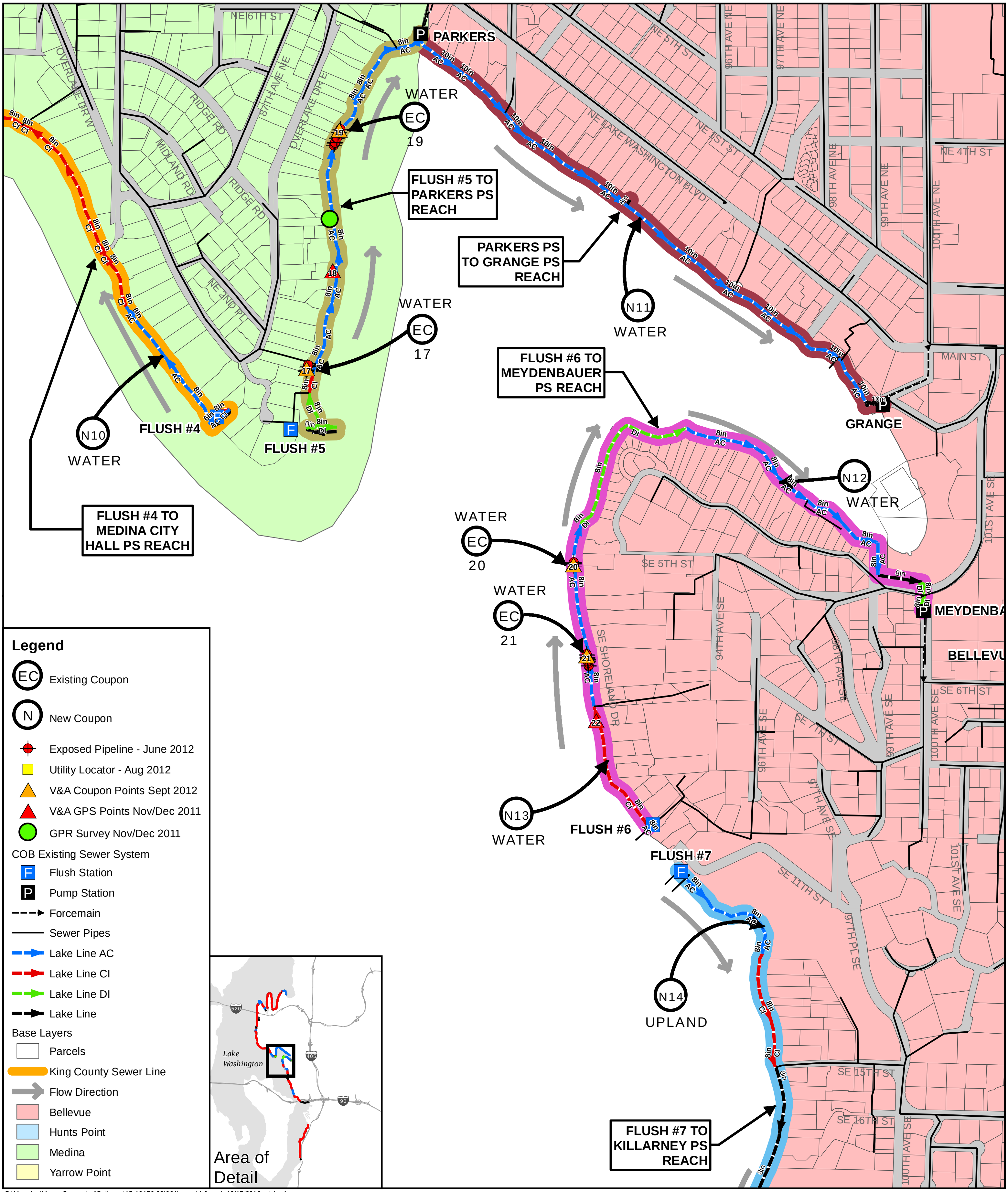
Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH
BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

N W E S
0 400 800 Feet

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS
Figure 3
October 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

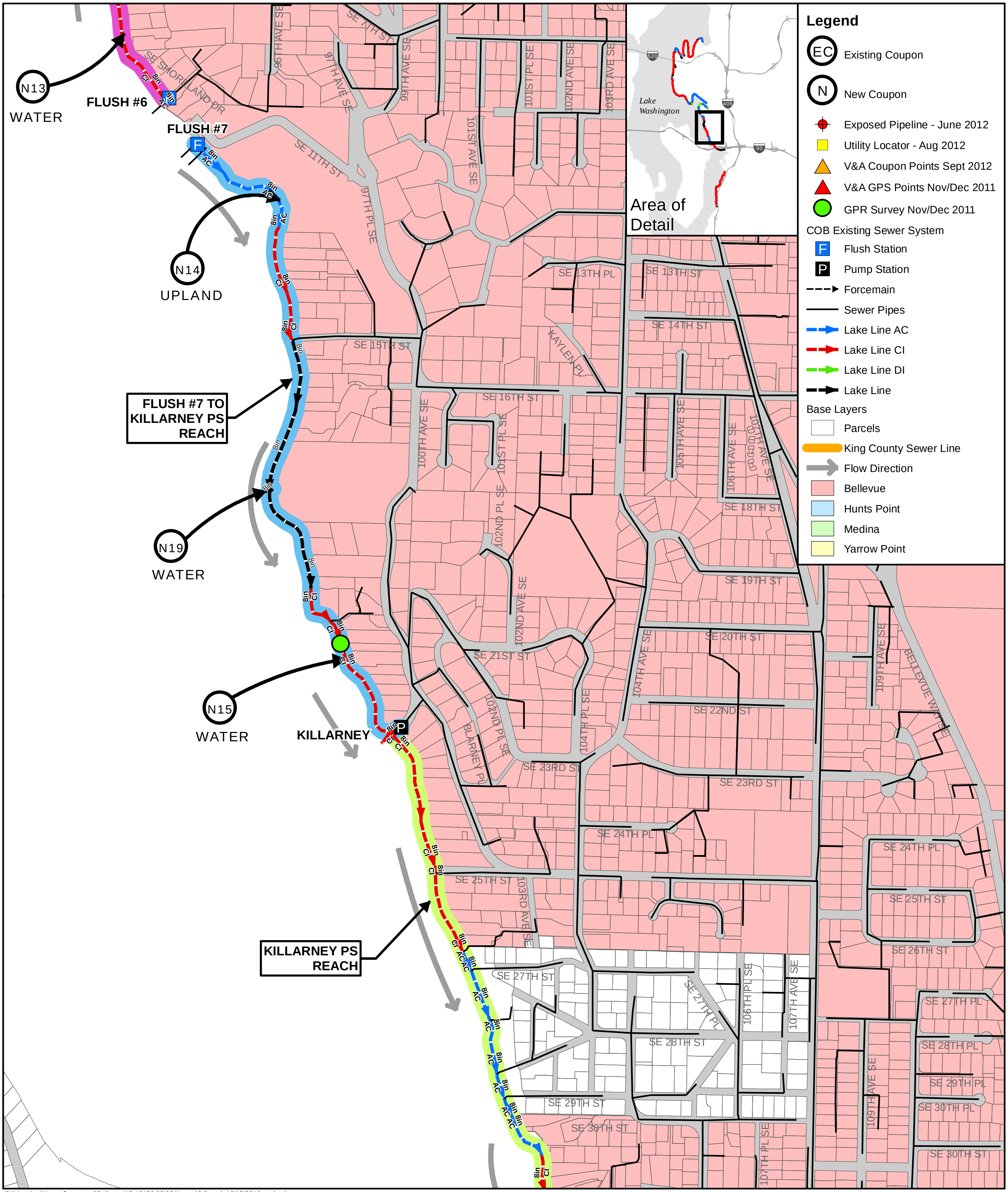
N W E S

0 400 800 Feet

CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS

Figure 4
October 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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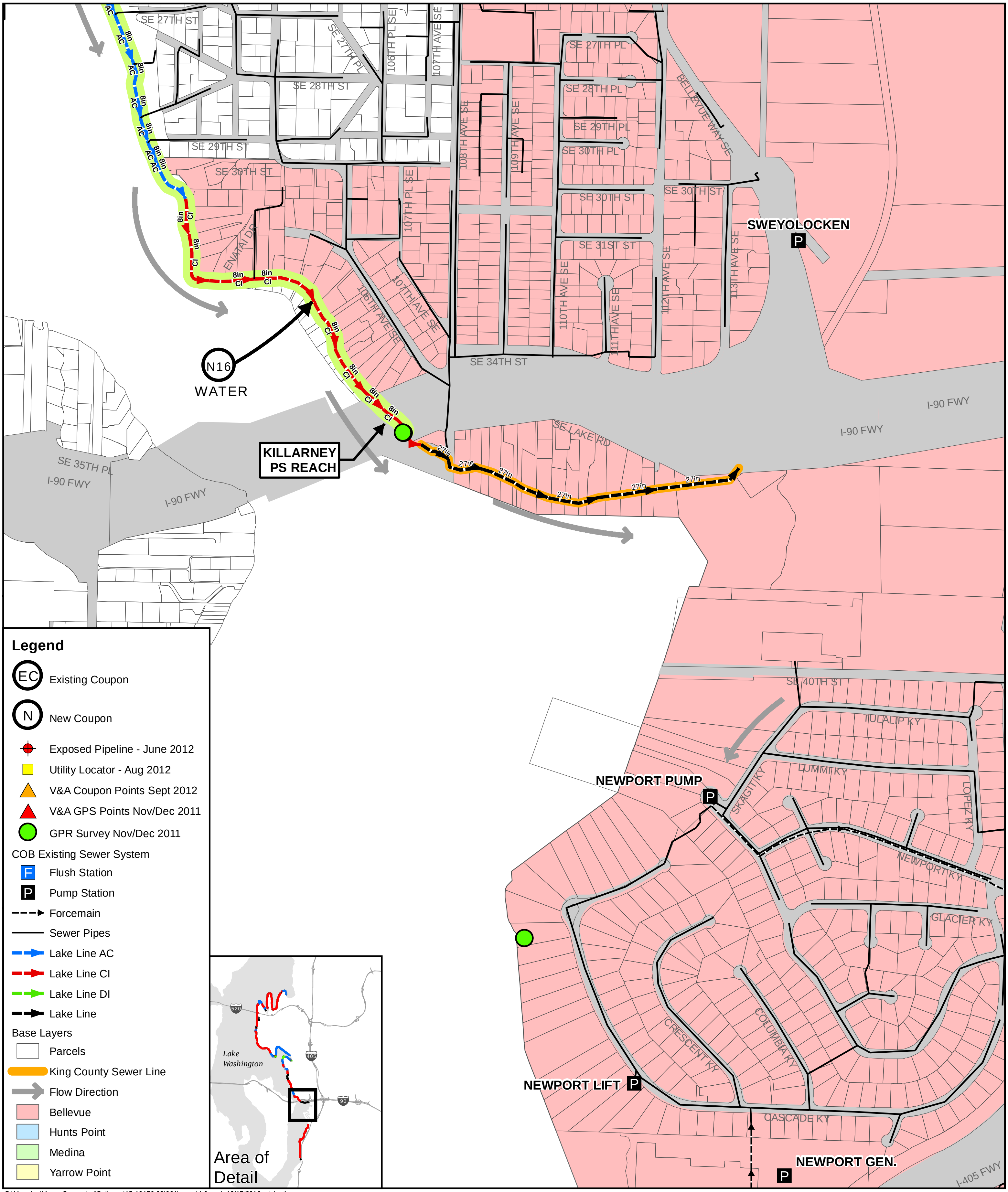
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS
Figure 5
October 2016



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TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
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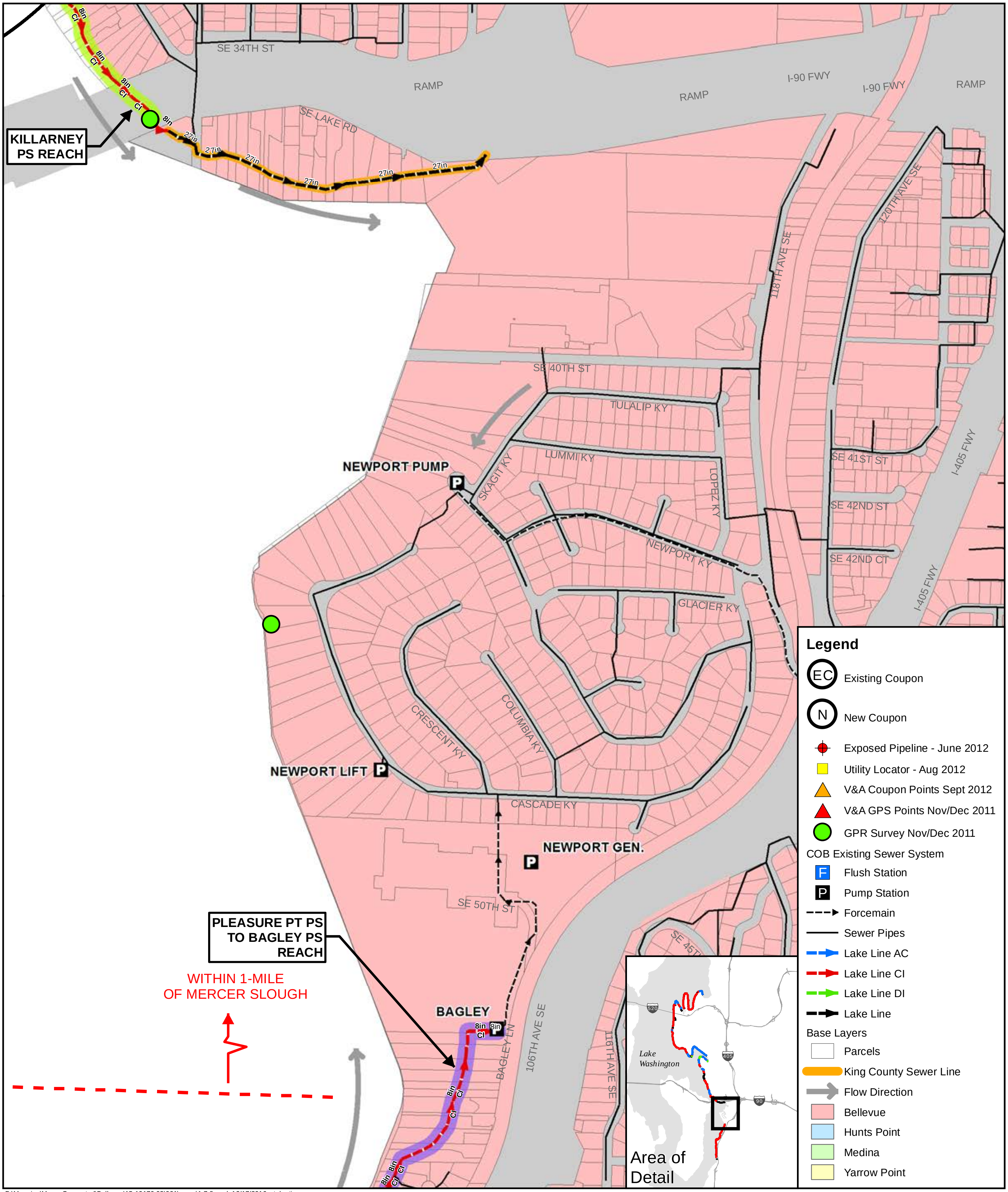
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS

Figure 6
October 2016



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TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
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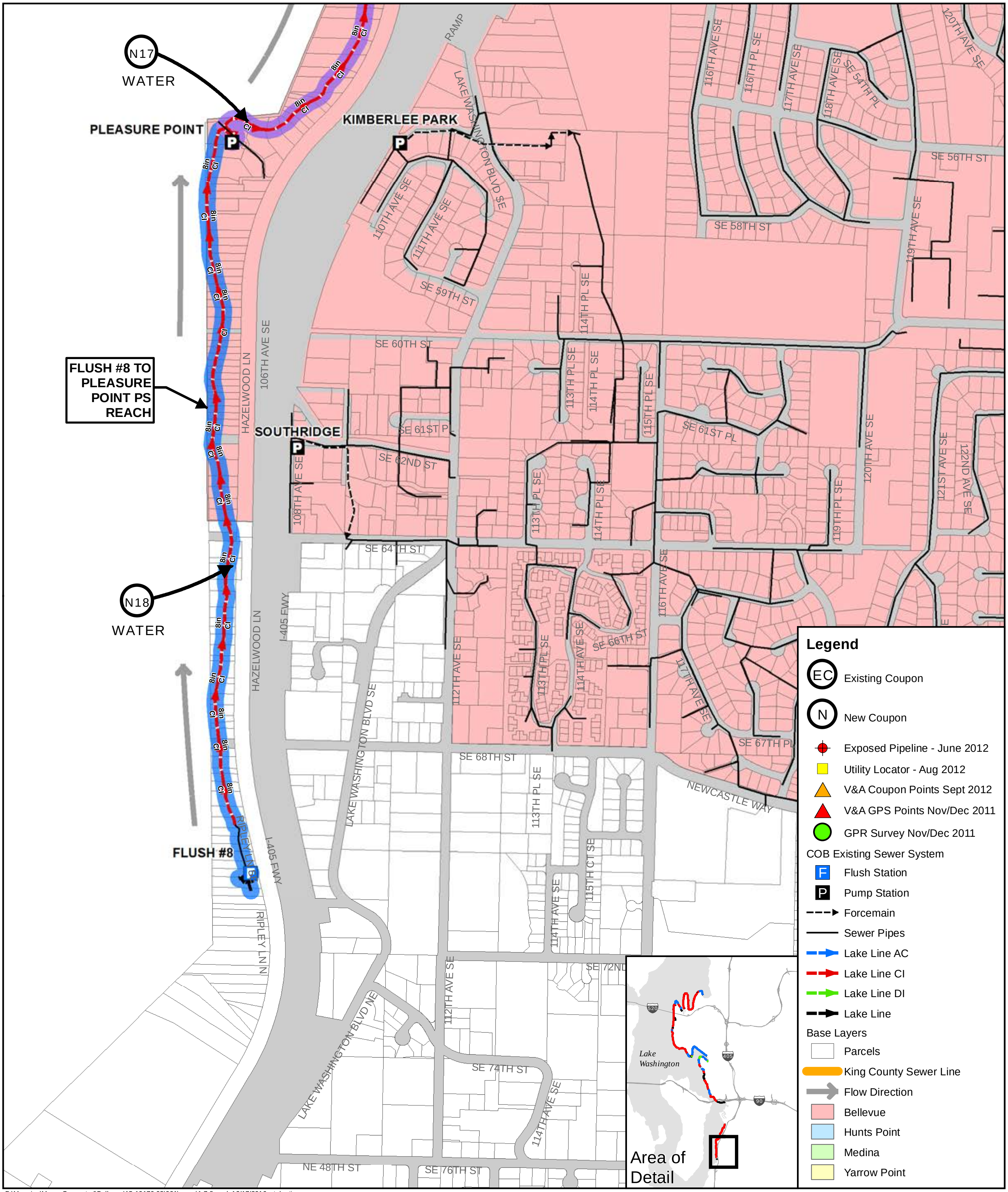
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS
Figure 7
October 2016

CITY OF BELLEVUE WASHINGTON



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TETRA TECH
BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
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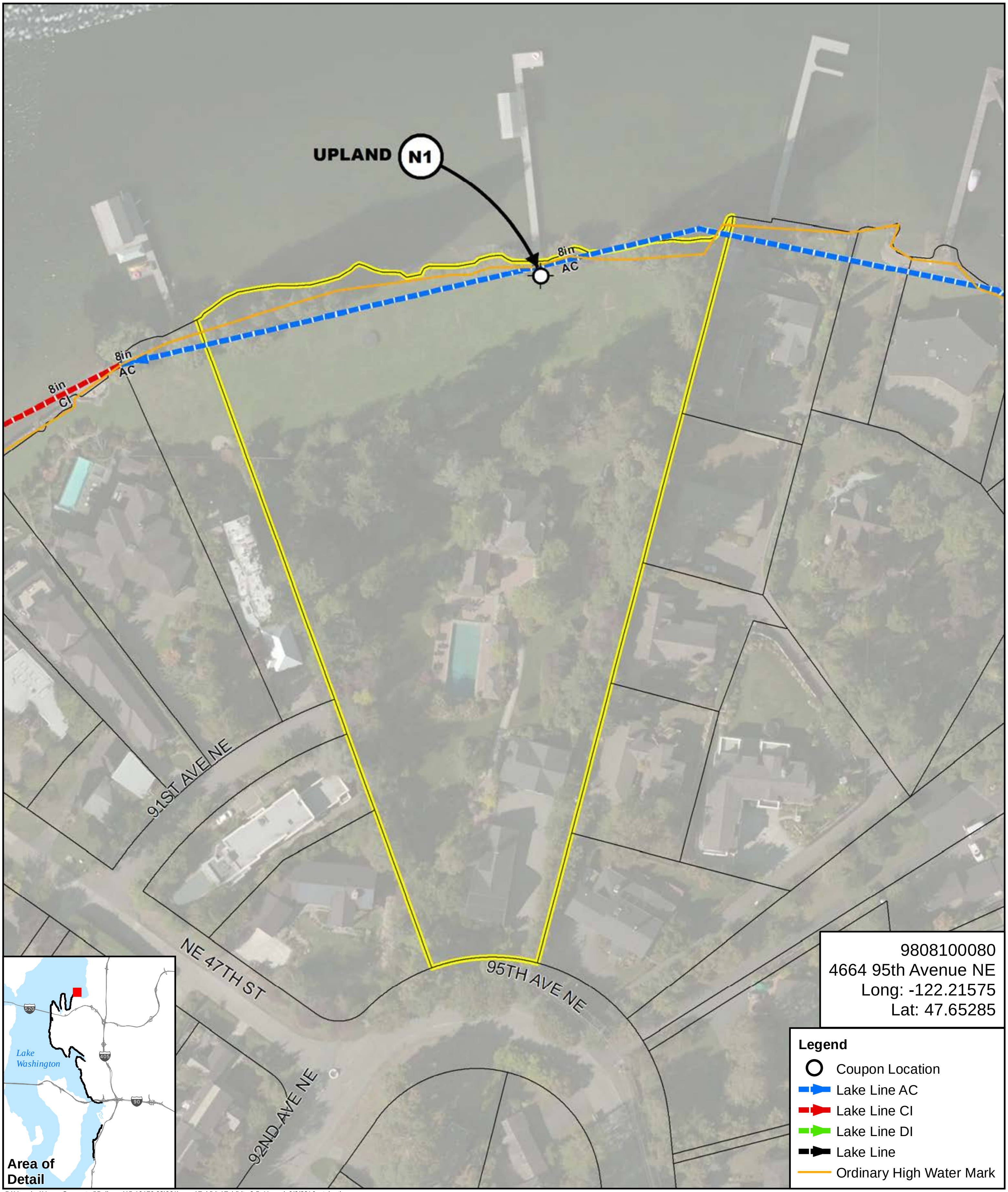
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
COUPON LOCATIONS
Figure 8
October 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

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Existing Sewer System: COB Jan 2011
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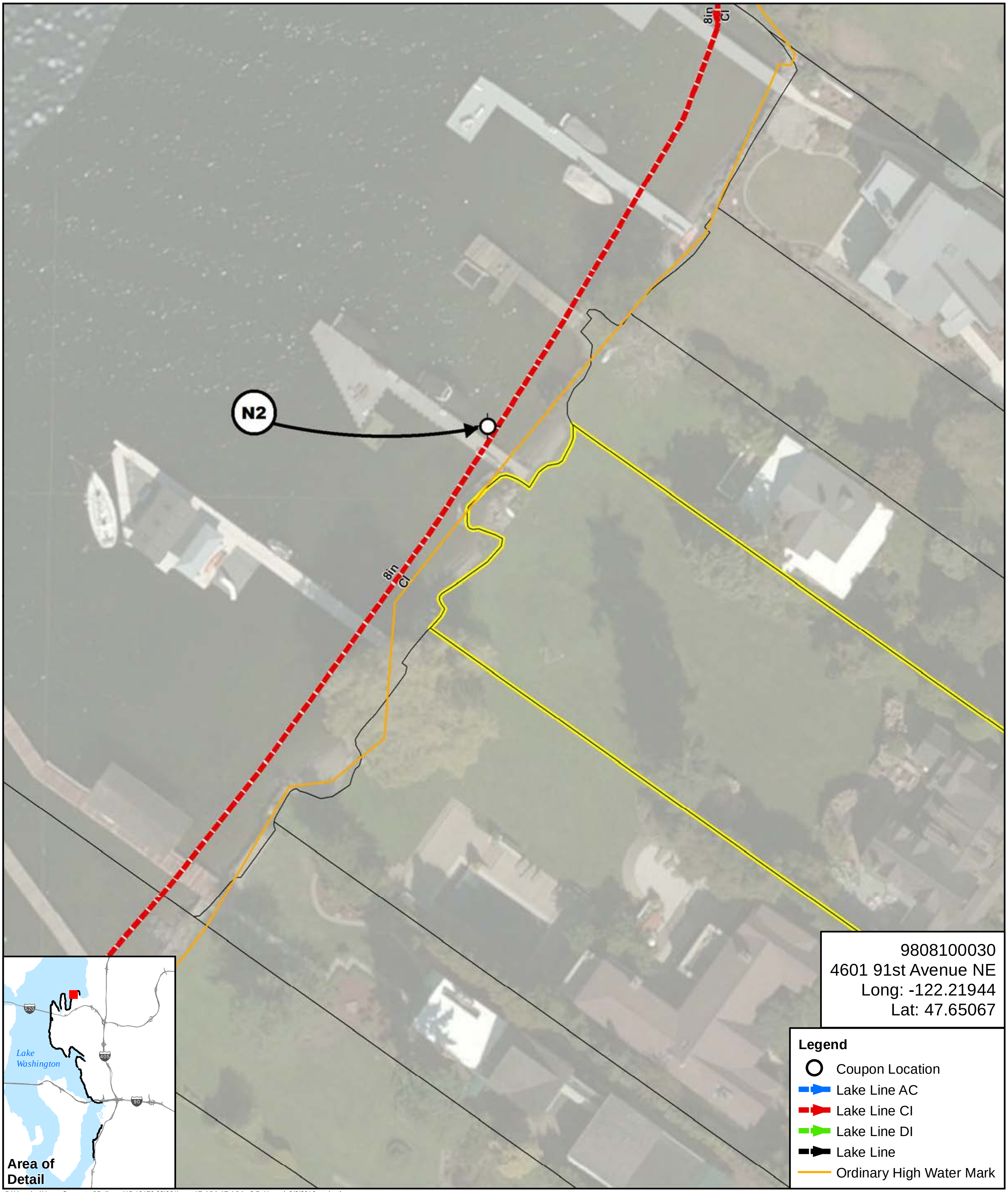
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N1
September 2016

CITY OF BELLEVUE WASHINGTON



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

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Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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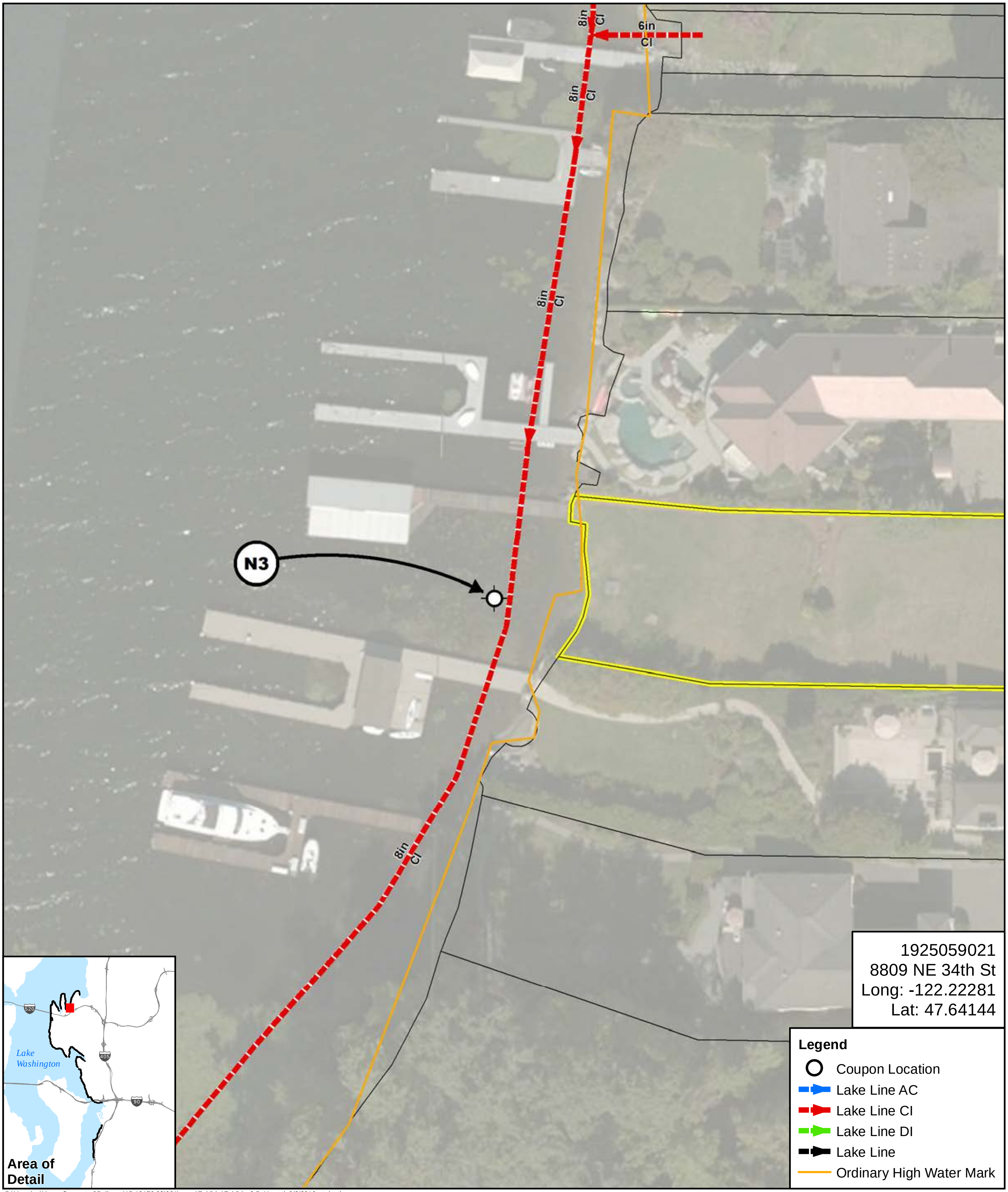
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N2
September 2016



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TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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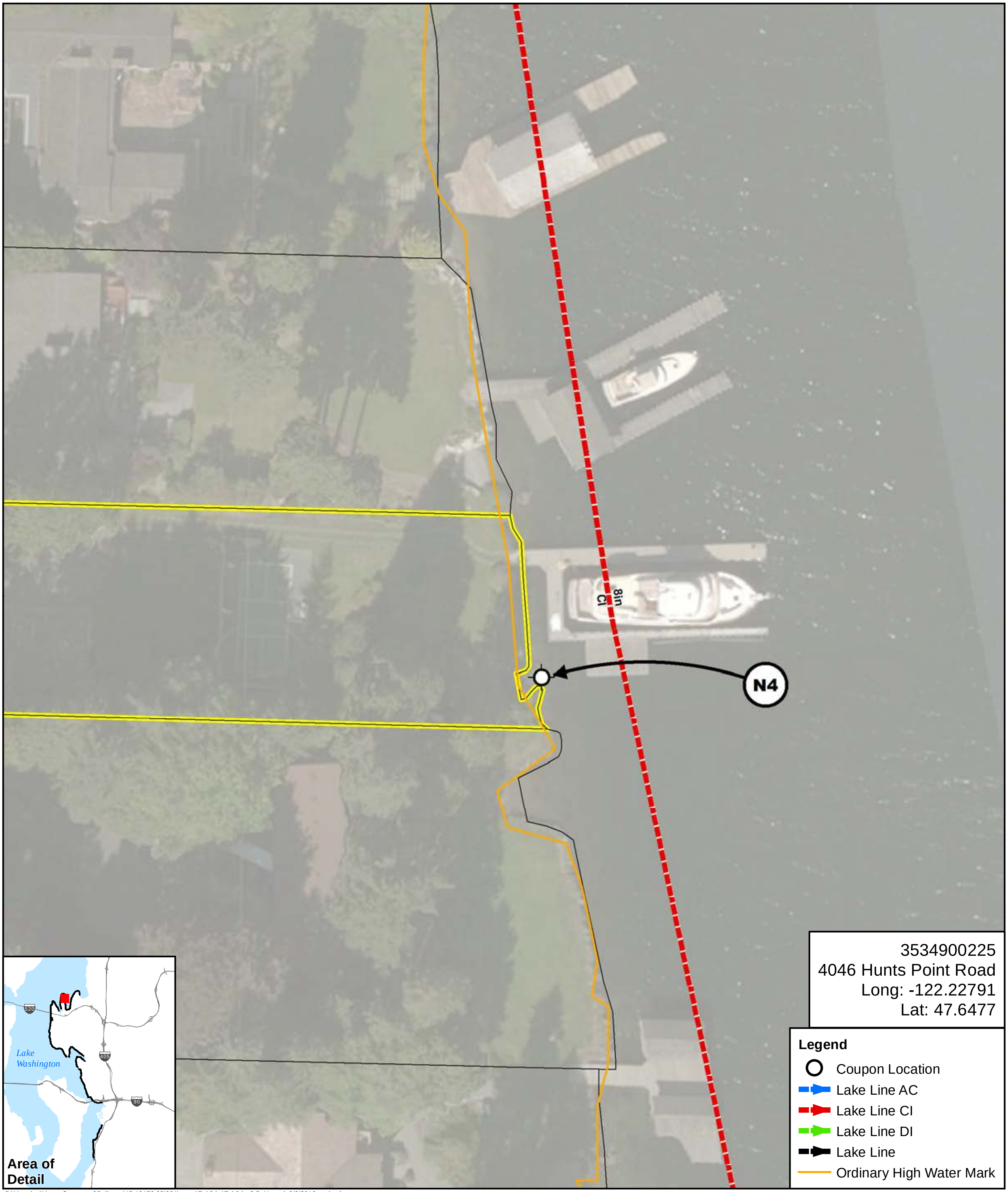
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N3
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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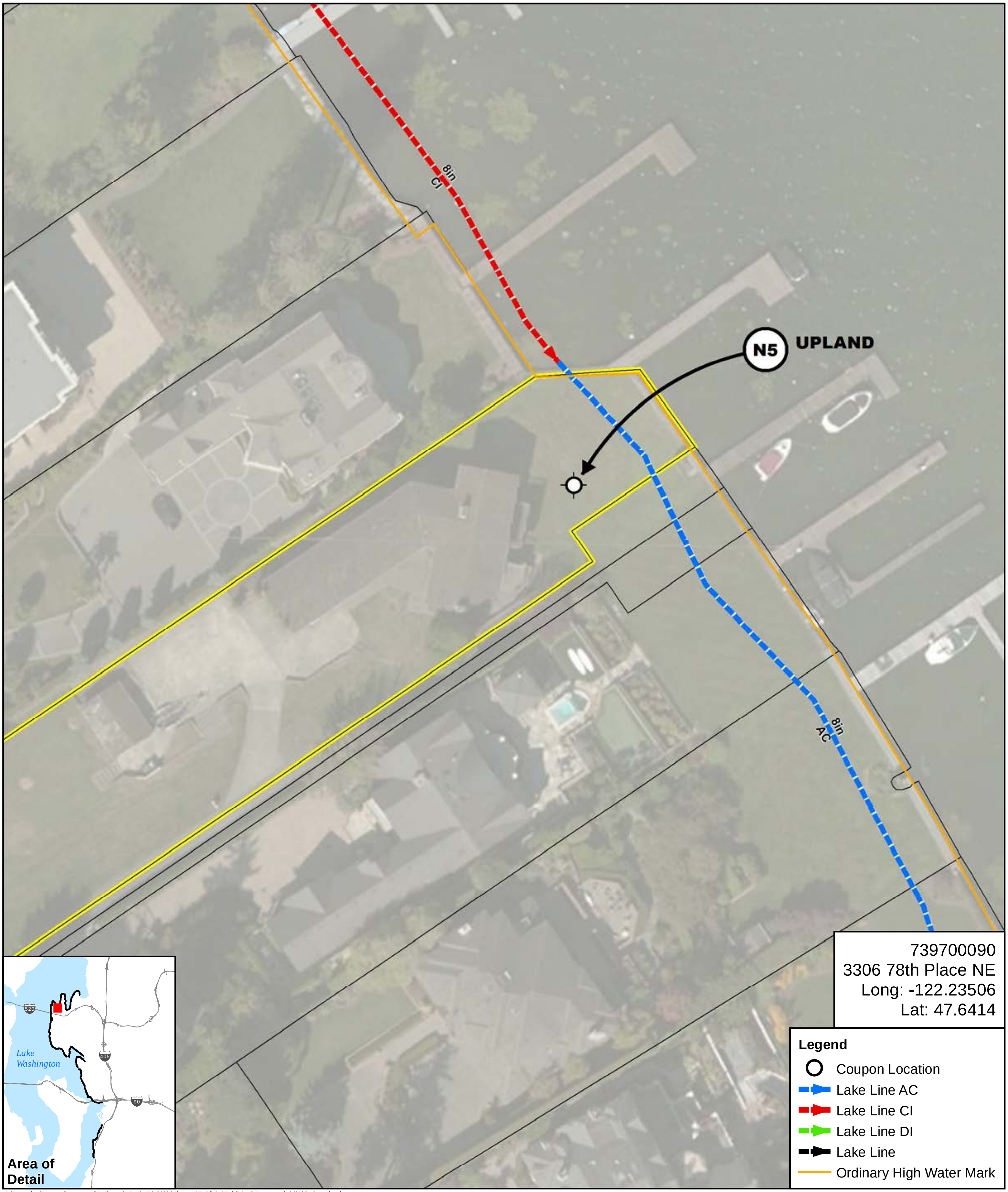
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N4
September 2016

CITY OF BELLEVUE WASHINGTON



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Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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N W E S

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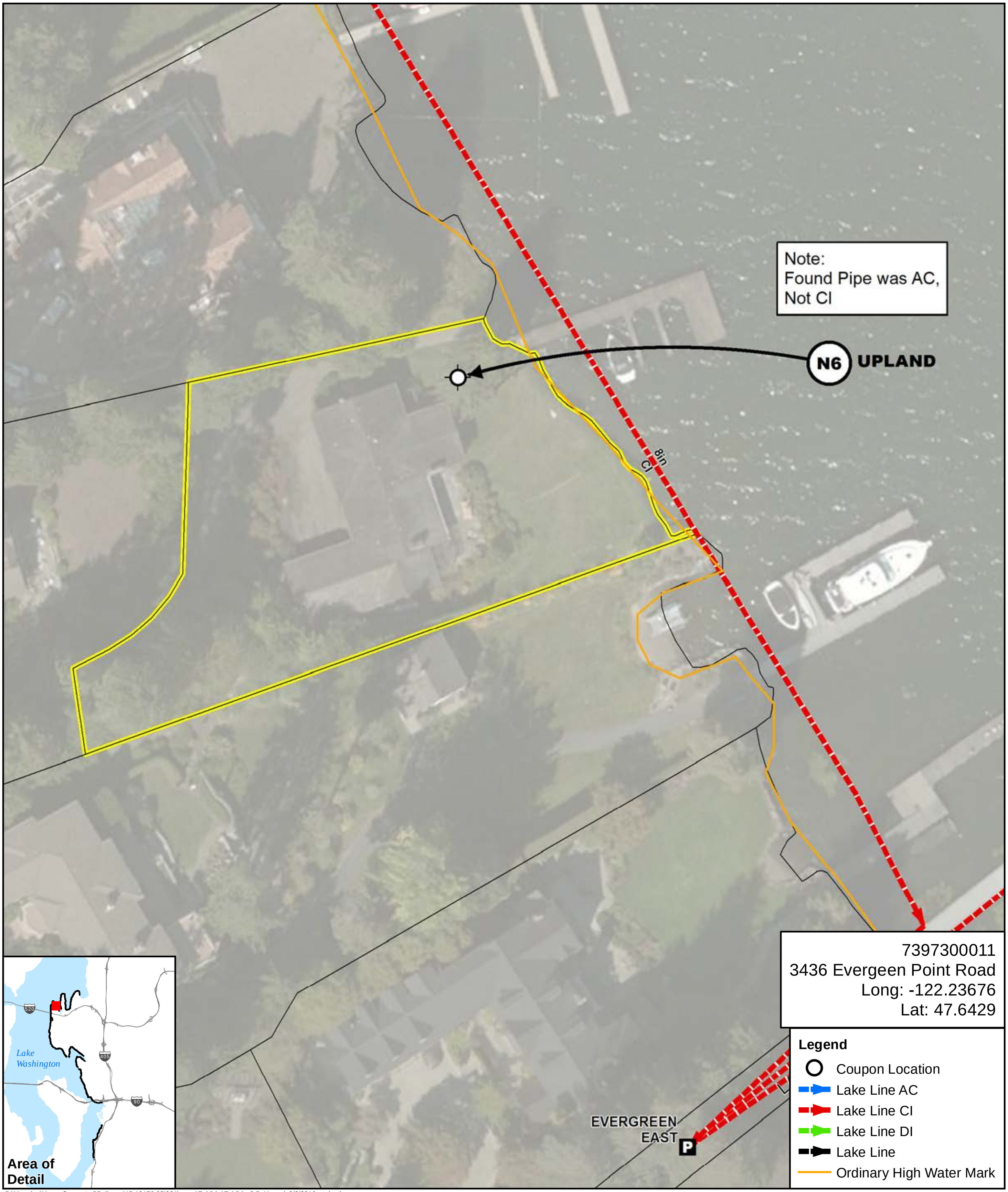
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N5
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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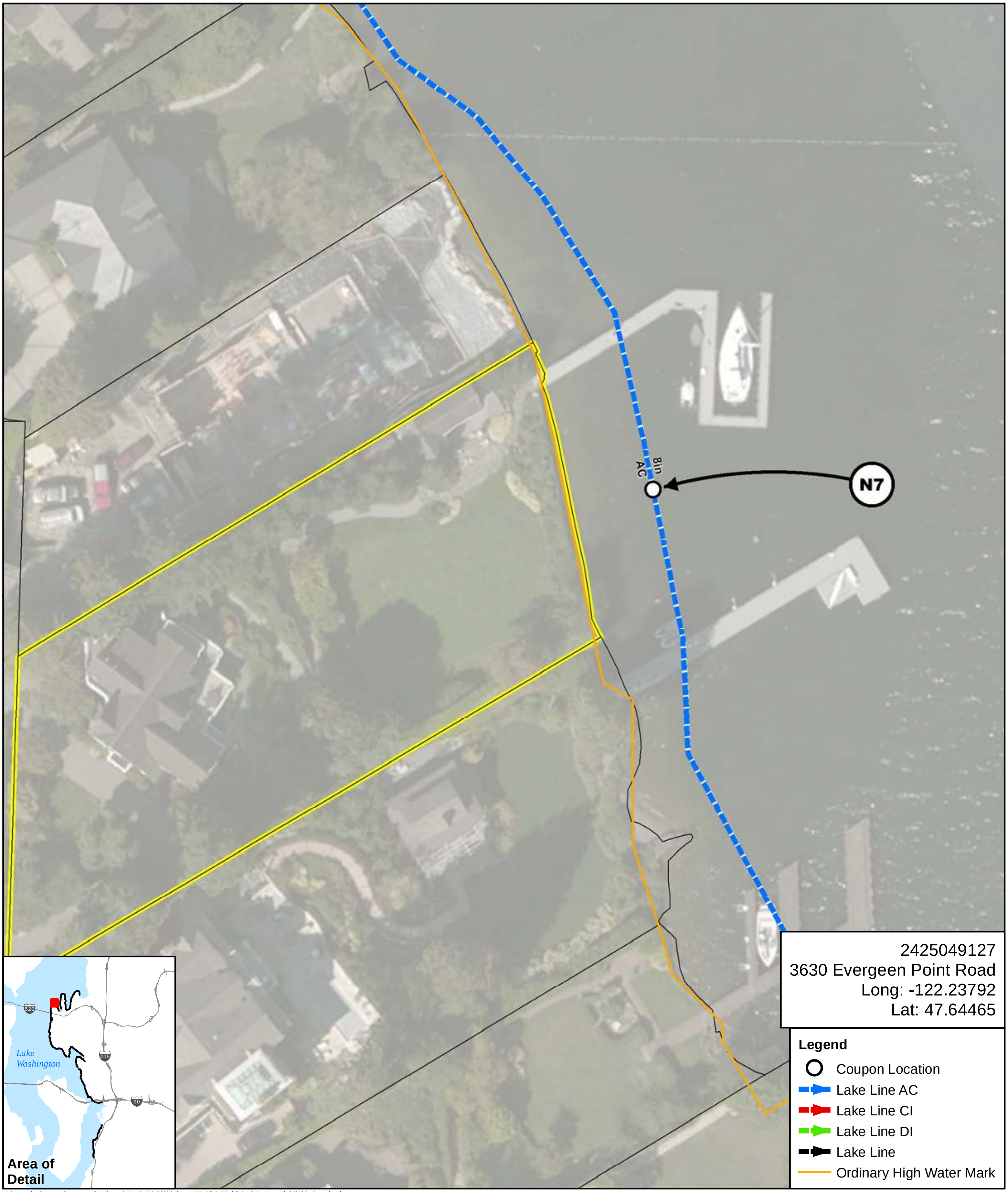
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N6
September 2016



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TETRA TECH

BHC CONSULTANTS

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King County base data 2015: Aerial ESRI Online
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SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS

CITY OF BELLEVUE WASHINGTON

Figure N7
September 2016

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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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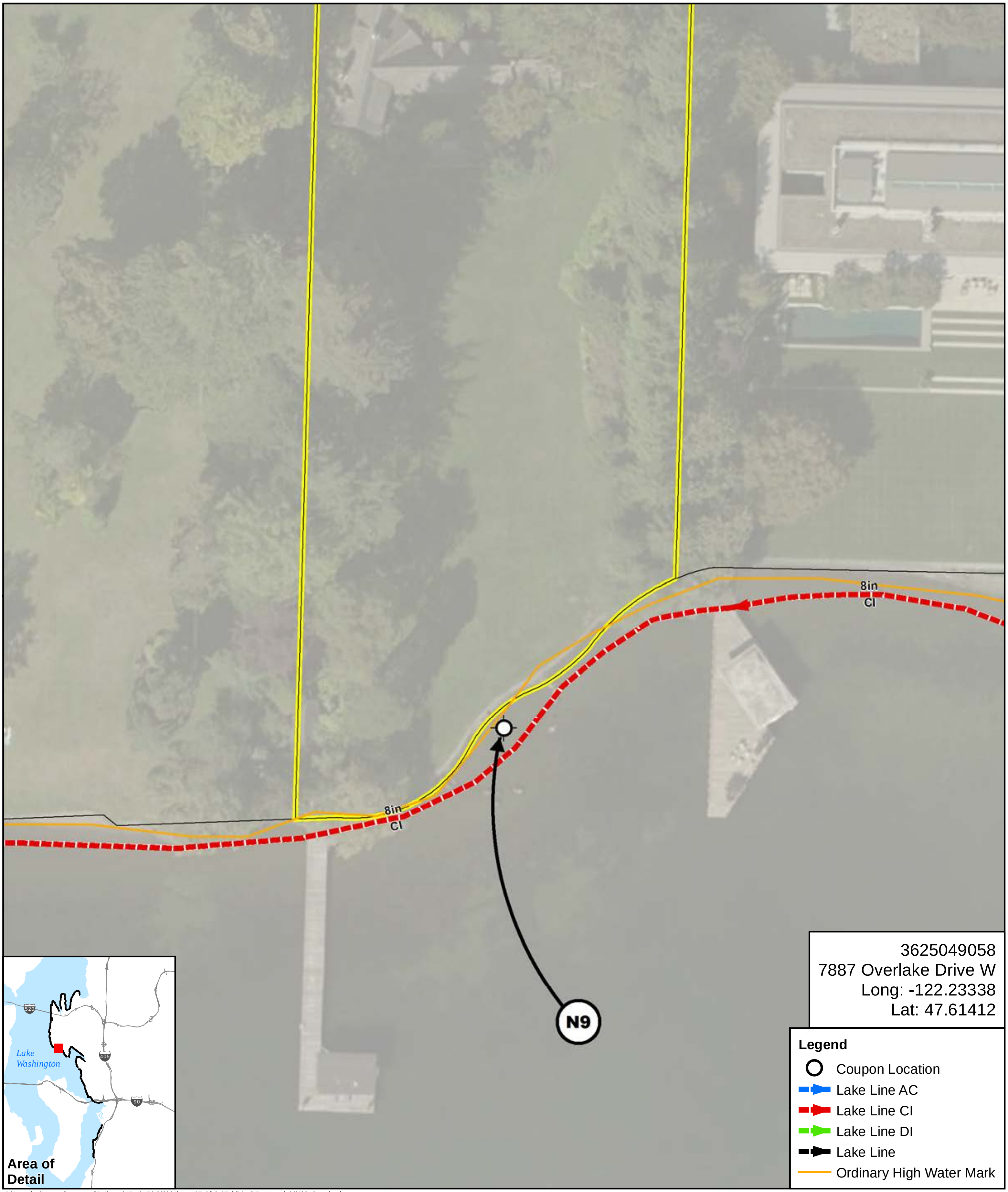
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N8
September 2016

CITY OF BELLEVUE WASHINGTON



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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N W E S

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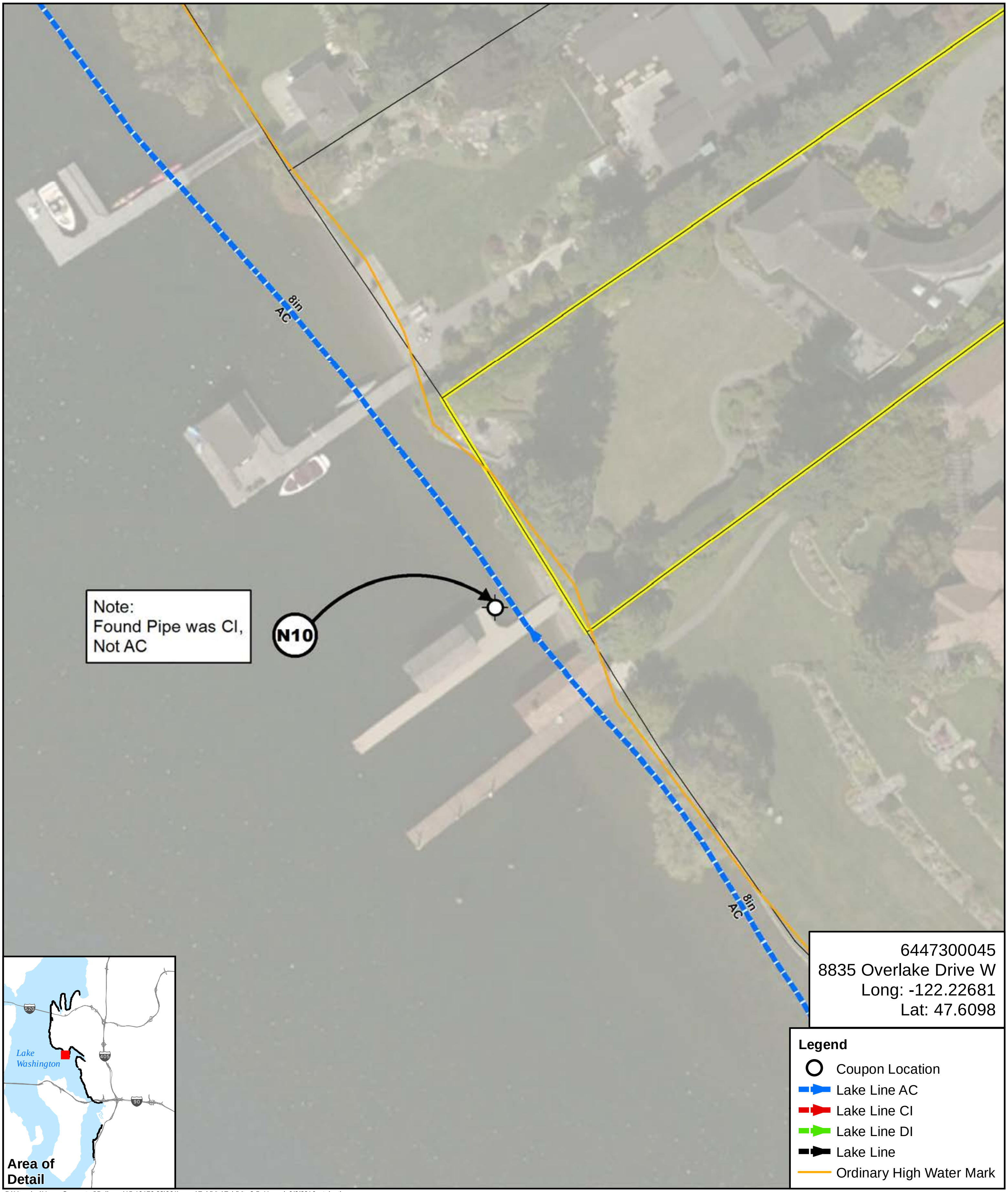
SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N9
September 2016

CITY OF BELLEVUE WASHINGTON



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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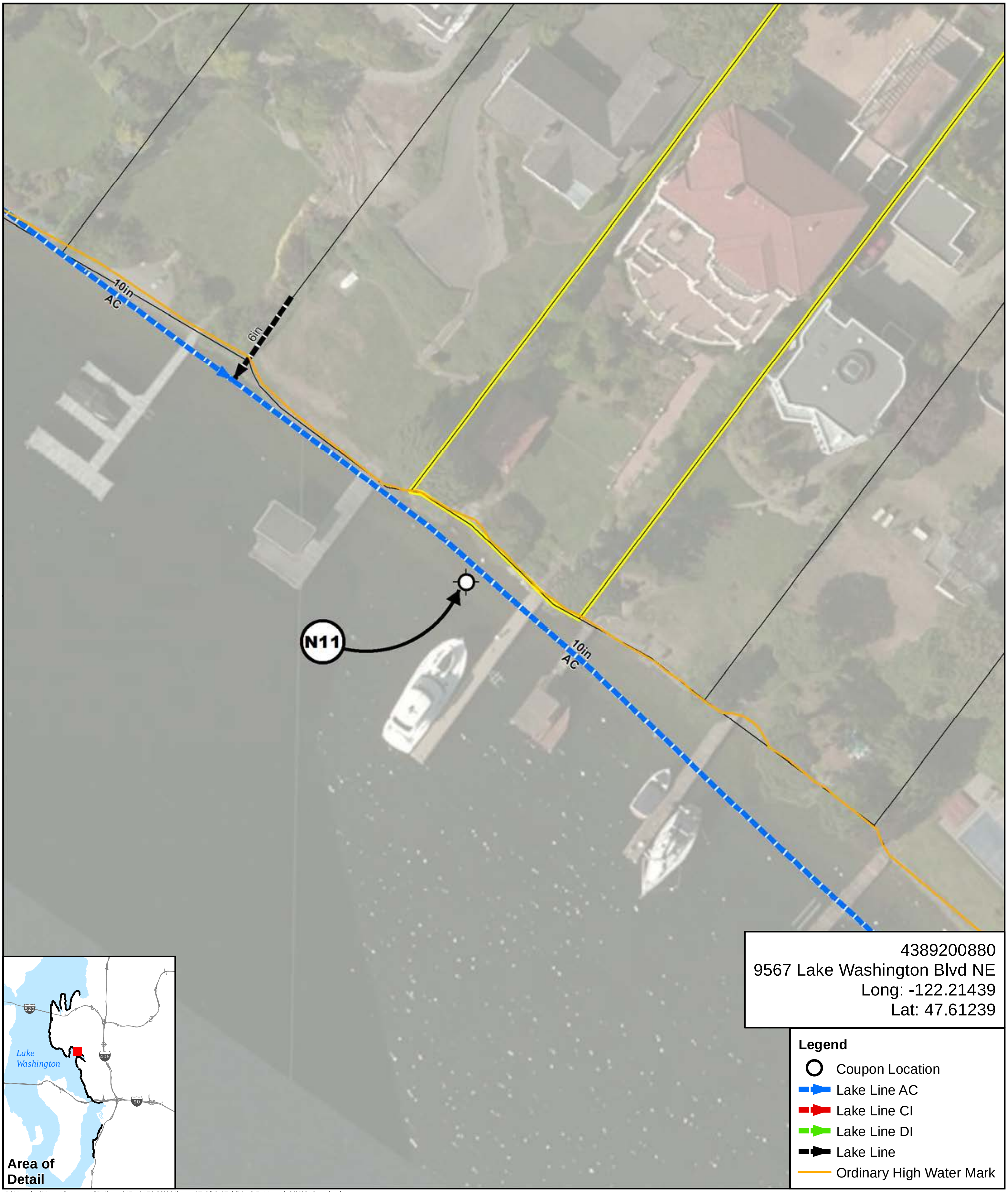
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS

Figure N10
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
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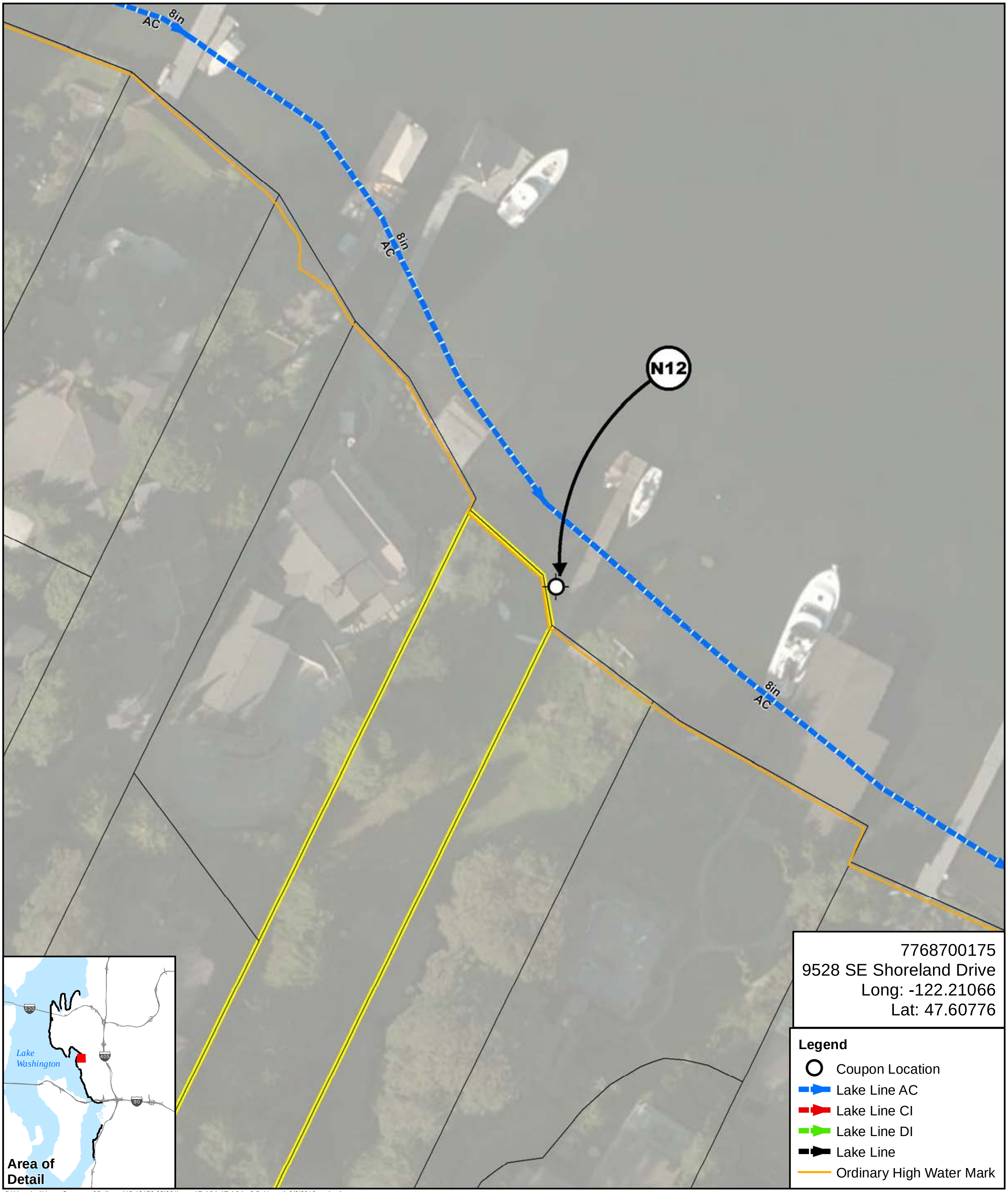
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N11
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
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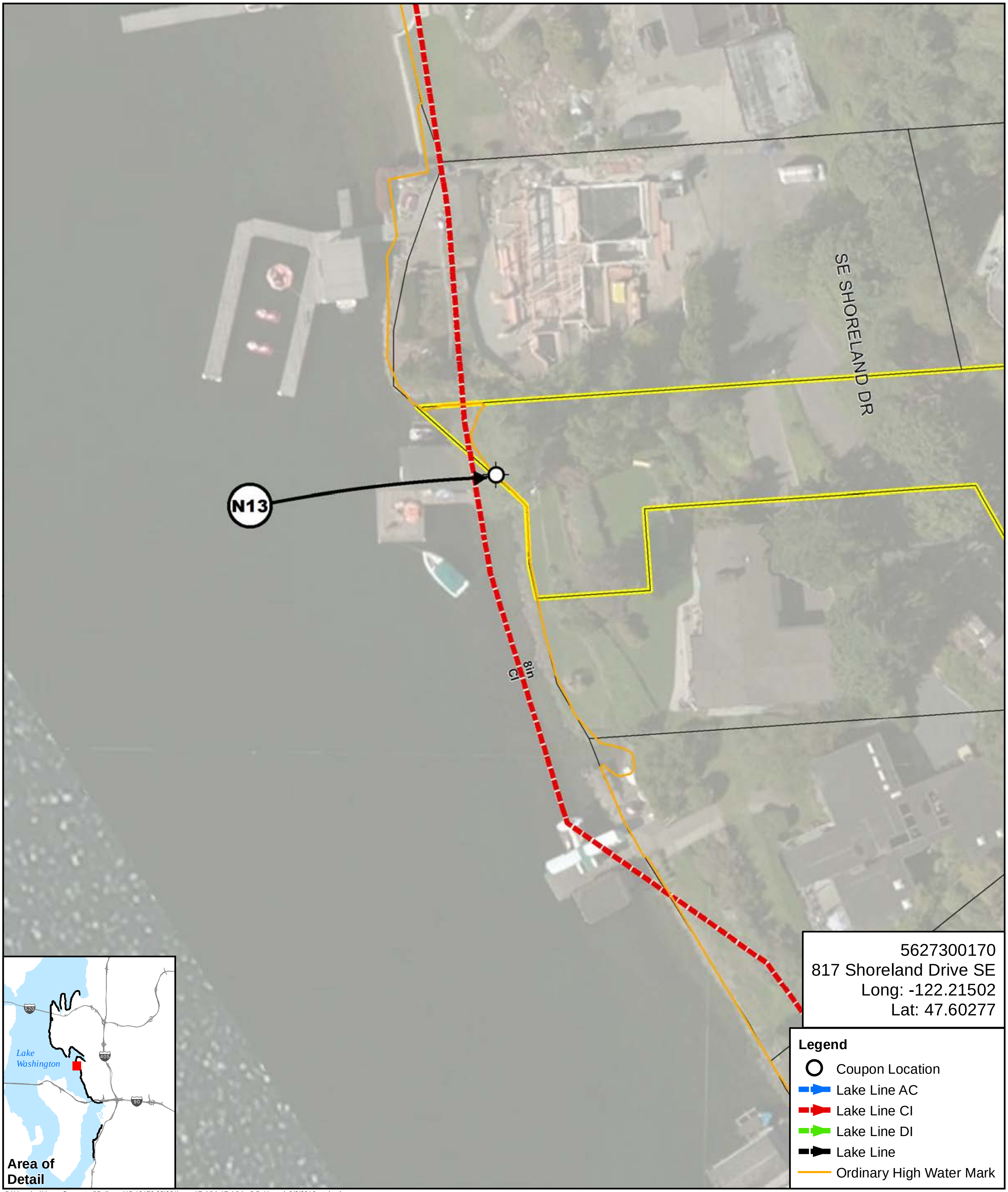
N W E S

0 25 50 Feet

CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N12
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

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King County base data 2015: Aerial ESRI Online
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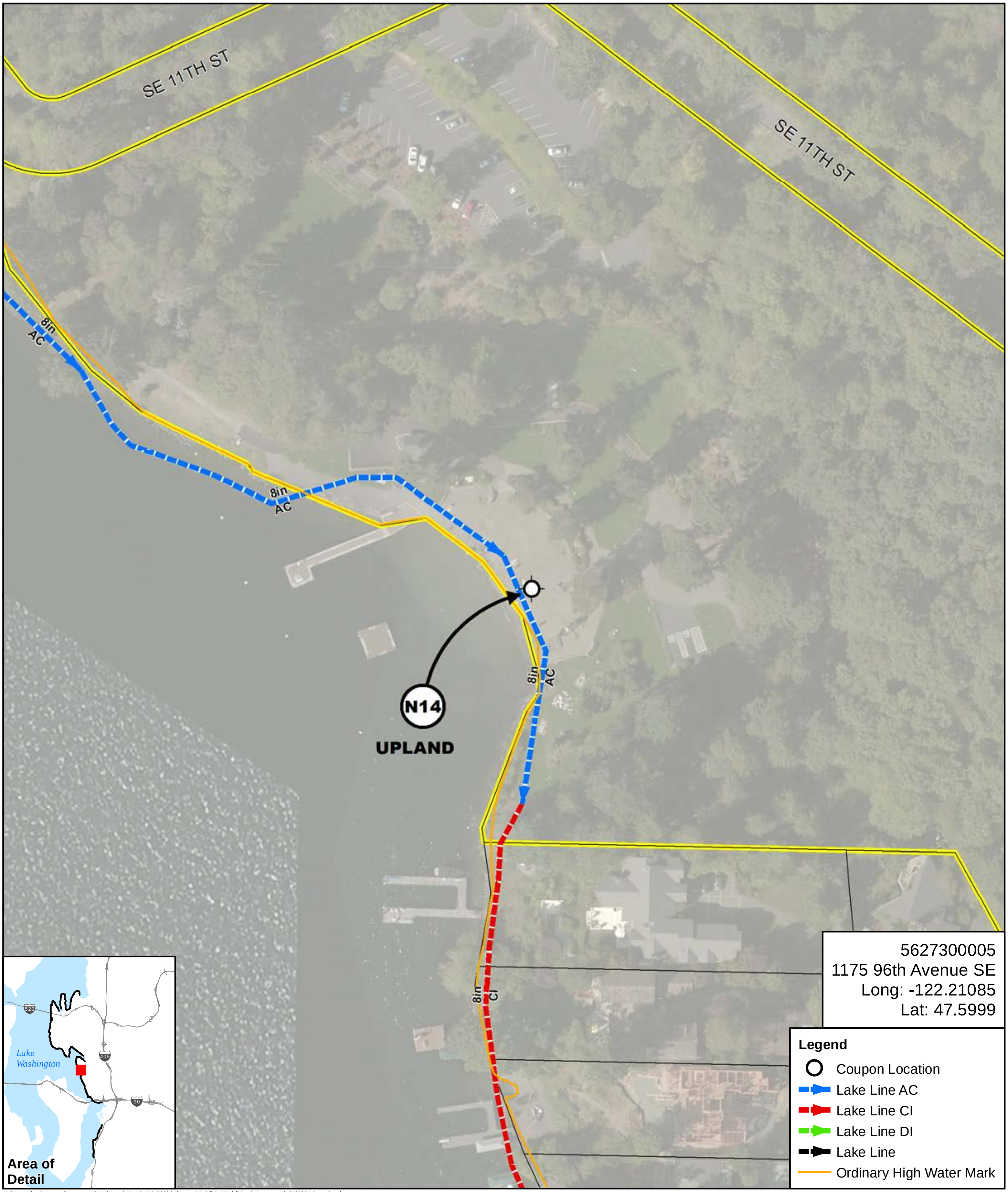
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS

Figure N13
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

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Existing Sewer System: COB Jan 2011
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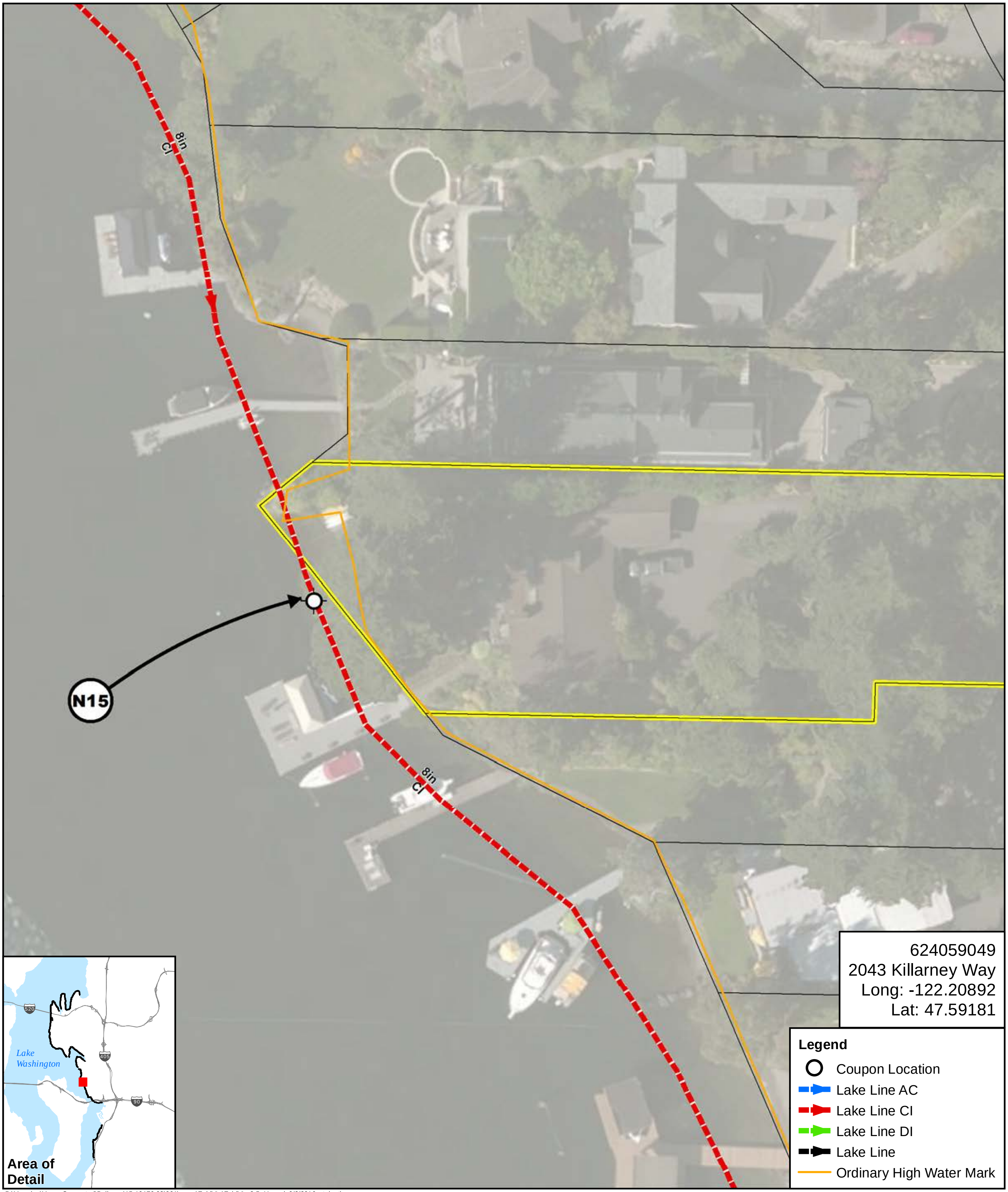
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N14
September 2016

CITY OF BELLEVUE WASHINGTON



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

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King County base data 2015: Aerial ESRI Online
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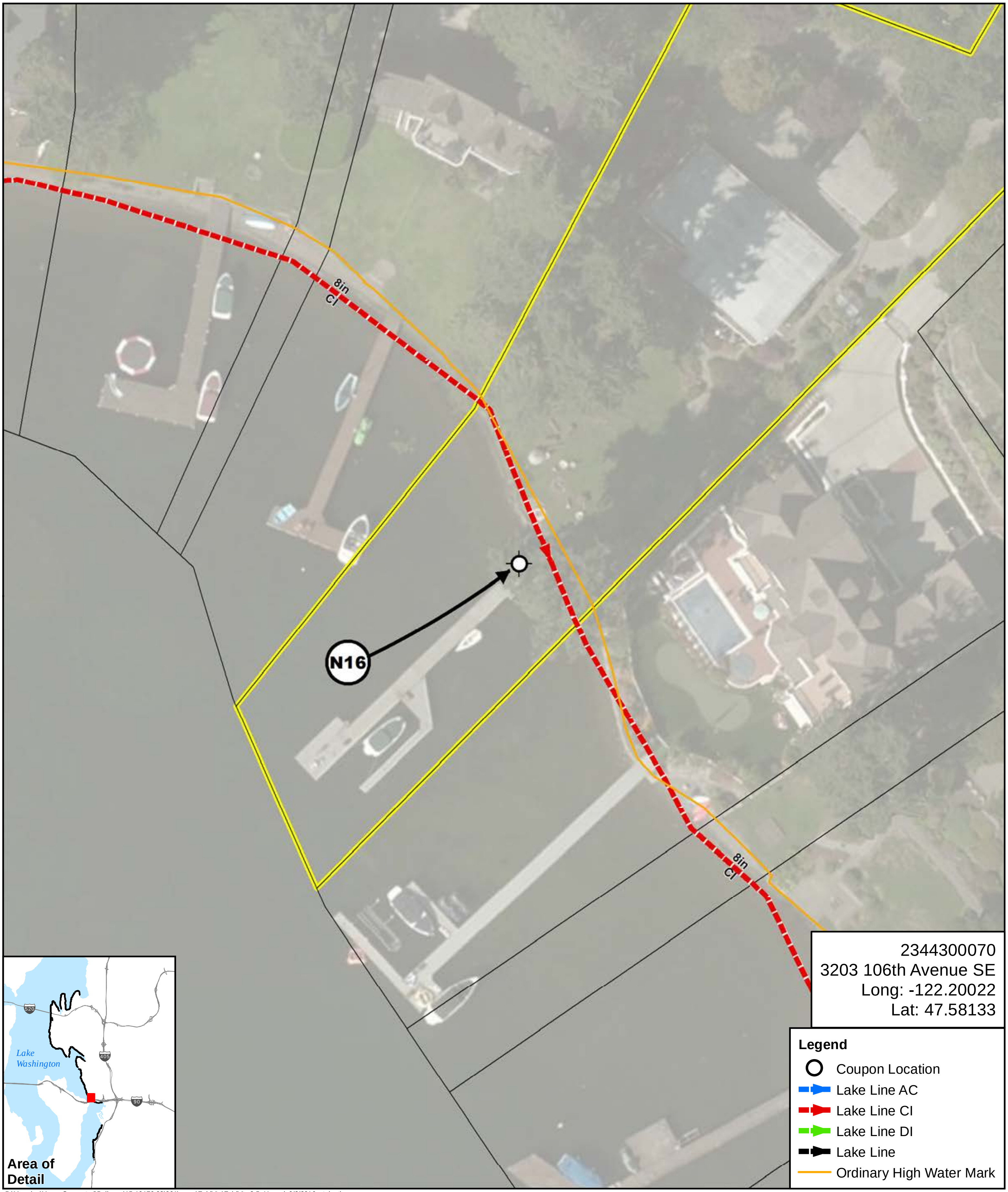
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS

CITY OF BELLEVUE WASHINGTON

Figure N15
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

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N W E S

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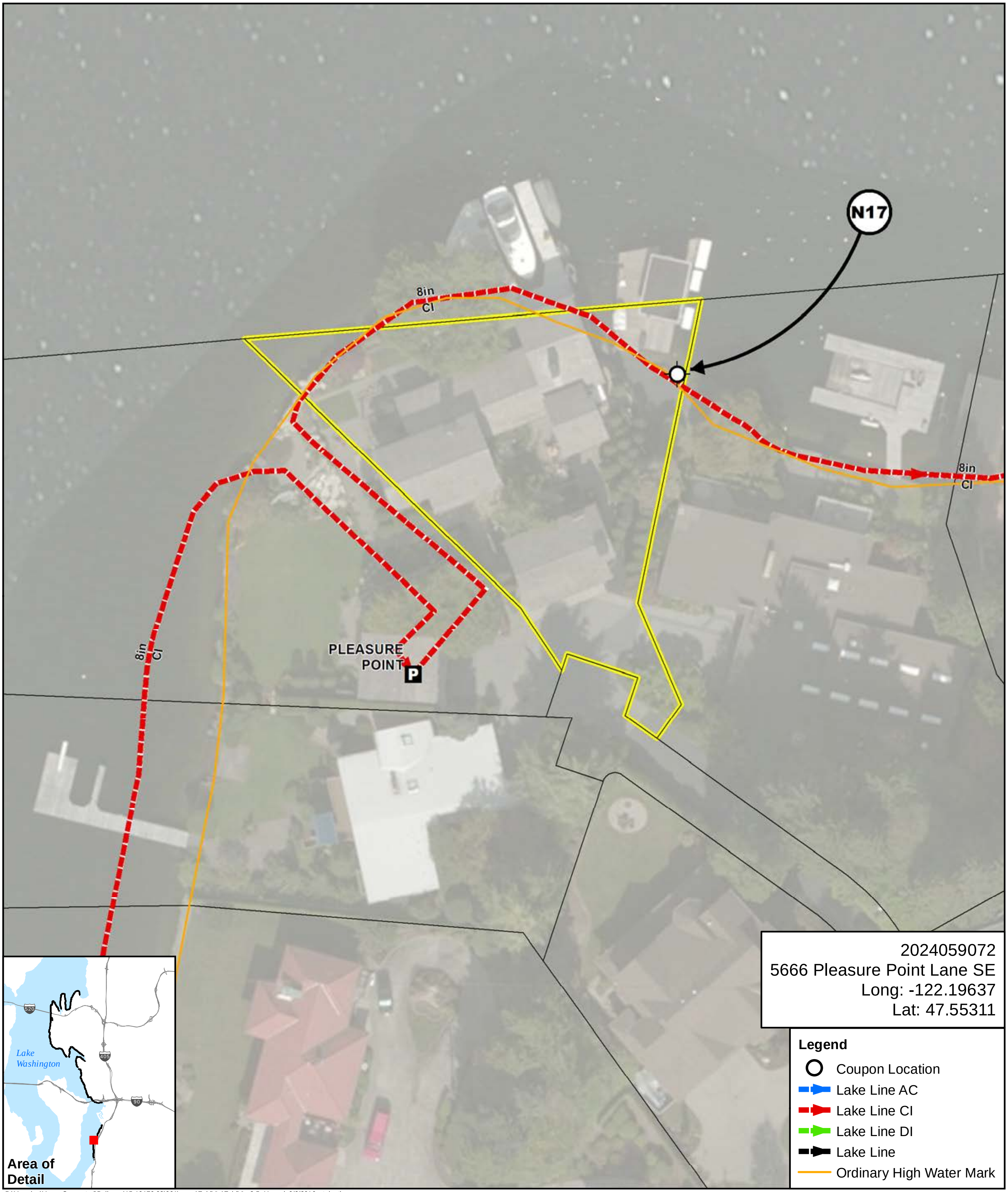
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N16
September 2016

CITY OF BELLEVUE WASHINGTON



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TETRA TECH
BHC CONSULTANTS

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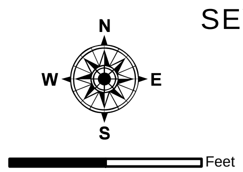
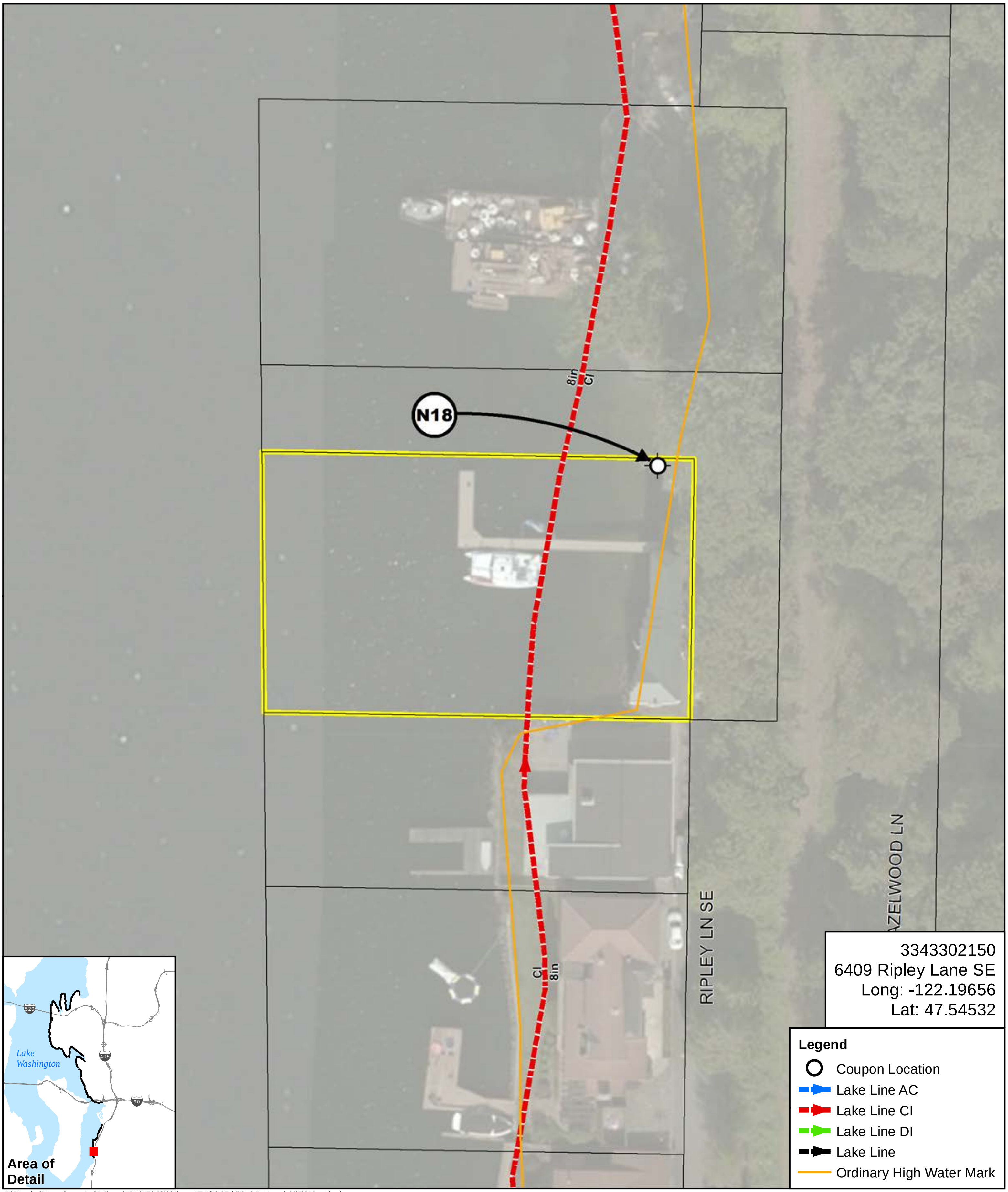


SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N17
September 2016

CITY OF BELLEVUE WASHINGTON



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TETRA TECH

BHC CONSULTANTS

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N W E S

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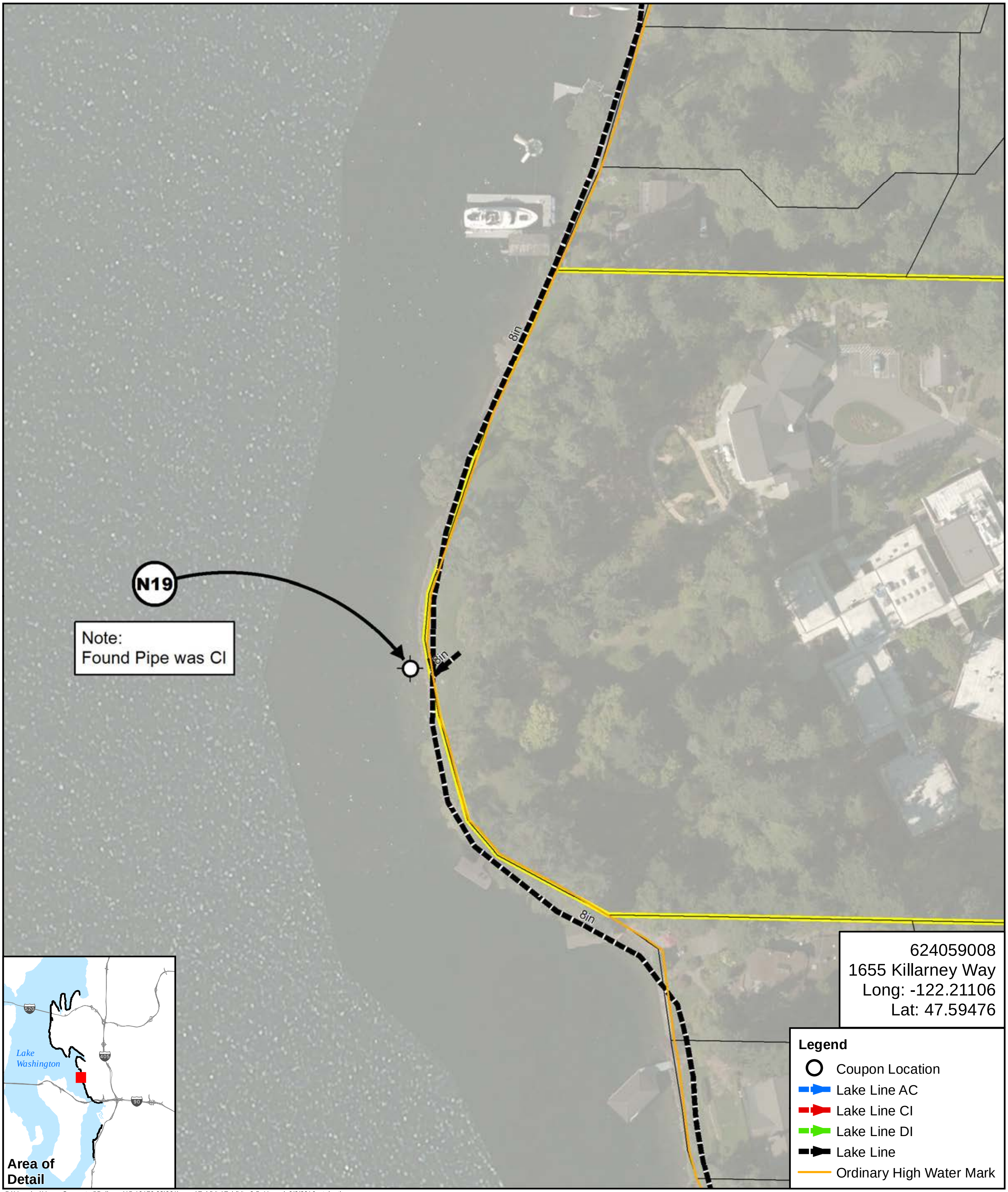
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS

CITY OF BELLEVUE WASHINGTON

Figure N18
September 2016



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TETRA TECH

BHC CONSULTANTS

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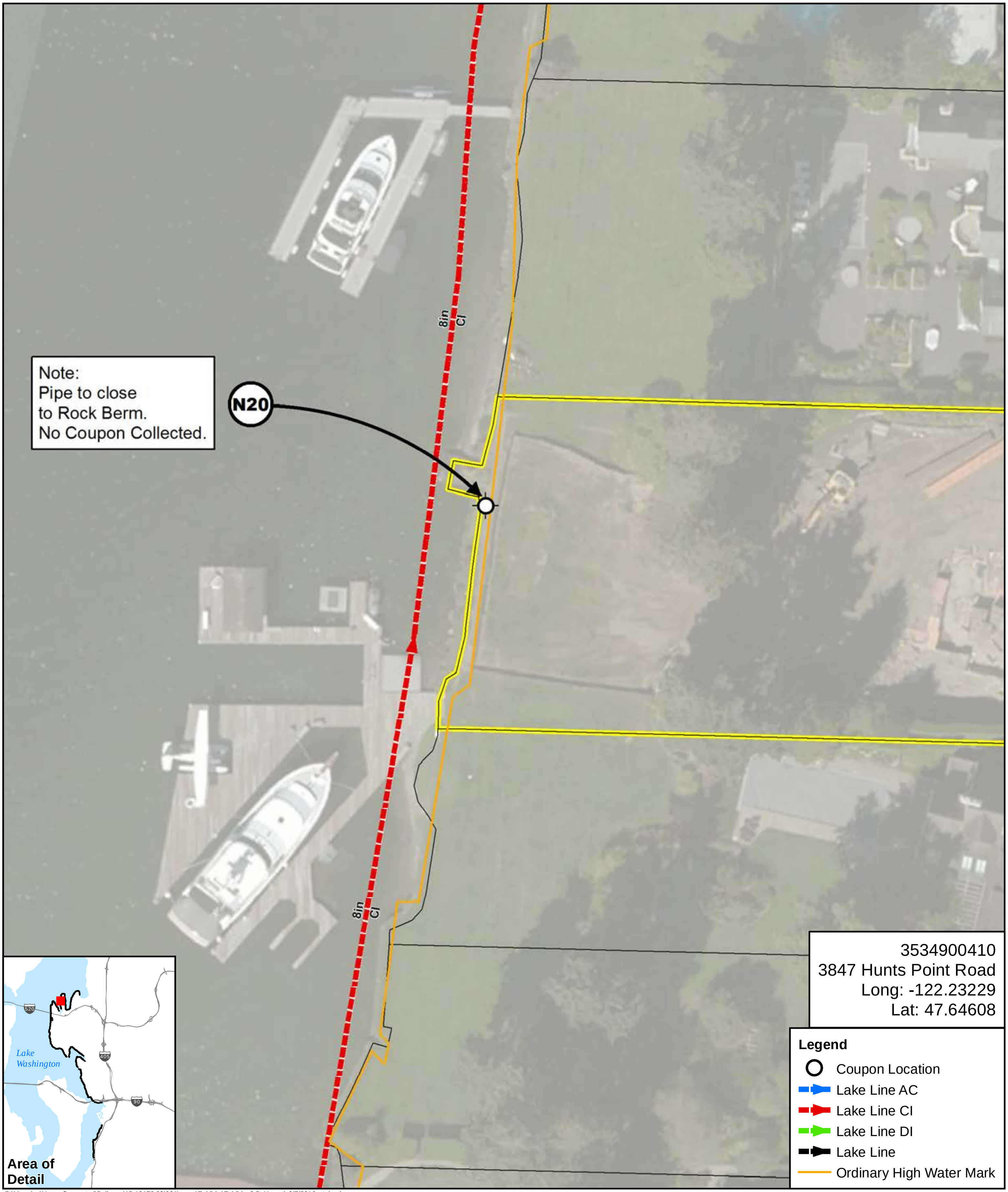
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N19
September 2016



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

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King County base data 2015: Aerial ESRI Online
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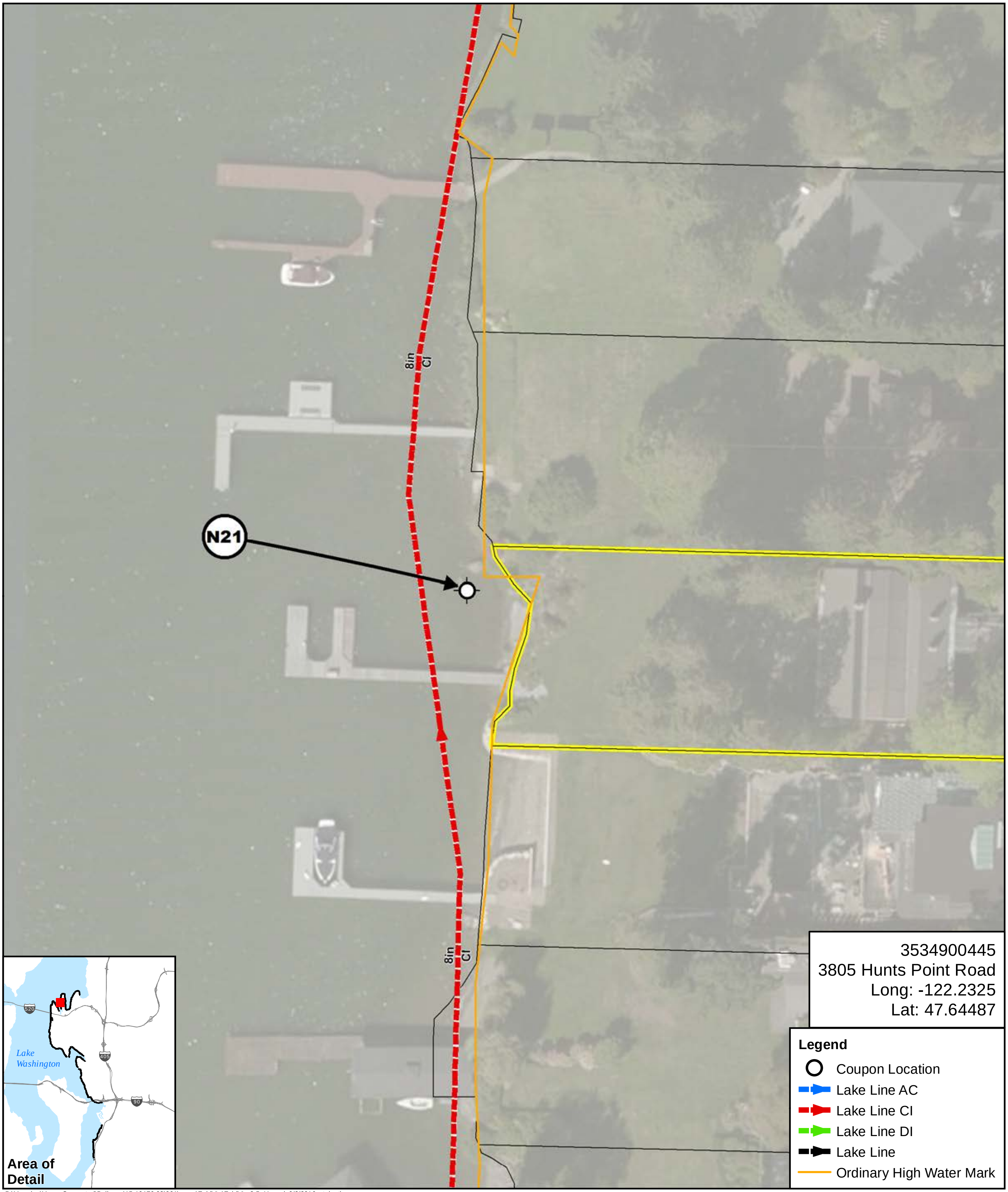
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N20
September 2016

CITY OF BELLEVUE WASHINGTON



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Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2015: Aerial ESRI Online
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

N W E S

0 25 50 Feet

CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
PROPOSED COUPON LOCATIONS
Figure N21
September 2016

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix B. Summary Coupon Data Table

Coupon	Location	PIN	Jurisdiction	LONGITUDE	LATITUDE	SITE_ADDRESS	Field Comments	Pipe Diamter	Pipe Material	Excavation Depth	Water Depth	Distance To OWHM	Collection Date	Install Date	Condition Comments
N1	Upland	9808700900	Yarrow Point	-122.21420	47.65139	4644 95TH AVE NE	See Note 1	8"	AC	<6' cover	n/a	n/a	06/28/2016	1959	40% Deterioration
Field Data	Upland			-122.21575	47.65285	4664 95TH AVE NE	See Note 2	8"	AC		n/a				
N2	Water	9808100030	Yarrow Point	-122.21857	47.65017	4601 91ST AVE NE		8"	CI	<2' cover	3 - 10'	6 ft	08/02/2016		0% wall loss
Field Data	Water			-122.21944	47.65067		Pipe found at staked location. No issues collecting coupon	8"	CI	1' cover	2'				
N3	Water	1925059021	Yarrow Point	-122.22156	47.64146	8809 NE 34TH ST		8"	CI	<2' cover	3 - 10'	16 ft	08/01/2016		0% wall loss
Field Data	Water			-122.22281	47.64144		See Note 3	8"	CI	1' cover	1.5'				
N4	Water	3534900227	Hunts Point	-122.22944	47.64779	4046 HUNTS POINT RD		8"	CI	<2' cover	3 - 10'	38 ft	08/01/2016		Liner is no longer effective protection
Field Data	Water			-122.22791	47.64770		Pipe found at staked location. No issues collecting coupon	8"	CI	1' cover	4.5'				4.78% wall loss
N5	Upland	7397300101	Medina	-122.23524	47.64107	3304 78TH PL NE	See Note 4	8"	AC	<6' cover	n/a		07/05/2016	1960	55% Deterioration
Field Data	Upland			-122.23506	47.64140	3306 78TH PL NE	See Note 5	8"	AC	6.5' cover	n/a				
N6	Upland	2425049128	Medina	-122.23806	47.64297	3436 EVERGREEN POINT RD		8"	CI	<6' cover	n/a		06/29/2016	1960	70% Deterioration
Field Data	Upland			-122.23676	47.64290		See Note 6	8"	AC	6' cover	n/a				Delamination
N7	Water	2425049136	Medina	-122.23913	47.64530	3660 FAIRWEATHER LN		8"	AC	<2' cover	3 - 10'	15 ft			No coupon taken
Field Data	Upland					3630 Evergreen Point Road	See Note 7								
N8	Upland	4000500075	Medina	-122.24285	47.62624	1651 73RD AVE NE		8"	AC	<6' cover	n/a		06/30/2016	1960	40% Deterioration
Field Data	Upland			-122.24307	47.62629		See Note 8	8"	AC	5.5' cover	n/a				
N9	Water	3625049058	Medina	-122.23347	47.61485	7887 OVERLAKE DR W		8"	CI	<2' cover	3 - 10'	10 ft	08/03/2016		0% wall loss
Field Data	Water			-122.23338	47.61412		See Note 9	8"	CI	2' cover	0.5'				
N10	Water	6447300045	Medina	-122.22625	47.61021	8835 OVERLAKE DR W		8"	AC	<2' cover	3 - 10'	23 ft	07/26/2016		Liner is no longer effective protection
Field Data	Water			-122.22681	47.60980		See Note 10	8"	CI						6.2% wall loss
N11	Water	4389200880	Bellevue	-122.21392	47.61281	9567 LAKE WASHINGTON BLVD NE		8"	AC	<2' cover	3 - 10'	12 ft	07/26/2016		35% Deterioration
Field Data	Water			-122.21439	47.61239		See Note 11	10"	AC	2.5' cover	2'				
N12	Water	7768700170	Bellevue	-122.21106	47.60771	9520 SE SHORELAND DR		8"	AC	<2' cover	3 - 10'	19 ft	07/19/2016		40% Deterioration
Field Data	Water			-122.21066	47.60776	9528 SE SHORELAND DR	See Note 12	8"	AC	1' cover	1.5'				
N13	Water	5627300165	Bellevue	-122.21444	47.60263	817 SHORELAND DR SE		8"	CI	<2' cover	3 - 10'	14 ft	07/20/2016		Liner is no longer effective protection
Field Data	Water			-122.21502	47.60277		See Note 13	8"	CI	1' cover	1.5'				7.4% wall loss
N14	Upland	5627300005	Bellevue	-122.20980	47.59989	1175 96TH AVE SE		8"	AC	<6' cover	n/a		06/28/2016		40% Deterioration
Field Data	Upland			-122.21085	47.59990	9600 SE 11th St, Chism Beach Park	See Note 14	8"	AC	4' cover	n/a				
N15	Water	0624059049	Bellevue	-122.20779	47.59164	2047 KILLARNEY WAY		8"	CI	<2' cover	3 - 10'	21 ft	07/22/2016		23.5% wall loss
Field Data	Water			-122.20892	47.59181	2043 KILLARNEY WAY	See Note 15	8"	CI	Exposed	5'				
N16	Water	2344300070	Bellevue	-122.19983	47.58170	3203 106TH AVE SE		8"	CI	<2' cover	3 - 10'	6 ft	07/25/2016		No liner present
Field Data	Water			-122.20022	47.58133		See Note 16	8"	CI	2.5' cover					15.6% wall loss
N17	Water	2024059072	Bellevue	-122.19672	47.55303	5666 PLEASURE POINT LN SE		8"	CI	<2' cover	3 - 10'	1 ft	07/27/2016		No liner present
Field Data	Water			-122.19637	47.55311		See Note 17	8"	CI	1' cover	2.5'				6.4% wall loss
N18	Water	6828100010	Bellevue	-122.19659	47.54961	5859 PLEASURE POINT LN SE		8"	CI	<2' cover	3 - 10'	24 ft	07/27/2016		Liner is no longer effective protection
Field Data	Water			-122.19656	47.54532	6409 Ripley Lane SE	See Note 18	8"	CI	1' cover	3.5'				5.1% wall loss

Coupon	Location	PIN	Jurisdiction	LONGITUDE	LATITUDE	SITE_ADDRESS	Field Comments	Pipe Diamter	Pipe Material	Excavation Depth	Water Depth	Distance To OWHM	Collection Date		
N19	Water	0624059008	Bellevue	-122.20932	47.59547	1655 KILLARNEY WAY		8"	CI	<2' cover	3 - 10'	1 ft	07/25/2016		16.3% wall loss
Field Data	Water			-122.21106	47.59476		See Note 19	8"	CI	Exposed	3.5'				
N20	Water		Hunts Point			3847 HUNTS POINT ROAD		8"	CI	<2' cover	3 - 10'		N/A		No coupon taken
Field Data	Water			-122.23229	47.64608	Pipe found at base of rock wall	See Note 20	8"	CI	2' cover	1'				
N21	Water		Hunts Point			3805 HUNTS POINT ROAD		8"	CI	<2' cover	3 - 10'		08/04/2016	1960	0% wall loss
Field Data	Water			-122.23250	47.64487	New location	See Note 21	8"	CI	1.5' cover	2'				

Notes:

1. Moved from 4644 95th Ave NE due to inadequate access to pipe for construction equipment at original site.
2. Groundwater encountered near the springline of the pipe. Seepage was handled with a trash pump. By the time the pipe was found, it was too late in the day to collect the coupon so excavation was buttoned up for the day. Returned the next morning and collected the coupon. Location had ~1" of static pressure above the crown of the pipe.
3. Stake was missing and dock had been replaced since staked location photo was taken. Shifted coupon location to south of staked location in photo to avoid an unknown pipe along the lake bottom. Asbuilts called for pipe to be 6' off bank. Found pipe 14' off the bank after digging 3' deep trench from 6' off bank. Left curtain in place for the evening to allow turbidity to settle.
4. Coupon scheduled for 3304 78th Place NE, but when crew showed up onsite to obtain coupon, the property owner objected to work and decision was made to move to site next door to the south (3306 78th Place).
5. Attempted to find pipe based on asbuilts from adjacent parcels but asbuilt wasn't very accurate. Spent several hours trying to find pipe. Dug 10'W x 10'L x 10'D hole without finding pipe. Started trenching towards lake, but still hadn't found pipe by time trench was within 15' of the lake. Started probing the west wall of trench and finally found the pipe about 2' west of where excavation had started. By the time the pipe was found, it was too late in the day to finish excavation/tap pipe so buttoned up the hole for the night. Returned on 7/5/2016, completed the excavation, and obtained the coupon. Took swing ties to locate found pipe. Goundwater was encountered near the bottom of the pipe. Seepage was handled with a trash pump. Location had ~1" of static pressure above crown of pipe. Backfill was wet so excavation was mounded and allowed to settle for a week before restoration was completed.
6. No stakes at location, so excavation was estimated based on photo evidence. Groundwater seepage encountered near pipe depth. Backfill soils very wet clay so backfill was allowed to settle for a week or so before installing sod and replacing rhododendrums. Static pressure was about 2.5" above crown of pipe. Pipe was AC and not CI as indicated on GIS maps.
7. Insufficient access to get construction equipment to pipe. Currently looking for other sites with better access.
8. Pipe found at staked location. Limited access required smaller excavator. Groundwater encountered near crown of pipe. Trash pump was used to remove water. No static pressure encountered by pilot hole. Coupon obtained without incident.
9. No stake at location. On 7/27/2016, crew tried finding pipe south of location shown in photo in order to avoid excavation in swimming area near concrete steps. Setup curtain south of photo location based on asbuilt swing tie information. Unable to find pipe at revised location. Lake bottom very fine silty/clayey material so turbidity was an issue. Had to shut down operation for several hours to allow turbidity to settle. Stopped for the day at 3:11 without finding pipe. Returned to site on afternoon of 8/2/2016 and deployed curtain at photo location. Succeeded in finding pipe but it was too late in the day to get coupon. Turbidity continued to be an issue at the photo location. Returned on morning of 8/3/2016 and obtained coupon.
10. Pipe found at staked location. No issues obtaining coupon, except pipe is CI and not AC as indicated on GIS maps.
11. First in-water coupon obtained in this phase. Work started on 7/18/2016, continued on 7/19/2016, and was completed on 7/26/2106. Excavation was slow due to flat lake bottom (and no portagee). Had to relocate excavation due to undermining of rock berm. Had issues with the wrong repair bands on the boat (pipe was 10" AC, not 8" AC). Came back on 7/26/2016 after obtaining correct repair band. Pipe had residual static pressure, resulting in some spilled sewage.
12. No issue finding pipe and obtaining coupon. Property owner showed up and was angry, claiming he hadn't been contacted about the work. Crew worked 2 hrs OT to avoid returning to this location to complete work. Plotting the GPS coordinates from the field work indicates the stake (and subsequent coupon) was actually taken in front of 9528 SE Shoreland Drive.
13. Divers had issue reading OD tape measurements. The diver read the OD as 8.3 inches, which would not have fit any of the clamps onboard. Decided to relocate to N19 while searching for appropriate repair band. Determined later that day that tape was being read incorrectly, so crew returned to N12 later in the day and obtained the coupon. By the time the coupon was obtained, it was too late in the day to backfill and allow turbidity to settle without incurring OT. Returned on the morning of 7/21/2016 to backfill excavation. Location had a slight static pressure in the pipe when pilot hole was drilled.
14. Located excavation pit based on City asbuilts and found pipe fairly quickly. No static pressure found when pilot hole was drilled. Pipe had about 1" of sewage in pipe.
15. No stake at this location. Probed for pipe based on photo location but couldn't find the pipe. Conversation with property owner indicated pipe may be deep. During discussion with property owner, his neighbor (Fowler) showed up and indicated pipe was exposed in front of his property (2043 Killarney Way). Fowler granted permission to obtain coupon from in front of his property. Called City and received permission to revise location. When pipe was tapped with the pilot bit, strong suction was experienced so the City was contacted. Decision was made to not cut coupon until we had method to prevent coupon being sucked into the pipe. Returned the next day with a toggle bolt welded to the pilot bit and were able to obtain the coupon.
16. No stake at this location. Probed for pipe based on photo but was unable to find it. Talked to property owner who showed crew a cleanout under the dock. Decided to relocate excavation to south side of dock near cleanout. Found pipe, which was fairly deep. Site experienced significant turbidity, requiring all three curtains to combat. Had to stop work for several hours to allow turbidity to settle before continuing work. Due to issues finding pipe and turbidity, coupon collection spanned two days.
17. Stake had broken off and was submerged, which made locating the pipe more challenging. Were initially looking for stake on the wrong side of the house. Once stake was found, coupon collection went reasonable smoothly.
18. Address on photo did not agree with address on GIS map. Based on review of correspondence, the original site was per the photo (64th Street R/W). Subsequent to the photo being taken, the coupon location was shifted to the 60th Street right of way extension to minimize permitting jurisdictions. However, when the field notebook was assembled, the shift between the photo location and the updated location was not caught. Because the shift occurred after the City had installed the stakes, the 60th Street location did not have a stake marking the pipe. The crew went to the photo location (64th Street R/W), found the stake and took the coupon at that location.
19. When the coupon was drilled, the pressure head of the lake water sucked the coupon off the hole saw and into the pipe. Diver was unable to retrieve the coupon. After discussion with the City, the repair band was installed and no further work was performed at this location until we had determined a method to avoid losing the coupon. Returned on 7/25/16 and cut a second coupon using a hole saw with a toggle bolt to retain the coupon.
20. This location was directed by the City as a replacement in-water coupon for N7. No stakes in the water. Attempted to find pipe based on asbuilt. Had significant issues finding the pipe. Called City utilities to have them assist with locating the pipe. Eventually found pipe but it was too close to the rock berm (~12" to 18" off wall) to safely excavate without undermining the wall. After consulting with City, decision was made to relocate about 4 lots south.
21. Found cleanout and probed for pipe south of the cleanout. Found pipe easily and obtained coupon with no issues.

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix C. Field Observation Reports

Table C-1. In-Water Coupon Collection Daily Report Summary

	Report
7/18/2016	First day. Started at N11. Spent entire day without finding pipe.
7/19/2016	N11—Found pipe and exposed it by 8:45. This pipe was 10-inch, not 8-inch, so could not take a coupon. Let turbidity settle and moved to N12 by 11:00. Found pipe quickly and exposed it by 12:50. Worked overtime to install repair sleeve by 2:30 and complete the site the same day, due to angry homeowner.
7/20/2016	N13—Found pipe by 7:40 and exposed it by 8:40. Measured outside diameter was smaller than repair bands, so let turbidity settle and moved to N19 by 10:30. Found same measurement. After some discussion, discovered that tape measure has 1-1/2 inches before measurement starts. Drilled coupon, but suction in pipe pulled the coupon out of the hole saw and into the pipe. Diver was unable to retrieve the coupon. After discussion with the City, the repair band was installed and no further work was performed at this location until a way could be found to avoid losing the coupon. Returned to N13 and obtained coupon by 2:00. Left without backfilling to avoid overtime.
7/21/2016	N15—Found stake but had not found pipe by 9:00. Adjacent homeowner to north (2043 Killarney Way) gave permission to take coupon at his property where the pipe was visible. Drilled pilot hole by 10:30 and again experienced strong suction, so stopped to see if suction would subside. At 12:00, it had not, so stopped until a method to retain coupon could be devised. Left at 1:15. Returned to N13 to backfill hole.
7/22/2016	Returned to N15 and obtained coupon using a toggle bolt to retain it in the hole saw. Moved to N16 where it took a while but found pipe with help of a neighbor. Excavated but could not obtain coupon due to turbidity.
7/25/2016	Returned to N19 and cut a second coupon using a hole saw with a toggle bolt to retain the coupon. Moved to N16. No stake was found at this location. Probed for pipe based on photo but were unable to find it. Talked to property owner, who showed crew a cleanout under the dock. Decided to relocate excavation to south side of dock near cleanout. Found pipe, which was fairly deep, at 1:45. Site experienced significant turbidity, requiring all three curtains to combat. Had to stop work for several hours to allow turbidity to settle before continuing work. Obtained coupon at end of shift. Due to issues finding pipe and turbidity, coupon collection spanned two days. Left curtains up overnight.
7/26/2016	Returned to N16 to pick up turbidity curtains. Moved to N10 and found stake. Obtained coupon by 9:30. Pipe was cast iron, not asbestos cement as shown on GIS map. Moved to N11 and obtained coupon. This pipe required a different repair sleeve to be purchased because the pipe was 10-inch instead of 8-inch. Work at this site had started on 7/18 and continued on 7/19.
7/27/2016	N17—Could not find pipe or stake so moved to N18. Address on photo did not agree with address on GIS map. The crew went to the photo location (64th Street R/W), found the stake and took the coupon at that location. Based on correspondence, the original site was per the photo (64th Street R/W). The coupon location was shifted to the 60th Street right of way extension after the photo had been taken, to minimize permitting jurisdictions. However, when the field notebook was assembled, the shift between the photo location and the updated location was not caught. Because the shift occurred after the City had installed the stakes, the 60th Street location did not have a stake marking the pipe. Returned to N17 and found the stake broken off and submerged on the other side of the house. Obtained coupon and moved on to N9 after letting turbidity settle. No stake was found at this location. Crew tried finding pipe south of location shown in photo in order to avoid excavation in swimming area near concrete steps. Set up curtain south of photo location based on as-built swing tie information. Unable to find pipe at revised location. The lake bottom was very fine silty/clayey material, so turbidity was an issue. Shut down operation for several hours to allow turbidity to settle. Stopped for the day at 3:11 without finding pipe.
7/28/2016	Returned to N9. Worked from 7:30 to 9:30. Stopped until 11:00 due to turbidity. Worked from 11:00 to 11:30. Stopped until 1:00 but still too turbid to continue, so stopped and moved to N20, which was an added coupon location to replace N7, which turned out to be an upland site. Attempted to find the pipe based on an as-built. Could not find a cleanout to locate the pipe.
8/1/2016	N4—Found pipe and collected coupon by 9:40. Moved to N3. Stake was missing and dock had been replaced since staked location photo was taken. Shifted coupon location to south of staked location in photo to avoid an unknown pipe along the lake bottom. As-built drawings called for pipe to be 6 feet off bank. Found pipe 14 feet off the bank after digging 3-foot-deep trench from 6 feet off bank. Collected coupon and left curtain in place for the evening to allow turbidity to settle.
8/2/2016	Backfilled N3 from previous day. Stake found at N2. Found pipe quickly and completed work by 12:15. Returned to N9 at 12:50 and deployed curtain at photo location. Succeeded in finding pipe at 1:20 but it was too late in the day to get coupon. Turbidity continued to be an issue at the photo location. Stopped for day at 1:40 to avoid overtime.
8/3/2016	Returned to N9 and obtained coupon by 10:00. Moved back to N20 by 10:45 and called City to help locate the pipe. Eventually found it at 2:05 but too close to a rockery wall to excavate safely. After consulting with City, we decided to relocate four lots to the south.
8/4/2016	N20 replacement. At this site, (N21 on spreadsheet) found pipe near cleanout and obtained coupon.

Bellevue Lake Line Condition Assessment – Phase 2
Contact List for Coordination between Work Crew and City

City of Bellevue:

1) Front desk 425-452-7840. Explain to them what you are calling about and ask to track down one of the people below
2) Project manager Debbie Harris – desk 425-452-4367, will go to front desk if she does not answer
3) Crew leader Clint Emry - desk 425-452-2922, will go to front desk if he does not answer, cell 425 890 7947 cemry@bellevuewa.gov
4) Richard Peckler Eng. Tech. 425-452-4359 or 425-457-4142
5) Crew leader John Ellman 425-452-2046 also should go to front desk, cell 425- 864-1990
6) Andy Heider (Parks) 425-864-1663
7) Jon Wilson (Parks Scheduling) 425-452-4278
8) Pat Harris (Parks Resource Manager) 425-452-6855

Tetra Tech:

1) Front Desk 206-883-9300. Explain to them what you are calling about and ask to track down one of the people below
2) Project manager Neil Thibert - desk 206-883-9345, will go to front desk if he does not answer, cell 425-395-6195 neil.thibert@tetratech.com
3) Mark Hopkinson - desk 206-883-9354, cell 206-445-5063
4) Kevin Goss - desk 425-883-9348, cell 206-399-4034

BHC:

1) Project monitoring Tony Fisher - desk 206-505-3400, cell 425-891-2211 tonyfisher@bhcconsultants.com

Ballard Marine:

1) Adam Litt - desk 360-695-5163, cell 360-518-4864
2) Chris Moritz – desk 206-853-6854

Buno Construction:

1) Dan Buno - desk 360-863-2893, cell 206-423-4512
2) Sam Buno – cell 206-426-4513

Norton Corrosion:

1) Front Desk 425-483-1616
2) John Keppler – desk 425-483-1616 ext 7019, cell 425-501-3401
3) Eric Shadle – desk 425-483-1616 ext 7016, cell 206-909-4189

Confluence Environmental:

1) Front Desk 206-397-3741
2) Chris Cziesla – cell 206-321-6537

The Watershed Company:

1) Kenny Booth – desk 425-822-5242 X-209

BHC CONSULTANTS

DAILY REPORT

Report No.: N1
Page: 1 of 1
Date: 6/28/2016

Project: Bellevue Lake Line Ph. 2 Project No.: 10176.02
Owner: City of Bellevue Contract No.:
Contractor: Buno Construction Sup't/Foreman: Kevin Grant
Crew Size: 3 Subcontractor(s):
Day: Tuesday Time Start: 12:30 pm Time Stop: 3:30 pm
Site Condition: Weather: Temperature:

List Equipment on Site:	Caterpillar 304	Trash Pump
Equipment Truck & Trailer		

REPORT (including discussions with Contractor)

Located excavation pit based on City provided asbuilts (15 feet upland of ex. Dock). Buno started excavating to expose the existing sewer main. Pipe was found about 6' bgs. By the time the pipe was found, it was too late in the day to tap the main and obtain the coupon. Tony called the City to let them know we were stopping for the day and would obtain the coupon on 6/29/2016. Buno covered the excavation with sheets of plywood and set the bucket of the excavator on the plywood to protect the hole.

Site Visitors:

Contactor's Representative: Resident Engineer: Tony Fisher

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BHC CONSULTANTS

DAILY REPORT

Report No.: N1
Page: 1 of 7
Date: 6/29/2016

Project:	Bellevue Lake Line Ph. 2	Project No.:	10176.02
Owner:	City of Bellevue	Contract No.:	
Contractor:	Buno Construction	Sup't/Foreman:	Kevin Grant

Crew Size: 3 Subcontractor(s):

Day: Tuesday Time Start: 8:00 am Time Stop: 11:00 am

Site Condition: Weather: Temperature:

List Equipment on Site:	Caterpillar 304	Trash Pump
Equipment Truck & Trailer		

REPORT (including discussions with Contractor)

Buno removed the plywood covering the hole and cleaned up the bottom of the hole. A trash pump was setup to remove the groundwater that had accumulated overnight. The pump discharged the effluent about 70 feet away from the shoreline onto the grass. The discharge completely infiltrated the ground with no release to the lake. Buno then installed the Romac SS1 and slid it to the side in preparation of tapping the pipe. Tony called Clint (left message) to let him know we were tapping the pipe. Buno drilled a pilot hole in the pipe to check static pressure inside the pipe and it resulted in about 1 inch of head above the crown of the pipe. Buno then proceeded to core the pipe with a 4-inch bit. The exterior of the pipe and the core appeared to be in decent shape. Buno then slid the repair clamp into place and tightened the bolts. Buno then backfilled the excavation and smoothed out the ground. The site is scheduled for substantial landscaping, so the housing contractor indicated no further restoration was required. While Buno was backfilling the excavation, Tony rinsed off the pipe coupon, marked it "N1", then installed it in a gallon zip lock bag and filled the bag with distilled water. The water/coupon filled bag was then inserted into a second zip lock bag to provide dual protection.

Site Visitors:

Contactor's Representative: Resident Engineer: Tony Fisher

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CONSTRUCTION PHOTOS

1601 Fifth Avenue, Suite 500 ◆ Seattle, WA 98101 ◆ (206) 505-3400 ◆ FAX (206) 505-3406
www.bhcconsultants.com

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CONSTRUCTION PHOTOS

DAILY REPORT

Report No.: N5
Page: 1 of 1
Date: 6/30/2016

Project: Bellevue Lake Line Ph. 2 Project No.: 10176.02
Owner: City of Bellevue Contract No.:
Contractor: Buno Construction Sup't/Foreman: Kevin Grant
Crew Size: 3 Subcontractor(s):
Day: Tuesday Time Start: 11:30 am Time Stop: 3:30 pm
Site Condition: Weather: Temperature:

List Equipment on Site:	Caterpillar 304	Trash Pump
Equipment Truck & Trailer		

REPORT (including discussions with Contractor)

The location to start digging for the pipe was estimated based on asbuilt information from the
Adjacent lot (3304 78th Place NE). After excavating a hole that was approximately 10' x 10' x
10' deep without finding the pipe, the decision was made to start trenching towards the lake to
That trench line was extended to about 15 feet from the bulkhead without finding the pipe.
Buno then started probing around the upland wall of the original trench and was finally able to
discover the pipe. However, by that time, it was too late in the day to expose the pipe since
that work would require the spoils pile to be relocated before further excavation could occur.

Site Visitors:
Contactor's Representative: Resident Engineer: Tony Fisher

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DAILY REPORT

Report No.: N5
Page: 1 of 7
Date: 7/05/2016

Project: Bellevue Lake Line Ph. 2 Project No.: 10176.02

Owner: City of Bellevue Contract No.:

Contractor: Buno Construction Sup't/Foreman: Kevin Grant

Crew Size: 3 Subcontractor(s):

Day: Tuesday Time Start: 9:00 am Time Stop: 1:00 pm

Site Condition: Weather: Temperature:

List Equipment on Site:	Caterpillar 304	Trash Pump
Equipment Truck & Trailer		

REPORT (including discussions with Contractor)

Buno began excavating to expose the pipe, which was found about 6.5 feet bgs to the crown of the pipe. Tony obtained swing ties from two spots on the bulkhead to locate the pipe (see attached sketch). Groundwater was encountered near the bottom of the pipe, so Buno excavated a sump to control the water. Once the pipe was exposed, Buno installed the Romac SS1 and slid it to the side in preparation of tapping the pipe. Tony then called Clint to arrange to have the pump station shut down. Buno then drilled a pilot hole to check the static pressure, which was just slightly above the crown of the pipe. Buno then proceeded to core the pipe with a 4-inch bit. The exterior of the pipe and the core appeared to be in decent shape. Buno then slid the repair clamp into place, tightened the bolts, and then backfilled the excavation and smoothed out the ground. The property owner was consulted about restoration requirements and an agreement was reached to seed the area once the backfill had a chance to dry out and settle. This work will likely occur next week. While Buno was backfilling the excavation, Tony rinsed off the pipe coupon, marked it "N5", then installed it in a gallon zip lock bag and filled the bag with distilled water. The water/ coupon filled bag was then inserted into a second zip lock bag to provide dual protection.

Site Visitors:

Contactor's Representative: Resident Engineer: Tony Fisher

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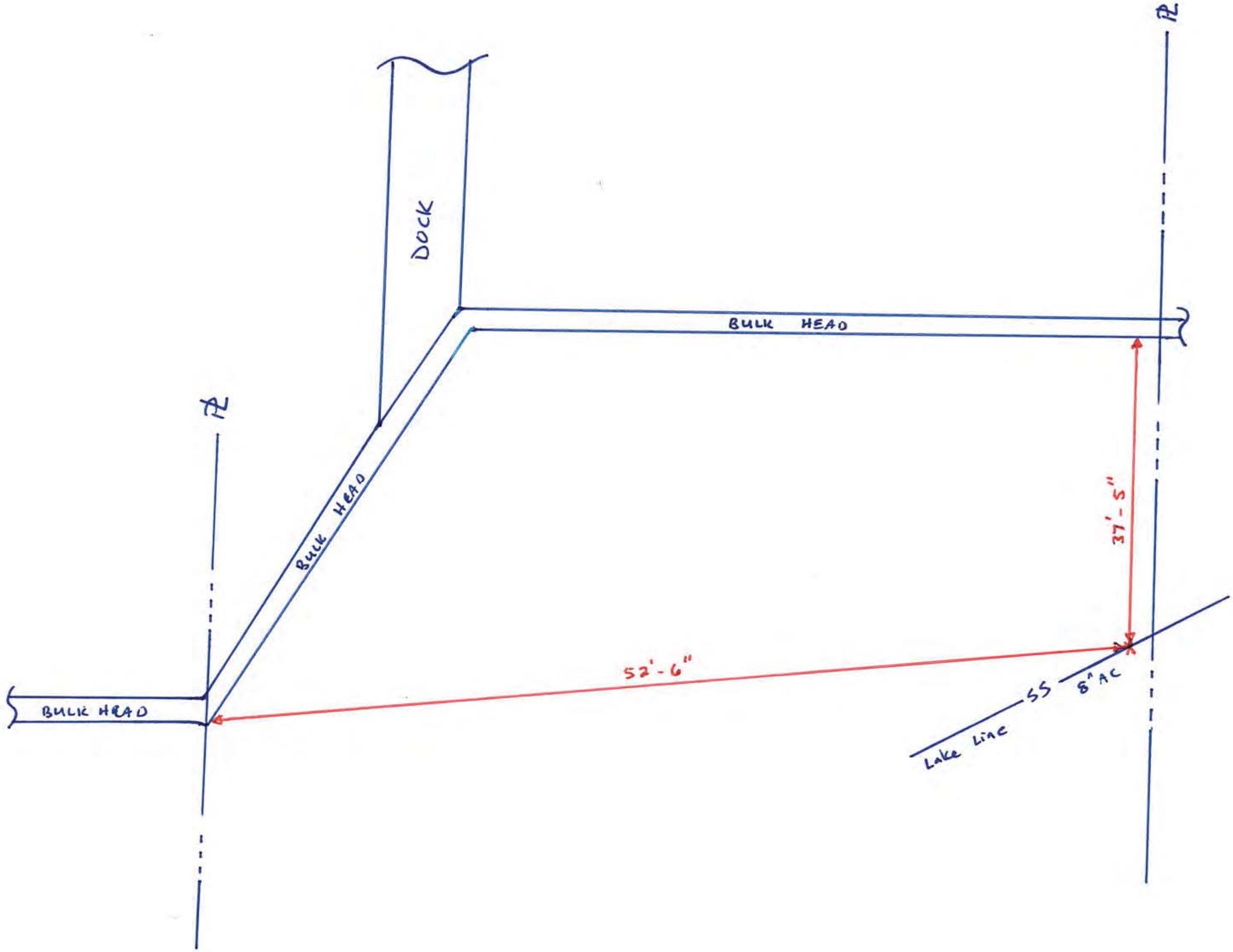
3306 78th PL NE



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DAILY REPORT

Report No.: N6
Page: 1 of 7
Date: 6/29/2016

Project:	Bellevue Lake Line Ph. 2	Project No.:	10176.02
Owner:	City of Bellevue	Contract No.:	
Contractor:	Buno Construction	Sup't/Foreman:	Kevin Grant
Crew Size:	3	Subcontractor(s):	

Day: Tuesday Time Start: 11:00 am Time Stop: 4:00 pm

Site Condition: ______ Weather: ______ Temperature: ______

List Equipment on Site:	Caterpillar 304	Equipment Truck & Trailer

REPORT (including discussions with Contractor)

The original plan was to obtain the next coupon at 3310 78th Place NE in Medina. However, when Tony knocked on the door to let the owner know we were going to start working, he objected to the work and insisted we move the work to the adjacent lot to the south that was under construction. Tony contacted Debbie, explained the situation, and the consensus was to move the operation to 3436 Evergreen Point Road while Debbie tried to get a right of entry for the revised location.

At 3436 Evergreen Point Road, the excavation pit was located based on a photo that had been taken when the line was located earlier in the year (the stakes were no longer present). Buno started excavating to expose the existing sewer main. Pipe was found about 6' below the edge of the concrete driveway. Groundwater was infiltrating into the trench, but the site did not provide any good discharge sites so the decision was made to not pump out the groundwater. Buno then installed the Romac SS1 and slid it to the side in preparation of tapping the pipe. Buno then drilled a pilot hole in the pipe to check the static pressure, which was about 2 to 3 inches above the crown of the pipe. Buno then proceeded to core the pipe with a 4-inch bit. The exterior of the pipe and the core appeared to be in decent shape. Buno then slid the repair clamp into place and tightened the bolts. Buno then backfilled the excavation and smoothed out the ground. Because the soils were very wet and consisted of a lot of clay, the

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DAILY REPORT

decision was made (after coordinating with the property owner) to let the backfill settle for a
few days before installing sod.
While Buno was backfilling the excavation, Tony rinsed off the pipe coupon, marked it "N6",
then installed it in a gallon zip lock bag and filled the bag with distilled water. The water/
coupon filled bag was then inserted into a second zip lock bag to provide dual protection.
While the work at 3436 Evergreen Point Road was occurring, Debbie succeeded in gaining
entry rights to 3306 78th Place. After the work at 3436 Evergreen Point Road was completed,
Buno obtained permission from the onsite contractor at 3306 78th Place to park their excavator
onsite for the night.
Correspondence was received from the property owner on 6/30/2016 that indicated our work
damaged three rhododendrons and that the driveway also needed to be cleaned. Buno will
address those items when the sod is installed.

Site Visitors: ____________________

Contactor's Representative: ____________ Resident Engineer: Tony Fisher

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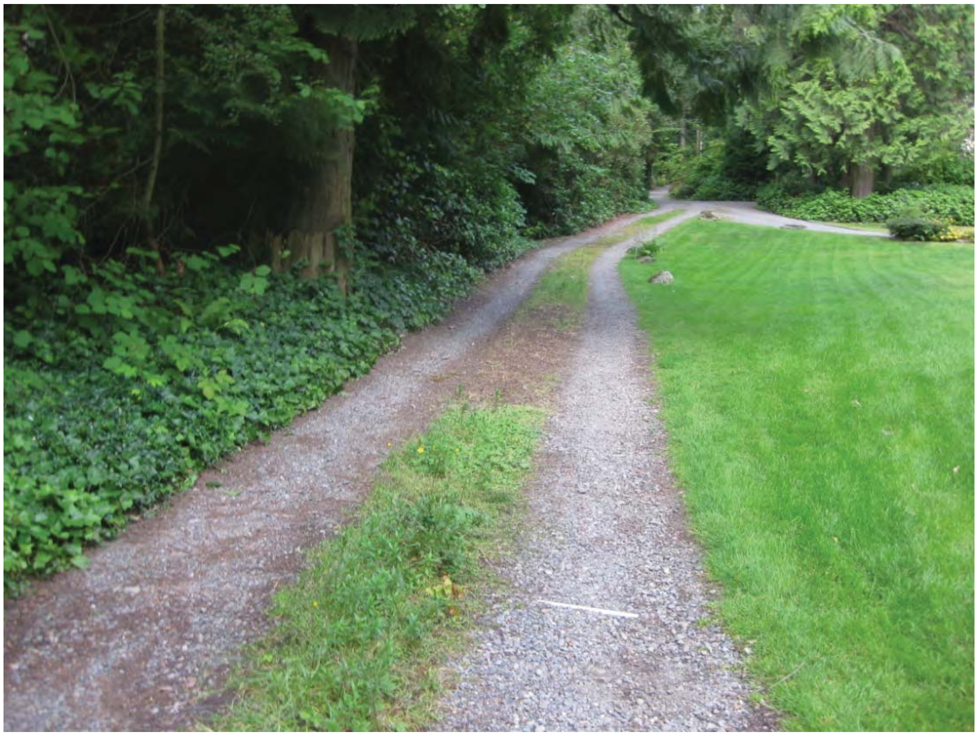

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DAILY REPORT

Report No.: N8
Page: 1 of 13
Date: 6/30/2016

Project:	Bellevue Lake Line Ph. 2	Project No.:	10176.02
Owner:	City of Bellevue	Contract No.:	
Contractor:	Buno Construction	Sup't/Foreman:	Kevin Grant
Crew Size:	3	Subcontractor(s):	

Day: Tuesday Time Start: 7:30 am Time Stop: 11:30 am

Site Condition: ____ Weather: ____ Temperature: ____

List Equipment on Site:	Kabota 08	Trash Pump
Equipment Truck & Trailer		

REPORT (including discussions with Contractor)

The City installed stake was still in place in the backyard, so Buno setup to excavate the pipe at that location. Debbie showed up while Buno was excavating the hole. The pipe was found about 5.5 feet bgs. Groundwater was encountered near the crown of the pipe. Buno used a trash pump to remove the water, discharging upstream onto the grass. All of the effluent Infiltrated into the ground with no runoff reaching the lake. Once the pipe was exposed, Buno installed the Romac SS1 and slid it to the side in preparation of tapping the pipe. Buno then drilled a pilot hole to check the static pressure. No static pressure was encountered. Buno then proceeded to core the pipe with a 4-inch bit. The pipe contained minimal flow (~0.5' in the bottom of the pipe). The exterior of the pipe and the core appeared to be in decent shape. Buno then slid the repair clamp into place and tightened the bolts. Buno then backfilled the excavation and smoothed out the ground.

While Buno was backfilling the excavation, Tony rinsed off the pipe coupon, marked it "N8", then installed it in a gallon zip lock bag and filled the bag with distilled water. The water/ coupon filled bag was then inserted into a second zip lock bag to provide dual protection.

Site Visitors: ____

Contactor's Representative: ____ Resident Engineer: Tony Fisher

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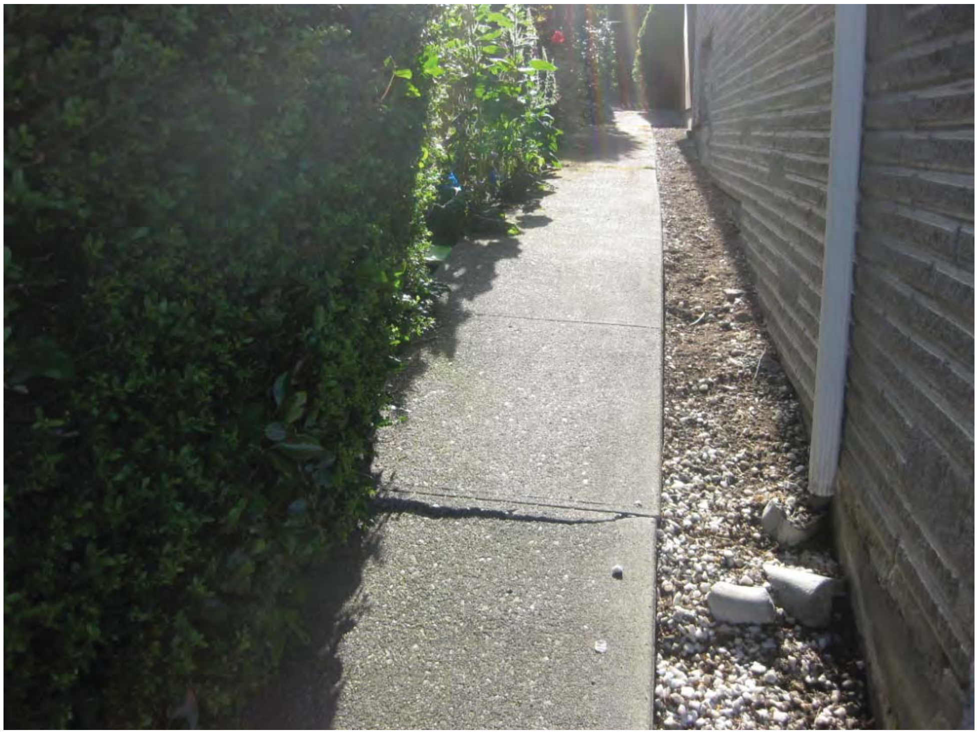

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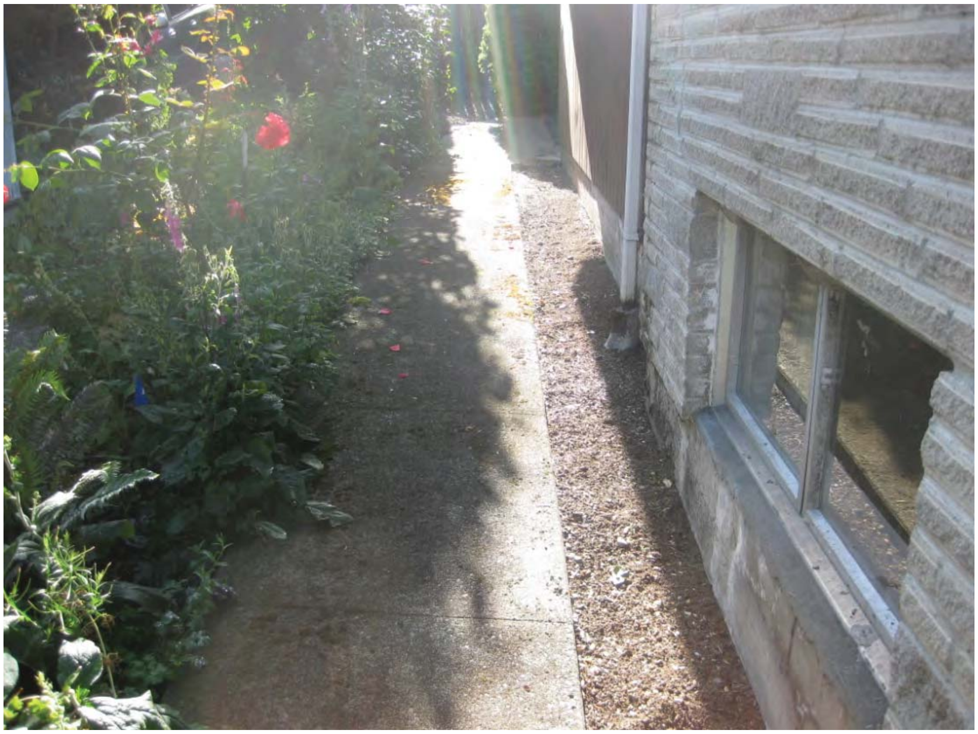

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DAILY REPORT

Report No.: N14
Page: 1 of 16
Date: 6/28/2016

Project: Bellevue Lake Line Ph. 2 | Project No.: 10176.02
Owner: City of Bellevue | Contract No.:
Contractor: Buno Construction | Sup't/Foreman: Kevin Grant
Crew Size: 3 | Subcontractor(s):
Day: Tuesday | Time Start: 8:00 am | Time Stop: 12:30 pm
Site Condition: | Weather: | Temperature:

List Equipment on Site:	Caterpillar 304	Vactor Truck
Equipment Truck & Trailer	Silt Fence	Trash Pump

REPORT (including discussions with Contractor)

Located excavation pit based on City provided asbuilts. Buno setup silt fence to define the working area then started excavating to expose the existing sewer main. Tony coordinated with Andy Heider to unlock bollards so that Buno could get vactor truck closer to the proposed excavation. Buno found the pipe about four (4) feet bgs. Tony called Clint and Richard to let them know we would be tapping the pipe (left messages). Buno installed the Romac SS1 repair clamp then slid it to the side so that the pipe could be cored. Buno drilled a pilot hole in the pipe to check static pressure inside the pipe. No static head was encountered. Buno then proceeded to core the pipe with a 4-inch bit. After core was removed, an inspection of the pipe revealed about 1 inch of sewage in the pipe. The exterior of the pipe and the core both appeared to be in decent shape. Buno then slid the repair clamp into place and tightened the bolts. Once the sleeve was installed, Tony called Clint (left message) and Richard to see if they wanted to pressurize the pipe before the hole was backfilled. Richard indicated that as long as the sleeve was snug, pressurizing the pipe wasn't necessary. Buno then backfilled the excavation and smoothed out the sand after removing the silt fence. While Buno was backfilling the excavation, Tony rinsed off the pipe coupon, marked it "N14", then installed it in a gallon zip lock bag and filled the bag with distilled water. The water/coupon filled bag was then inserted into a second zip lock bag to provide dual protection. Upon completion of the

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DAILY REPORT

restoration, Tony called Andy to let him know Buno was done and the site ready for his
inspection. He indicated he would stop by later in the day to review. Tony called Andy on 6
/29/16 to verify the restoration was acceptable and Andy indicated it was.

Site Visitors: ______________________________

Contactor's Representative: ________________ Resident Engineer: Tony Fisher

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		Date:	7/18/2016
Task Code:		**Location:**	Lake Washington
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	70
Weather Condition:	overcast

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0600- launch boats from 14th st. ramp in ballard/two boats TRV to meydenbauer

0700- Moritz on site with truck in meydebaur, meet with Tony.

0800- boats at marina in meydenbauer/ TRV to site N11

0815- at N11, setting up turbidity curtain/jet

0920- Diver L/S to jet for pipe

1000- found pipe, pipe closer to beach than marker. (see picture at bottom)

Move north west to get clear of rock wall on beach so as not to undercut it. Start new hole away from the rock wall.

1310- secure jetting to alow 30 minutes for silt to settle out in curtain.

1340- pull curtain and TRV to marina

1400- crew tie up boats and off site

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Ok to move location away from wall.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

Sewer pipe found too close to a retaining wall, crew moved north west to get away from undermining wall.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).

CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		7/18/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/19/2016
Task Code:	2203	**Location:**	Meydenbaur
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	70
Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- Depart marina for N11

Set up curtain and jet

0700- Jetting N11

0940- Take OD of sewer line for right clamp, OD 35'' for 10'' pipe. Job specs did not call for a 10'' clamps.

STBY to see if Bellevue sewer has a 10'' clamp to make repair, let tubity settle, remove curtain.

1057- depart N11 for N12, no repair clamp available today.

1116- Seting up on N12

Jeting

1248- Diver L/S to test clamp on pipe and prepair to drill

1333- 1336 Diver drilling pipe, cupon handed over to BHC.

1429- clamp installed and tourqued to specs, pipe jeted over to cover clamp.

Wait for turbitity to settle before pulling curtain

1530- Crew back at marina, house keeping on boats,1545 off site

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

1309-Cleared from Tetra Tech via BHC to work a 10 hour shift so crew wont have to retune to N12 becouse of unhappy homeowner.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

N11 is a 10'' pipe. It is also buried in 2'- 2 ½' of suger sand. Jeting difucult at that location due to depth of pipe and flat bottom in that location, pipe is about 4' away from shore line and shallow.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning?	☒ Yes	☐ No
Notes:		
Have protected species been encountered?	☐ Yes	☒ No
Notes:		
Turbidity Monitor system is functioning?	☒ Yes	☐ No
Notes:		

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable?	☒ Yes	☐ No
Notes:		
Environmental concerns/topics are discussed (as applicable) in job briefings?	☒ Yes	☐ No
Notes:		
Fuel delivered to site today? (See Spill Prevention/Refueling Plan for checklists)	☒ Yes	☐ No
Notes:		

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew?	☒ Yes	☐ No

PRODUCTION STATISTICS:

Task:

Task Code	Work Performed	Method(s)	Hours Worked	% Completed

Task:

Work Area	Work Performed	Method(s)	Hours Worked	% Completed

Task:

Work Area	Item	Method(s)	Hours Worked	% Completed

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).

CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		7/19/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/20/2016
Task Code:	A-2203	**Location:**	Lake Washington
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	70
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- Crew depart marina for N13

Set up cutain and jets

0715- start jeting

0725- move jet location 25’ to otherside of peir. Pipe too far inshore

Start jeting, portage online

0850-Test fit clamp on pipe, not 100% on the fit.

Let turbidity settle to get eyes on clamp, pull curtain

0955- move to N19 to let N13 setle out/ set up curtain

1035- jeting N19

1101- Start drilling N19

1129- hole cut, cupon sucked out of hole saw.

1140- tightening bolts

1154- Move back to N13

1230- Drill pilot hole to check water flow

Water flowing out, drill cupon

1345- N13 cupon on deck

1400- Trv to marina

1430- crew off site

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Cupon lost in N19, BMC put on romak repair clamp and instructed from BHC to wait on follow up if another attempt at that location is ok.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

At location N19 the cupon got sucked out of the hole saw due to diferential pressuer.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	Work Performed	Method(s)	Hours Worked	% Completed

Task:				
Work Area	Work Performed	Method(s)	Hours Worked	% Completed

Task:				
Work Area	Item	Method(s)	Hours Worked	% Completed

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).

CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		7/20/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/22/2016
Task Code:	A-2203	**Location:**	Lake Wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	70
Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina

0650- on location N15 to drill, set up.

0712- Diver L/S to drill out coupon

Coupon recovered and clamp installed, area graded

0810-Diver R/S

Move to N16

0844- on location N16, setting up curtain, jetting.

0952- move to the south side of dock/clean out because pipe was not located at stake.

Pipe found south of cleanout, pipe direction puts it 6-10 feet inshore of staked area.

1127- Shut down due to turbidity readings, deploy secondary curtain. BHC monitored turbidity, jet ops were secured for the day at 1230 to give adequate time to settle out before the curtain is puled.

1400- depart N16/ trv to marina

1430- crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

From BHC- Secure jetting due to high turbidity readings @1127. Once turbidity settled out enough to resume jetting there wasn't enough time left to work and give time to settle out again.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

N16 was located 40 feet from the stake, under 3 feet of 8'' minus and a layer of concrete over-pour in the area.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

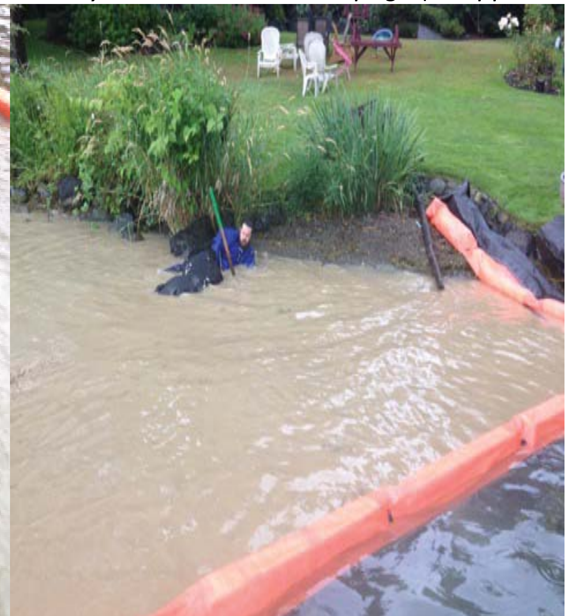
PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).



CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		7/22/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	SIGNATURE	DATE

		Date:	7/25/2016
Task Code:	2203	**Location:**	Lake Wa.
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	70
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina for N16. 0650- onsite

0728- deploy curtain, set up jet portage.

0852- diver L/S to install clamp, drill coupon, tighten clamp

0918- cupon recovered, 0932- clamp torqued, 0936- start backfilling hole.

1010- letting turbity settle.

1030- leave turbidity in and motor to N19.

1106- diver L/s to drill coupon from n19

1114- coupon recovered, torqueing clamp

1131- 1159: Stby for sewer department personel to stop by work site.

Trv to N16, still turbid. BHC asked if we could leave boom overnight at location. BMC crew secured and anchored curtain to pier. Left curtain overnight to let settle.

From there crew could not jet or portage, crew went north to inspect the other locations. Looking to verify spots and to see if pipe is exposed in any other locations and can be drilled and clamped without having the curtain on site.

Crews inspected N10 and N9. Both appear to be under the same tremi pour that N16 had on it. It appears that the pipe was possibly backfilled with concrete, it has the characteristics of a sloppy tremi pour. All personnel, including BHC looked at samples and our on the same page. Pictures of N16 bellow and pictures of concrete in Fridays report.

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Leave boom overnight at N16 by BHC.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

No boom to take to next location to jet. Water to turbid to remove the boom. BMC utilized the last few hours to scout the next locations to see if any pipe is exposed. Other locations appear to have a layer of concrete over the pipe. Layer somewhat visible in the pictures of N16 bellow.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning?	☒ Yes	☐ No
Notes:		
Have protected species been encountered?	☐ Yes	☒ No
Notes:		
Turbidity Monitor system is functioning?	☒ Yes	☐ No
Notes:		

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable?	☒ Yes	☐ No
Notes:		
Environmental concerns/topics are discussed (as applicable) in job briefings?	☒ Yes	☐ No
Notes:		
Fuel delivered to site today? (See Spill Prevention/Refueling Plan for checklists)	☒ Yes	☐ No
Notes:		

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew?	☒ Yes	☐ No

PRODUCTION STATISTICS:

Task:

Task Code	Work Performed	Method(s)	Hours Worked	% Completed

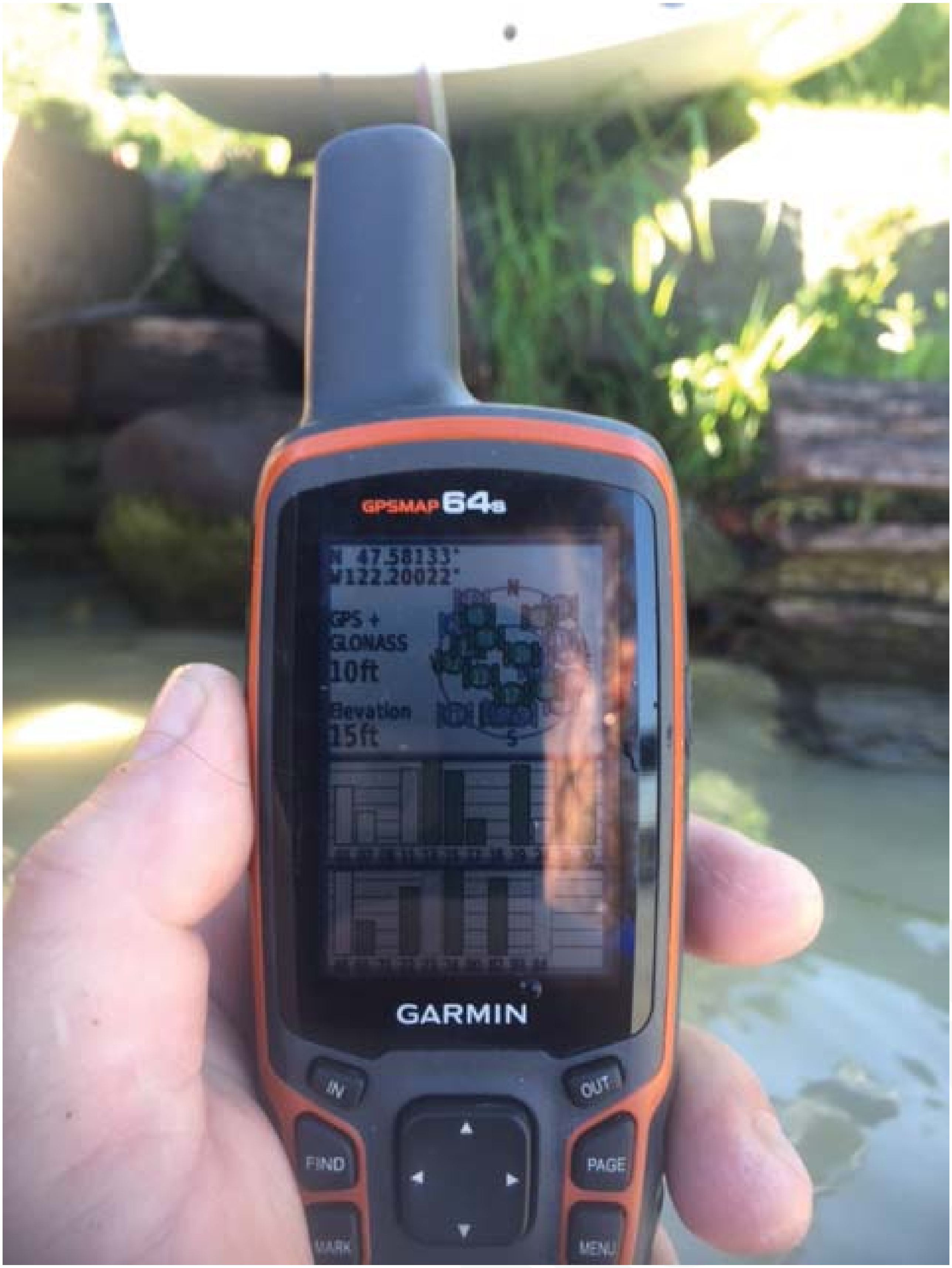
Task:

Work Area	Work Performed	Method(s)	Hours Worked	% Completed

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).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CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		7/25/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/26/2016
Task Code:	2203	**Location:**	Lake Wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	70
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina

Trv to N16 to recover boom that was left out to let turbidity settle. (pictured below)

0720-On site at N10 to jet and get coupon (picture of over pour & GPS below)

0920- Diver L/S to drill

0945- coupon recovered to deck

1000- Clamp installed, backfilling.

1021-1147 turbidity settling, one crew member to romak to pick up large clamp.

Pull curtain and move to N11

1240- test fitting clamp over pipe

1304- Coupon recovered, clamp installed.

Let turbiditiy settle, crew to do housekeeping on gear while waiting.

1606- pull boom out, load. Trv to marina

1630- crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Let turbidity settle more at N11 from BHC.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:

Task:

Task Code	Work Performed	Method(s)	Hours Worked	% Completed

Task:

Work Area	Work Performed	Method(s)	Hours Worked	% Completed

Task:

Work Area	Item	Method(s)	Hours Worked	% Completed

REPORT CONTINUATION PAGE:

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CONTRACTOR CERTIFICATION:		
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Contractor Quality Control Manager:		
PRINTED NAME	***SIGNATURE***	***DATE***
Client Quality Control Manager / Authorized Representative:		
PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/27/2016
Task Code:	2203	**Location:**	Lake wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	70
Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630-crew depart marina

0655- on location N17, BHC unsure of property details, thinks wrong spot, moving to N18.

0750- N18 has wrong addres, move further down as per BHC through the City of Bellevue.

0811- Diver LS to jet/ Portage

Pipe found @ 0832, drill, clamp and backfill by 1029

Let turbidity settle, Depart N18 @ 1121.

Trv to and set up on N17

1154- Diver L/S to jet/Portage

Pipe found @1202, drilled, clamped and backfilled by 1335

1340- depart N17 for N9, not muck time needed for turbidity to settle at this location.

1445- Jetting N9 looking for pipe

1458- Diver L/S to jet

1510-BHC concerned about the water turbidity

1515- Diver reach surface

Lots of wave action at this location and turbidity is splashing out

1527- BHC called it for the day

1600- crew at marina doing housekeeping on boats

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

From BHC, secure ops on N9 due to turbidity for the day. Make more toggles, N. Southard to weld more toggles tonight after shift.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

Too much turbidity at N9.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

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CONTRACTOR CERTIFICATION:

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Contractor Quality Control Manager:

Chris Moritz		7/27/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	7/28/2016
Task Code:	2203	**Location:**	Lake Wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	80
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- crew depart marina for N9

Set up curtain, jet & portage

0730- Diver L/S to find pipe

0927- pull diver to let turbidity settle

1102- Diver L/S to find pipe

1131-pull diver to let turbidity settle

1309- stlil too turbid, not settling to BHC required numbers. Move to scout another location, BHC wants to look at N20 that got added by the city.

1340- BHC confirming location.

1415- on site N20

1421- Diver L/S to look for pipe, curtain around N9 to settle still, diver hand probing area for pipe as per BHC.

1500- pull diver

1505- trv back to N9 to recover curtain

1530- on N9, pulling curtain, depart at 1452

Trv to marina and tie up, secure boats for the weekend.

1630- crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Let turbidity settle, BMC was on standby for aproxamitly 3 hours while the turbidity settled as per BHC. As per BHC, trv to scout N20, hand probe for pipe.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

The main issue I saw with N9 and the turbidity was it was a very shallow location with little to no grade. Basicly a big flat/shallow (4-8 inches of water)area. We also got a lot of wave action from the due south exposure, and no protection from any point or cove, basicly open to the chop. The soil was also very hard/compact and left the water grey, it looks like slopy concrete tremi/overpour on the pipe. I recommend abandoning N9 for now and work on other locations. We have already spent a day and a few hours on this location with no progress.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

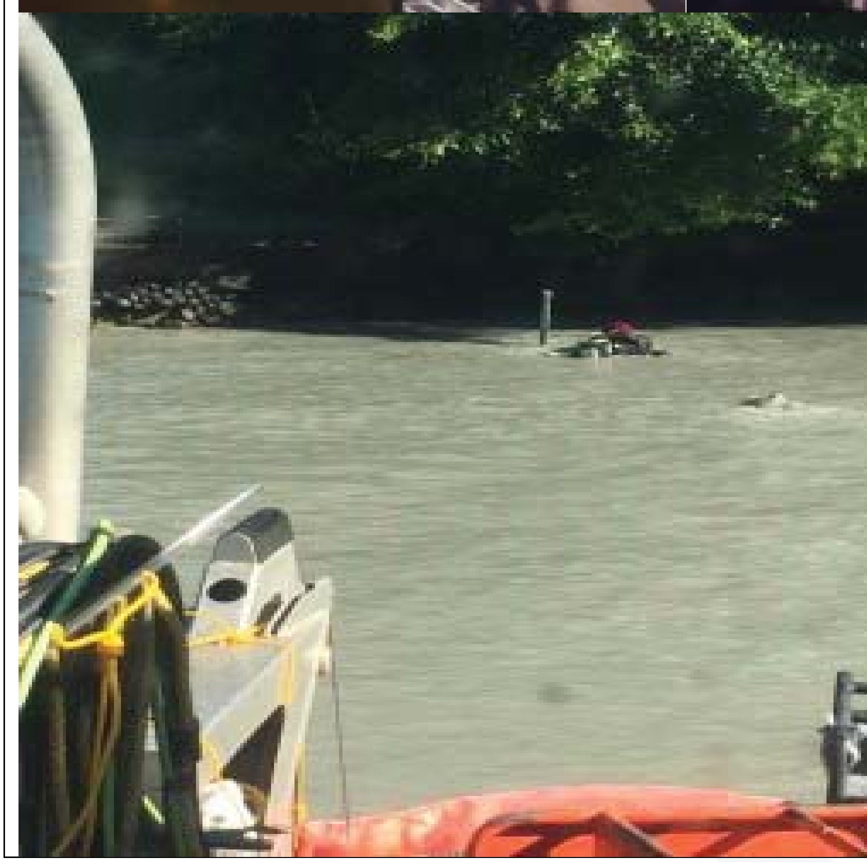
Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).





CONTRACTOR CERTIFICATION:		
I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.		
Contractor Quality Control Manager:		
Chris Moritz		7/28/2016
PRINTED NAME	***SIGNATURE***	***DATE***
Client Quality Control Manager / Authorized Representative:		
PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	8/1/2016
Task Code:	2204	**Location:**	Lake Wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	75
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630-0640 Crew meeting with BHC

0640- Depart marina for N4

0720-on site N4, set up pumps and curtain

0743- Diver L/S to jet/portage

0915- coupon recoverd

Clamp installed and backfilled

1021- set up on N3

1224- Pipe found, asbuilt not accurate.

1335- coupon on deck

Clamp installed, curtain left over night to let turbidity settle.

1400- depart N3, trv to marina

1430- crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☒ No

Notes:

Work package verified? ☐ Yes ☒ No

Notes:

Work package review by crew members? ☐ Yes ☒ No

Notes:

Hold points? ☐ Yes ☒ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

BHC asked home owner if curtain could stay and it was ok. BMC continued ops and recovered another coupon.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

N3 was found about 10 feet offshore of the stake.

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:

Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).

CONTRACTOR CERTIFICATION:

I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		8/1/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

			Date:	8/2/2016
Task Code:	2203	**Location:**	Lake wa	
Contract/Job #:	1015068	**Facility/Structure:**		

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	70
Weather Condition:	overcast

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina

0708- @ N3 to jet in

0725- Diver L/S

0807- Diver R/S, break down on N3

0835- set up on N2

0850-Diver L/S to jet/portage

1054- coupon on Deck

1157- done backfilling area, let turbidity settle

1221- depart N2 for N9

1258- jetting for pipe @ N9, pipe found

1340- letting turbidity settle

1406-depart N9

1430- @ marina, crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☐ No

Notes:

Work package verified? ☐ Yes ☐ No

Notes:

Work package review by crew members? ☐ Yes ☐ No

Notes:

Hold points? ☐ Yes ☐ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Jet in front of steps (pictured below) on waterfront/ beach access in front of N9, by BHC. Pipe was found at that location. Last week attempt at that location was 30' to the east.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	Work Performed	Method(s)	Hours Worked	% Completed

Task:				
Work Area	Work Performed	Method(s)	Hours Worked	% Completed

Task:				
Work Area	Item	Method(s)	Hours Worked	% Completed

REPORT CONTINUATION PAGE:

Provide additional details, descriptions, sketches, etc. and indicate by QCR attribute number (e.g. SAFETY) item to be commented on. Also reference any attachments on this page (as applicable).

CONTRACTOR CERTIFICATION:

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Contractor Quality Control Manager:

Chris Moritz		8/2/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:		
PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	8/3/2016
Task Code:	203	**Location:**	Lake Wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS: **A** - No weather condition interruptions of any kind occurring on this or previous shifts. **B** - Weather occurred during this shift that caused a complete stoppage of work. **C -** Weather occurred during this shift that caused a partial stoppage of work. **D -** No weather condition during this shift, work stopped due to previous adverse weather. **E -** No weather condition during this shift, work partially stopped due to previous adverse weather. **OTHER -** Explain:	**Weather Classification:**	Class A
	Temperature:	75
	Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina

0650- on N9

Setting up curtain, jet and portage

0710- Diver L/S to jet

0840- coupon on deck, torqueing clamp

Back fill, let turbidity settle. Off site @ 1000

1030- on N20, BHC sorting out where to jet.

1149- L/S to jet

1240- city sewer personnel on site to assist with locating pipe.

1339- jetting stake sewer department put in the ground

1359- pipe @ N20 found (pictured Below, Crew marked actual) two and a half feet inshore of marker and two feet down, pipe a foot and a half off rock wall and deeper than sewer department thought. Concerned about undermining and damaging retaining wall.

BHC wants to secure ops at this location, pipe too close to the rock wall. Coordinating with the city on a new location.

1515- looking at new location

Trv to marina, Boat and gear sort

1630- off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☐ No

Notes:

Work package verified? ☐ Yes ☐ No

Notes:

Work package review by crew members? ☐ Yes ☐ No

Notes:

Hold points? ☐ Yes ☐ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

Make more Toggles, From BHC. Crew damaged remaining toggles recovering N9. N. Southard to weld a few more tonight.

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

Could not find pipe at initial location on N20 closer to the cleanout, Aproxamently 20 feet from it, sewer department came and placed a steak. Pipe not found at that location either. Diver probed further in shore and found it close to a rock wall. Pipe was located too deep to be able to dig that close to the retaining wall. (pictured below)

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

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CONTRACTOR CERTIFICATION:		
I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.		
Contractor Quality Control Manager:		
PRINTED NAME	***SIGNATURE***	***DATE***
Client Quality Control Manager / Authorized Representative:		
PRINTED NAME	***SIGNATURE***	***DATE***

		Date:	8/4/2016
Task Code:	2203	**Location:**	Lake wa
Contract/Job #:	1015068	**Facility/Structure:**	

WEATHER CLASSIFICATIONS:
A - No weather condition interruptions of any kind occurring on this or previous shifts.
B - Weather occurred during this shift that caused a complete stoppage of work.
C - Weather occurred during this shift that caused a partial stoppage of work.
D - No weather condition during this shift, work stopped due to previous adverse weather.
E - No weather condition during this shift, work partially stopped due to previous adverse weather.
OTHER - Explain:

Weather Classification:	Class A
Temperature:	75
Weather Condition:	sunny

BMC CREW(S) / SUBCONTRACTOR(S) AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

0630- depart marina
0730- on N21
0756- diver L/S
0851- coupon on deck, diver to tourqe clamp, backfill
0907- Diver R/S, going to backfill
0920- let turbidity settle
0935- depart N21
1030- drop off tony at maydebauer marina
Trv to ballard via the canal, recover boats, start demob
1430- crew off

Location(s) of Work Performed Today:	

Is the work package onsite? ☐ Yes ☐ No

Notes:

Work package verified? ☐ Yes ☐ No

Notes:

Work package review by crew members? ☐ Yes ☐ No

Notes:

Hold points? ☐ Yes ☐ No

Notes:

TYPE AND RESULTS OF INSPECTION:

TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS:

VERBAL INSTRUCTIONS RECEIVED:

List any instructions given by Client and/or authorized representative(s) and personnel and actions taken

REMARKS:

Indicate conflicts with plans, specifications or instructions, acceptability or incoming materials, offsite surveillance activities, progress or work, delays – cause and extent thereof, days of no work – indicating reasons

REQUESTS FOR INFORMATION:

☐ RFI Attached

Control #:

ENVIRONMENTAL QUALITY CONTROL:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

Have protected species been encountered? ☐ Yes ☒ No

Notes:

Turbidity Monitor system is functioning? ☒ Yes ☐ No

Notes:

SPILL PREVENTION AND REFUELING PLAN:

Adequate spill prevention measures and equipment are in place and readily deployable? ☒ Yes ☐ No

Notes:

Environmental concerns/topics are discussed (as applicable) in job briefings? ☒ Yes ☐ No

Notes:

Fuel delivered to site today?
(See Spill Prevention/Refueling Plan for checklists) ☒ Yes ☐ No

Notes:

SAFETY:

Include all infractions of Client and/or Project Plan(s). Note any instructions from Client Representatives (STR, Safety Dept., Fire Protection, QC, etc.). Describe Corrective Actions taken as applicable.

Safety meeting held today with this crew? ☒ Yes ☐ No

PRODUCTION STATISTICS:				
Task:				
Task Code	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Work Performed**	**Method(s)**	**Hours Worked**	**% Completed**

Task:				
Work Area	**Item**	**Method(s)**	**Hours Worked**	**% Completed**

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I certify that this report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period are in compliance with the contract requirements unless specifically noted otherwise above.

Contractor Quality Control Manager:

Chris Moritz		8/4/2016
PRINTED NAME	***SIGNATURE***	***DATE***

Client Quality Control Manager / Authorized Representative:

PRINTED NAME	***SIGNATURE***	***DATE***

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix D. Pipe Coupon Analysis Report

Prepared for:

Tetra Tech, Inc.
1420 Fifth Avenue, Ste 6000
Seattle, WA 98101

SEWER LINE PLACEMENT STUDY
LAKE WASHINGTON PHASE 2
BELLEVUE, WASHINGTON

Prepared by:

Norton Corrosion Limited, LLC
Cathodic Protection and Corrosion Control
Since 1959
8820 222nd Street SE, Woodinville, WA 98077
Phone (425) 483-1616 • Fax (425) 485-1754
e-mail: sales@nortoncorrosion.com
www.nortoncorrosion.com

NCL File No. E-21762-P
October 21, 2016

Table of Contents

Appendix

1.0 Introduction

Norton Corrosion Limited (NCL) was tasked to provide test results for laboratory corrosion analysis of 19 pipeline samples provided to NCL between June 29 and July 28, 2016. Authorization to perform this work was issued per Subcontract Professional Services Agreement dated August 21, 2015 under Tetra Tech Job No. 135-12630-15001. These samples were collected and provided to NCL under Task 661 and 662. Pipe Sample Coupon Analysis was to be provided under Task 664.

1.1 Laboratory Testing

Laboratory analysis was performed by Simon Forensic, LLC, Shoreline, Washington, under sub-contract to NCL. The attached report in Appendix A details the results obtained from the testing completed. A discussion follows.

2.0 Pipe Sample Descriptions and Tests Performed

Reportedly all samples were collected from buried 8" diameter pipe located just off shore in shallow water, or onshore near the lake shore in saturated soils. No visual assessment of the pipes was provided and soil samples were not obtained. The pipelines are believed constructed between 1959 and 1965. The original construction specifications including pipe schedule (wall thickness) are not available. NCL's analysis and estimate of corrosion rate are based on construction in 1965, which would represent the most conservative evaluation of the data obtained.

2.1 Asbestos Cement Pipe Coupons

Seven asbestos cement (AC) pipe coupons were submitted for analysis. Testing included the following:

1. Visual examination aided by low power stereomicroscopy
   a. Documentation of pipe condition and extent of wall loss as an indication of condition

2. Point micrometer wall thickness dimensional measurement
   a. Measurement of pipe wall cross section as an indication of degradation from original thickness

3. Measurement of surface hardness and scratch hardness tests
   a. Evaluation of pipe integrity as an indication of condition

4. Cross section chemical analysis (pH, Al, Ca, Fe, Mg, S, Si)
   a. Documentation of apparent competent wall cross sections as base line. Compare baseline to apparent degraded wall cross sections to approximate indication of condition and extent of cement mortar leaching

5. Phenolphthalein indicator staining
   a. Thickness measurement of calcium, in the form of lime, through cross section of the pipe wall as an indication of degradation due to acid attack and evaluation of gross leaching of cement mortar

6. Estimate of remaining pipe design life based on best judgment from the analysis data and calculations using pipe failure history

2.2 Cast Iron Pipe Coupons

Twelve cast iron (CI) pipe coupons were submitted for analysis. Testing included the following:

1. Visual examination aided by low power stereomicroscopy
   a. Documentation of pipe condition and extent of corrosion/wall loss as an indication of condition and cast iron graphitization

2. Point micrometer wall thickness dimensional measurement
   a. Measurement of pipe wall cross section as an indication of degradation from original thickness

3. Charpy impact test
   a. Evaluation of pipe integrity and toughness for an indication of condition and remaining ductility

4. Brinell hardness test
   a. Indication of pipe hardness

5. Chemical testing (C, Cr, Cu, Mg, Mn, Mo, Ni, P, Si, S, Ti, V)
   a. Documentation of apparent competent wall cross section as base line, compared to apparent degraded wall cross sections as an indication of condition

6. Petrographic examination of interior cement mortar lining
   a. Thickness measurement and lining evaluation as an indication of degradation of mortar lining due to acid attack. *NCL had noted that phenolphthalein staining testing and some EDS testing might be a better option for this type of testing.*

7. Estimate of remaining pipe design life based on best judgment from the analysis data and calculations using pipe failure history

3.0 Results and Conclusions

3.1 AC Pipe

The table below summarizes the AC pipe data not tabulated in the laboratory report in Appendix A.

Asbestos Cement Pipe										
Sample	Thickness	Phenolphthalein		pH			Mohs Hardness		Deterioration	Notes
		Inside	Outside	inside	center	outside	low	high		
	(in.)	(+/-)	(+/-)				(Scale #)	(Scale #)	(% of wall)	
N-1	0.70	+	+	6	9	6	3.0	6.0	40%	
N-5	0.66	+	+	7	8	7	4.0	4.0	55%	
N-6	0.65	+	+	4	7-8	6	1.0	4.0	70%	delamination
N-8	0.68	+	+	7	8	7	3.0	5.5-6	40%	
N-11	1.07	+	+	6.5	10-11	8-9	3.0	5.5	35%	
N-12	0.83	+	+	7	8-9	8	3.0	4.0	40%	
N-14	0.70	+	+	3-4	8-9	4	3.5	5.5	40%	

The AC pipe contains calcium (Ca) which makes it hard. As the calcium layer deteriorates, a softer, weaker asbestos layer remains behind. The asbestos cement pipe generally has both interior and exterior acid attack leading to a total effective deterioration of 35% to 70% of the wall thickness. Sample N-6 was the most severely impacted sample having a wall thickness of 0.65" with delamination leading to deterioration of 70% of the wall thickness and a low Mohs hardness of 1.0. This portion of the pipe wall can be expected to have a significantly reduced strength.

In discussion with the lab, the interior of the AC pipe samples appeared uniform in thickness, suggesting the measured wall thickness closely represents the original pipe thickness. It did not appear that all of the AC pipe samples were originally 1" thick, having eroded to their existing thickness. The AC pipe was likely installed under various projects for which the specified original thickness is unknown. The delamination on the interior surface of Sample N-6 appeared to have occurred in service an not as a result of sample collection.

The test results obtained using the pH pen, phenolphthalein and SEM-EDS data indicate the reduction of calcium content of both the internal and external surfaces has occurred due to acid leaching. This results in a substantially weaker pipe wall. The middle section of the pipe wall had a calcium content ranging from 19.5 % to 24.4%, which likely represents the original calcium content of new pipe. The pH of the middle sections ranged between 7 and 11; the original pH was likely 10.0 or above. As calcium is removed, the pH falls to 7 or below based on environmental conditions. The external surface layer had a pH between 3 and 7 correlating with low Mohs hardness data.

The following table summarizes wall thickness of the AC pipe, along with the depth of deterioration observed to the internal and external faces. The middle region, as defined here by the Phenolphthalein test as having a high pH, represents the remaining wall thickness that has been minimally impacted by dissolution of the calcium content.

Asbestos Cement Pipe					
Sample	Thickness	Material by Region			
	Total	Internal	Middle	External	% Loss
	(in.)	(in.)	(in.)	(in.)	
N-1	0.70	0.27	0.36	0.07	49%
N-5	0.66	0.18	0.30	0.18	55%
N-6	**0.65**	0.21	0.22	0.22	66%
N-8	0.68	0.03	0.36	**0.29**	47%
N-11	1.07	0.22	0.71	0.14	34%
N-12	0.83	**0.35**	0.35	0.14	58%
N-14	0.70	0.10	0.45	0.10	36%
	Minimum	Maximum	Remaining	Maximum	
	0.65	0.35	0.01	0.29	**98%**

Sample N-6 appears to have had the thinnest original wall thickness (0.65”) and suffered the greatest percentage of wall deterioration (66%). The wall deterioration of this sample more closely represented the average depth of deterioration than the maximum. The high percentage of deterioration is based in part on the fact this sample was the thinnest one examined.

As a worst case scenario, if one accepts the minimum wall thickness measured to represent the thinnest actual pipe wall installed (0.65”), then subtracts the maximum loss measured on the inside (0.35”) and the maximum wall loss on the outside (0.29”), the remaining wall thickness would be 0.01”, representing 98% deterioration of the pipe wall as a result of acid attack reducing the calcium content. This would also represent nearly 100% deterioration of the pipe wall. Realizing that the seven samples provided represent a small percentage of the piping system overall, it would not be unlikely to observe a greater depth of deterioration on the pipe in some areas.

The pipe installed would range from 51 to 57 years in age, based on the installation date between 1959 and 1965. The service life varies with the environmental conditions and can sometimes be related to soil characteristics not evaluated under this scope of work. NCL suggests that a correlation may still be observed if one evaluated the coupon data based on the depth of burial and where it was installed in relationship to the shoreline. This exercise may assist in prioritizing segments for replacement.

3.2 CI Pipe

The following table summarizes the cast iron pipe sample data not tabulated in the laboratory report. Considering the range of wall thicknesses and minimal extent of corrosion, it appears the pipe had various wall thicknesses ranging from approximately 0.32 to 0.41 inch.

Cast Iron Pipe										
	Wall	Internal	External	Corrosion	Wall	Liner	pH	pH	Hardness	Liner
Sample	Thickness	Corrosion	Pitting	Rate	Loss	Thickness	at metal	of mortar	Cement	Condition
	(in.)		(in.)	(mils/yr)	(in.)	(in.)			(Mhos)	
N-2	0.319	0.000	none	0.000	0.0%	0.135	11	11	4.5-5.0	good condition
N-3	0.390	0.000	0.000	0.000	0.0%	0.241	10-11	8	4.5-5.0	two layers, fractured to surface
N-4	0.339	0.016	0.000	0.314	4.8%	0.103	4	4	4.5-5.0	mortar intact, pH 4 at metal
N-9	0.333	0.000	0.000	0.000	0.0%	0.248	7	7	5.0-6.0	liner fractured, separating at metal surface
N-10	0.335	initiated	0.021	0.412	6.2%	0.075	low	<7	low - NA	cement is no longer effective
N-13	0.377	0.000	0.028	0.549	7.4%	0.175	6-7	6-7	7	cement is no longer effective
N-15	0.414	initiated	0.097	1.902	23.5%	0.073	3-4	3-4	low - NA	cement is no longer effective
N-16	0.405	initiated	0.063	1.235	15.6%	0.000	NA	NA	NA	liner is missing and corrosion has initiated
N-17	0.397	initiated	0.026	0.510	6.4%	0.000	NA	NA	NA	liner is missing and corrosion has initiated
N-18	0.364	initiated	0.018	0.353	5.1%	0.092	6-7	6-7	low - NA	cement is no longer effective
N-19	0.378	0.000	0.062	1.216	16.3%	0.097	7	5	5	cement is no longer effective
N-21	0.339	initiated	0.000	0.000	0.0%	0.105	6	6	4.5-5	cement is no longer effective

Four samples have a cement liner that has a pH of 7 or less indicating it has lost the ability to substantially mitigate corrosion. Samples N-16 and N-17 had no cement liner present.

As the cement liner deteriorates and the pH drops below 8-9, the iron surface will lose passivation and corrosion may initiate at the surface. The lower the pH at the metal surface, the more aggressive the rate of corrosion is expected to be. Several samples have mortar that has deteriorated and cracked, which may also lead to the loss of the liner. The metal below an intact liner with a low pH should experience a lower rate of corrosion than exposed metal where the liner is separated from the surface or broken away. The samples tested show all phases of deterioration from intact with a high pH, to low pH, to cracked and deteriorated, and finally removed from the metal surface.

Based on the date of construction, NCL has estimated the linear corrosion rate in mils per year. This does not necessarily mean the corrosion rate of the cast iron pipe is linear. NCL anticipates the future rate of internal corrosion will increase. Once the internal liner is compromised, the internal rate of corrosion initiates and that point in time remains undetermined. As the liner continues to deteriorate, the corrosion rate will increase to that of bare metal.

Sample N-15 had a pit 0.097" deep. The associated linear rate of corrosion would be less than 2 mils per year. Assuming a rate of 2 mils per year, the thinnest wall section measured (Sample N-2) of 0.319" would reach penetration over a total service life of 160 years, suggesting the cast iron pipe has an extensive service life remaining. NCL cautions that the quantity of samples is small and the possibility that there is more extensive external pitting corrosion exists. In addition, this does not account for the internal corrosion as discussed in the previous paragraph.

APPENDIX A

LABORATORY REPORT

17703 15th Ave NE, Shoreline, WA 98155 Phone: 206-713-3539 Email: omar@simonforensic.com Website: www.simonforensic.com

Simon Forensic, LLC

Norton Corrosion Limited
8820 222nd St SE
Woodinville, WA 98077

Date: August 22, 2016
Revised: October 13, 2016

Re: Tetra Tech City of Bellevue Sewer Line Assessment
NCL job #: E21762-P
Simon Forensic File# 1778

Gentlemen,

The seven (7) cement asbestos pipe cores and the twelve (12) cast iron pipe cores were documented and analyzed to determine their chemical composition, hardness, amount of degradation, and overall condition. The aim of this investigation is to aid in determining the approximate remaining lifetime of the various pipe sections.

Sample ID:
The samples were labeled as follows:

Cement-Asbestos pipes:
N-1, N-5, N-6, N-8, N-11, N-12, and N-14

Cast iron pipes:
N-2, N-3, N-4, N-9, N-10, N-13, N-15, N-16, N-17, N-18, N-19, and N-21

Conclusions:

Based upon the analysis to this point the following is a summary of the overall condition of each sample.

Asbestos Cement pipe Analysis:

- **N-1** was found to have an overall thickness of 0.70". The phenolphthalein test indicated that there is an acid attack occurring from both the inside and outside. The inside pH is approximately 6 at a depth of 0.27" in, with the center region (0.36") having a pH of 9, and an outer layer 0.07" with a pH of 6.

  The lower pH regions also had a reduced calcium percentage indicating acid leaching/attack.

The hardness at the inner layer of (0.23") had a Mohs hardness of approximately 3, transitioning to a Mohs hardness of about 6 through the center region.

This indicates that about 40% of the pipe cross section has had some chemical attack and degradation.

- **N-5** was found to have an overall thickness of 0.66". The phenolphthalein test indicated that chemical attack was occurring from both the inside and outside. The inside and outside regions were about 0.18" with a pH of approximately 7, the center region had a pH of 8.

  There was reduced calcium content at the inside and outside regions with a lower pH.

  The Mohs hardness across the sample was approximately 4.

  This indicates that about 55% of the pipe wall has had some reduction in pH and a reduced hardness.

- **N-6** was found to have an overall thickness of 0.65". The phenolphthalein test again indicated that there was chemical attack occurring from both the inside and outside.

  The inside region of about 0.22" had a pH of about 4 and this region was delaminating from the core. The outside region of about 0.22" also had a reduced pH at 6, while the inner 0.21" had a pH of 7-8. The low pH regions also had a reduced calcium content.

  The Mohs hardness was about 3 at the outside, 4 through the center dropping to 1 at the inner layer that was delaminating.

  This indicates about a 70% of the pipe wall has reduced pH and reduced hardness.

- **N-8** was found to have an overall thickness of 0.68". The phenolphthalein test indicates that there was a thin layer (0.03") of reduced pH at the inside with an outer layer about 0.29" with a pH of 7 and a Mohs hardness of 3.0. This potentially looked like two layers of different material or just more severe attack from the outside. This reduced pH region also had reduced calcium content.

  The lower middle section (0.39") had a pH of 8 and Mohs hardness of 5.5-6.0.

  This indicates about 40% of the pipe has a reduced pH and hardness.

- **N-11** was found to have an overall thickness of 1.07". The phenolphthalein test indicates that there is a reduced pH at both the inside and outside of the pipe sample.

  The inner layer of about 0.09" had a pH of 6.5, the next layer that was 0.13" had pH of 8-9, with the middle layer 0.71" had a pH of 10-11. The outer layer 0.14" had a pH of 8-9.

  The areas of reduced pH also had a reduced calcium content.

  The outer 0.14" had a Mohs hardness of 3.0, the middle (0.71") of the sample had a hardness of 5.5 and the inner region had a hardness of about 4.

  This indicates that about 35% of the cross section has a reduced hardness and pH.

- **N-12** (note this sample was initially labeled N-17 in the images due to partial wear on the bag ID) was found to have an overall thickness of 0.83". The phenolphthalein test indicates that the inner layer (0.35") had a pH of 7 with the middle region (0.35") had a pH of 8-9 and the outer layer (0.14") had a pH of 8.

  The reduced pH regions had a reduced calcium content.

  The inner region had a Mohs hardness of about 3.0, while the rest of the sample had a hardness of 4.0.

  This indicates that about 42% of the pipe wall from the inside and about 17% from the outside for a (combined total of 59%) has a reduced hardness and pH.

- **N-14** was found to have an overall thickness of 0.70". The phenolphthalein test indicates that there is a reduced pH at both the inside and outside surfaces.

  The inner layer of 0.1" had a pH reduced to 3-4, with the middle layer (0.45") had a pH of 8-9 with the outside layer (0.10") having a pH of 4.

  The inside of the layer had a Mohs hardness of 3.5, while the middle region had a hardness of 5.5, the outside layer had a hardness of 4 with a thin layer of loose material.

  This indicates that about 40% of the cross section has a reduced hardness and pH.

Cast Iron Pipe Analysis:

- **N-2** this sample had a cast iron overall thickness of 0.319" with no visible pitting.

  The cementitious layer (two approximate equal layers) on this sample was 0.135" with a pH of 11.

The Mohs hardness of the top layer was 4.5, while the layer directly above the cast iron was 5.

There was no loss in thickness from corrosion.

- **N-3** this sample had an overall cast iron thickness of 0.390" with no observed pitting of the cast iron.

  The cementitious layer (two approximate equal layers) on this sample was 0.241" with a pH of 8 on the top layer (exposed) and 10-11 adjacent to the cast iron.

  The Mohs hardness of the cement layer was 4.5-5.

  There was no loss in thickness from corrosion.

- **N-4** this sample had an overall cast iron thickness of 0.339" with observed pitting extending 0.016" into the cast iron.

  The cementitious layer on this sample was 0.103" with a pH of 4. This indicates that the cement layer is no longer providing corrosion protection.

  The Mohs hardness of the cement layer was 4.5-5.

  There was a 4.8% loss in thickness from corrosion.

- **N-9** this sample had an overall cast iron thickness of 0.333" with no observed pitting of the cast iron.

  The cementitious layer on this sample was 0.248" with a pH of 7 at the outside layer and a pH of 10 adjacent to the cast iron.

  The Mohs hardness of the cement layer was 5-6.

  There was no loss in thickness from corrosion.

- **N-10** this sample had an overall cast iron thickness of 0.335" with observed pitting extending 0.021" into the cast iron.

  The cementitious layer on this sample was 0.075" with a low pH, but the exact value could not be determined due to the discoloration of the cement. The presence of pitting on the ID indicates that the cement layer is no longer providing corrosion protection.

  The Mohs hardness testing crumbled the cement so value could not be obtained.

There was a 6.2% loss in thickness from corrosion.

- **N-13** this sample had an overall cast iron thickness of 0.377” with observed pitting extending 0.028” into the cast iron.

  The cementitious layer on this sample was 0.175” with a pH of 6-7. This indicates that the cement layer is no longer providing corrosion protection.

  The Mohs hardness of the cement layer was 6.5.

  There was a 7.4% loss in thickness from corrosion.

- **N-15** this sample had an overall cast iron thickness of 0.414” with observed pitting extending 0.097” into the cast iron from the outside surface.

  The cementitious layer on this sample was 0.073” with a pH of 3-4. This indicates that the cement layer is no longer providing corrosion protection.

  The Mohs hardness testing crumbled the cement layer so value could not be obtained.

  There was a 23.5% loss in thickness from corrosion.

- **N-16** this sample had an overall cast iron thickness of 0.405” with observed pitting extending 0.063” into the cast iron.

  There was no cementitious layer on this sample. The presence of the uniform corrosion at the ID indicates that the cementitious layer was lost in service (not during sampling), allowing for corrosion to proceed.

  There was a 15.6% loss in thickness from corrosion.

- **N-17** this sample had an overall cast iron thickness of 0.397” with observed pitting extending 0.026” into the cast iron.

  There was no cementitious layer on this sample. The presence of the uniform corrosion at the ID indicates that the cementitious layer was lost in service (not during sampling), allowing for corrosion to proceed.

  There was a 6.4% loss in thickness from corrosion.

- **N-18** this sample had an overall cast iron thickness of 0.364” with observed pitting extending 0.018” into the cast iron.

  The cementitious layer on this sample was 0.092” with a pH of 6-7. This indicates that the cement layer is no longer providing corrosion protection.

The Mohs hardness testing crumbled the cement layer so a value could not be obtained.

There was a 5.1% loss in thickness from corrosion.

- **N-19** this sample had an overall cast iron thickness of 0.378” with observed pitting extending 0.062” into the cast iron from the outside.

  The cementitious layer on this sample was 0.097” with a pH of 5 at the outer layer and about 7 at the cast iron interface. This indicates that the cement layer is no longer providing corrosion protection.

  The Mohs hardness of the cement layer was 5.

  There was a 16.3% loss in thickness from corrosion on the OD.

- **N-21** this sample had an overall cast iron thickness of 0.339” with no observed pitting of the cast iron.

  The cementitious layer on this sample was 0.105” with a pH of 6. This indicates that the cement layer will no longer provide effective corrosion protection.

  The Mohs hardness of the cement layer was 4.5-5.

  There was no loss in thickness from corrosion.

Composition:

Asbestos Cement:

The composition, specifically the calcium content of the asbestos cement fiberglass cross sections were analyzed by means of a Scanning Electron Microscope with Energy Dispersive Spectroscopy (SEM-EDS). The table below summarizes the calcium content on the inside, middle and outside of each cross section. The results below are weight percentage of calcium in the various regions.

Sample ID	Inside	Middle	Outside
N-1	2.8	23.1	12.5
N-5	1.8	24.4	8.2
N-5	0.8	21.6	1.5
N-8	23.7*	23.7	5.1
N-11	5.6	21.5	6.1
N-12	6.8	19.5	13.5
N-14	10.9	20.0	14.2

*This sample region was analyzed just inside of the thin 0.03” layer that had reduced pH.

Cast iron:

The composition of the cast iron pipes was determined by means of an Inductively Coupled Argon Plasma Spectrometer (ICP-AES) with the carbon and sulfur content determined by Leco combustion analysis.

Element, Wt. %	N-2	N-3	N-4	N-9	N-10	N-13
Carbon, C	3.74	3.55	3.70	3.72	3.71	3.87
Sulfur, S	0.077	0.074	0.095	0.092	0.091	0.089
Silicon, Si	0.79	0.82	0.61	0.75	1.15	1.12
Manganese, Mn	0.41	0.41	0.42	0.40	0.41	0.43
Magnesium, Mg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium, Cr	0.09	0.10	0.10	0.09	0.11	0.01
Molybdenum, Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel, Ni	0.12	0.13	0.10	0.12	0.16	0.15
Phosphorus, P	0.31	0.27	0.25	0.16	0.19	0.30
Copper, Cu	0.17	0.17	0.22	0.17	0.16	0.16
Titanium, Ti	0.03	0.03	0.03	0.04	0.04	0.05
Iron, Fe	Rem.	Rem.	Rem.	Rem.	Rem.	Rem.

Element, Wt. %	N-15	N-16	N-17	N-18	N-19	N-21
Carbon, C	3.69	3.49	3.41	3.56	3.49	3.81
Sulfur, S	0.095	0.083	0.091	0.101	0.096	0.081
Silicon, Si	1.13	1.43	1.35	1.25	1.13	1.40
Manganese, Mn	0.37	0.38	0.40	0.40	0.41	0.42
Magnesium, Mg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium, Cr	0.07	0.08	0.07	0.07	0.06	0.07
Molybdenum, Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel, Ni	0.14	0.18	0.17	0.14	0.16	0.21
Phosphorus, P	0.14	0.10	0.14	0.13	0.19	0.15
Copper, Cu	0.20	0.31	0.22	0.21	0.13	0.21
Titanium, Ti	0.03	0.04	0.04	0.03	0.05	0.04
Iron, Fe	Rem.	Rem.	Rem.	Rem.	Rem.	Rem.

Charpy impact testing:

The samples of cast iron were tested at +40ºF for charpy impact values. The samples were tested in the 10mm x 5 mm size due to their size. The following results were obtained.

Sample ID	Bar 1, Ft.-Lbs.	Bar 1, Ft.-Lbs.	Bar 1, Ft.-Lbs.
N-2	<1.0	<1.0	<1.0
N-4	<1.0	<1.0	<1.0
N-9	<1.0	<1.0	*
N-10	<1.0	<1.0	<1.0
N-13	<1.0	<1.0	<1.0
N-15	<1.0	<1.0	<1.0
N-16	<1.0	<1.0	<1.0
N-17	<1.0	<1.0	<1.0
N-18	<1.0	<1.0	<1.0
N-19	<1.0	<1.0	<1.0
N-21	<1.0	<1.0	<1.0

*Only two samples could be obtained from this sample.
Note, sample N-3 fractured during machining.

Brinell hardness:

The samples of cast iron were also tested for Brinell hardness, which revealed the following values.

Sample ID	Rockwell 'B'	BHN equivalent*
N-2	80.0	105
N-3	79.0	147
N-4	88.0	176
N-9	74.5	136
N-10	77.5	142
N-13	85.5	167
N-15	85.5	167
N-16	84.0	152
N-17	81.5	154
N-18	72.5	131
N-19	82.0	156
N-21	77.5	142

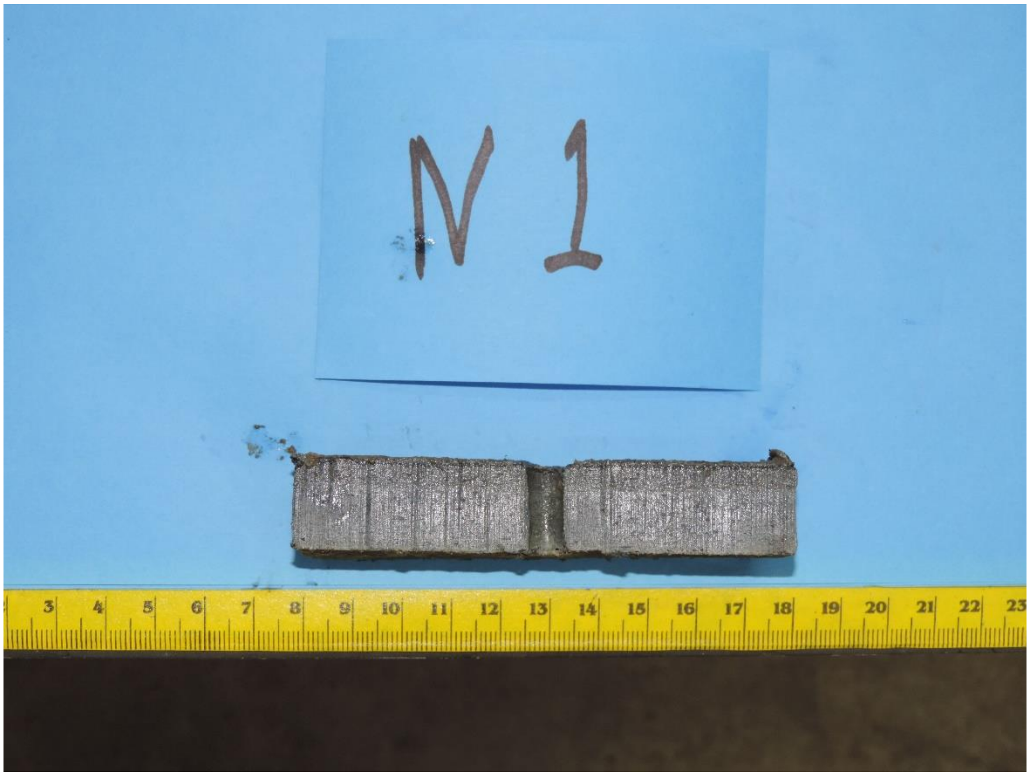
*Hardness conversion per ASTM E140 table 2, values are approximate and given for reference only.

Laboratory Observations and Data:

The following images and spectral data

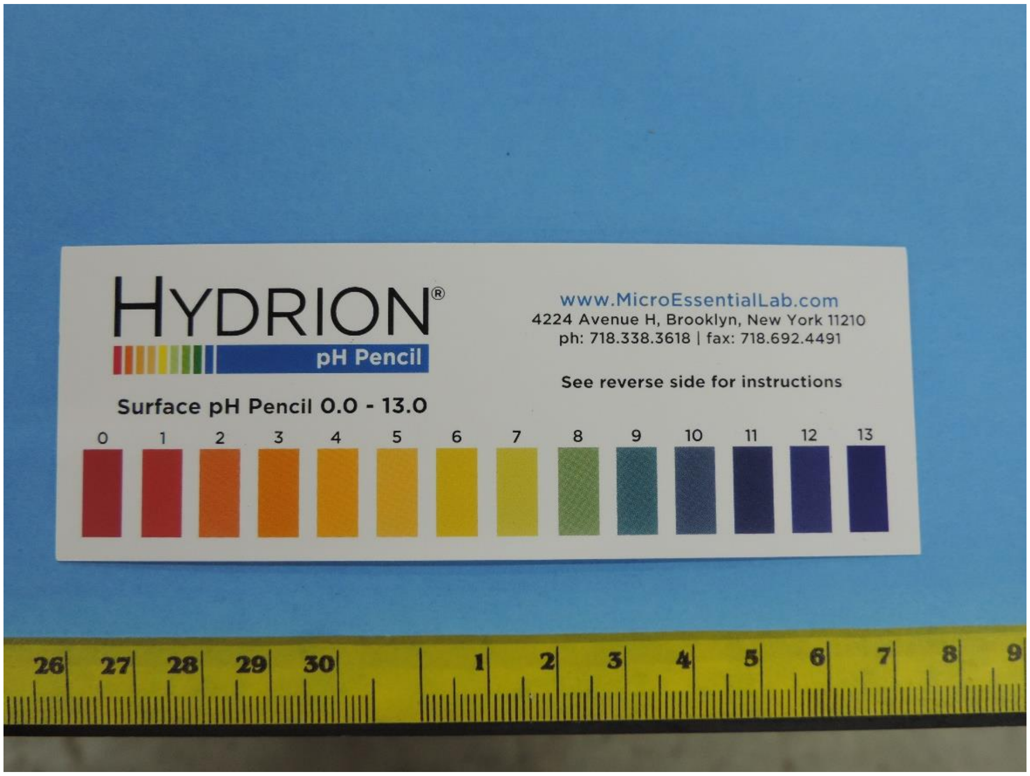
Overall view of sample N-1.

Overall view of sample N-1 after sectioning.

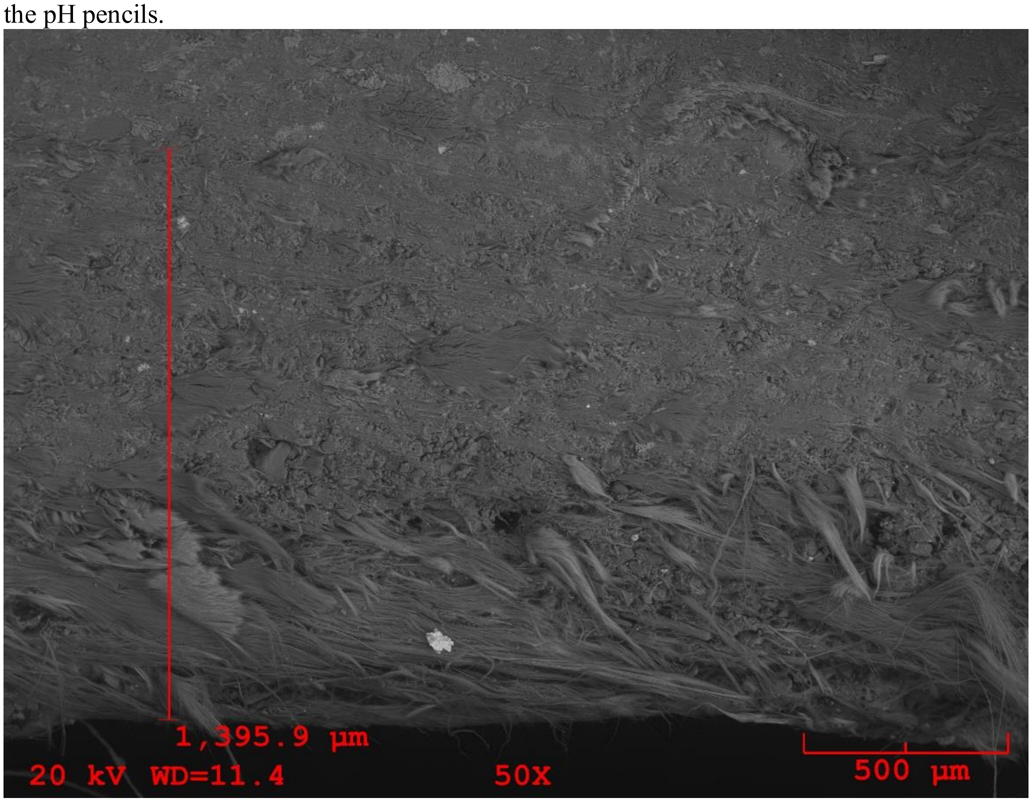


Close up of the cross section removed from sample N-1. The inside of the pipe is at the top of the sample.

Close up of the cross section of N-1 after phenolphthalein, hardness and pH testing. This indicate that the inner layer (bottom) has a reduced pH as well as the top layer.

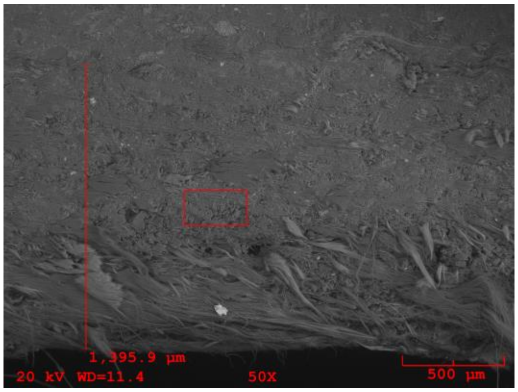


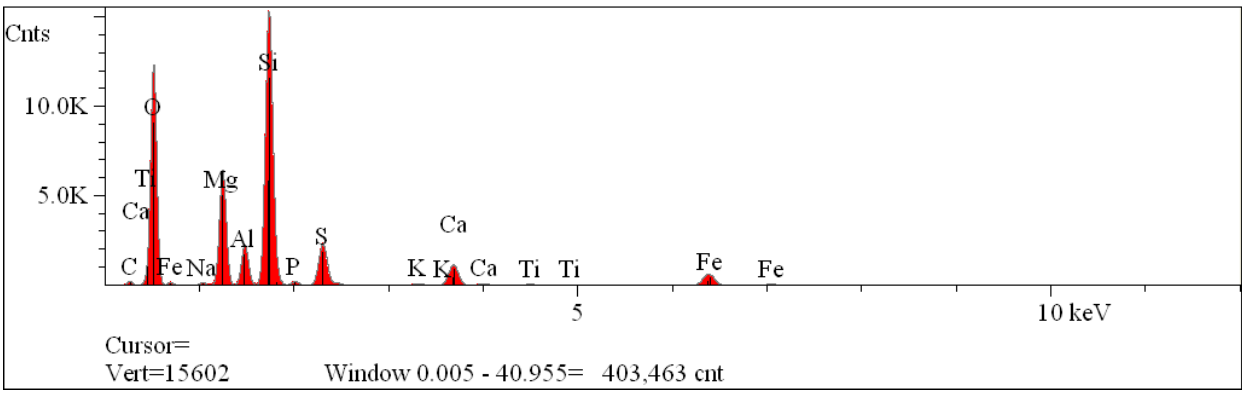
Overall view of the pH pencil color scale. The cross sections were tested with both phenolphthalein and the pH pencils.



50x SEM image of sample N-1 with an inner degraded layer measured.

Analysis Report: N-1 cross section-1-1



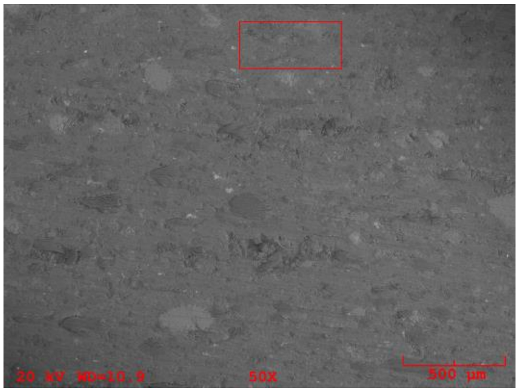


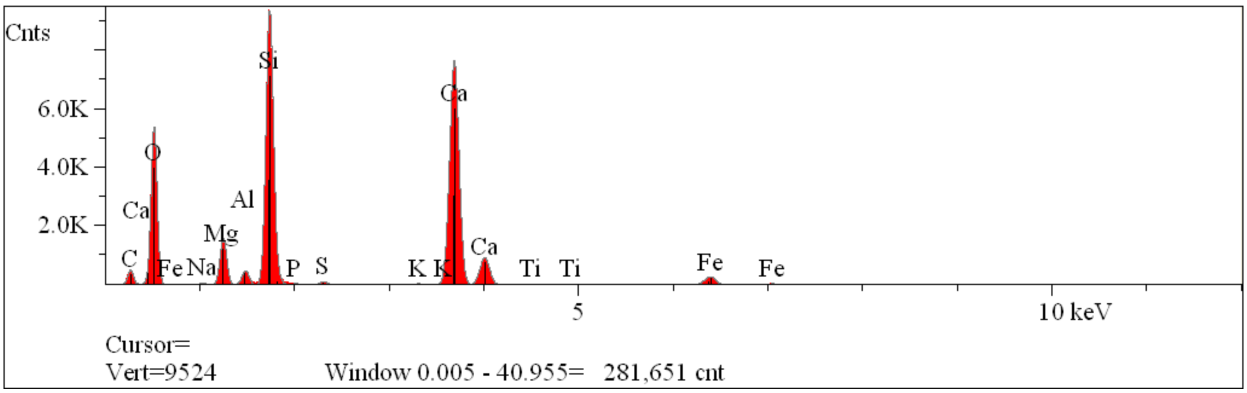
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,838.12	6.45	3.81	wt.%	0.01	0.00	
O	Ka	97,541.77	58.68	46.19	wt.%	0.00	0.00	
Na	Ka	1,570.42	0.34	0.39	wt.%	0.00	0.00	
Mg	Ka	56,649.70	8.41	10.06	wt.%	0.00	0.00	
Al	Ka	20,519.50	2.69	3.57	wt.%	0.00	0.00	
Si	Ka	148,470.17	17.03	23.53	wt.%	0.00	0.00	
P	Ka	2,399.51	0.31	0.48	wt.%	0.00	0.00	
S	Ka	25,846.16	2.93	4.62	wt.%	0.00	0.00	
K	Ka	1,612.69	0.16	0.31	wt.%	0.00	0.00	
Ca	Ka	14,572.14	1.43	2.82	wt.%	0.00	0.00	
Ti	Ka	1,180.76	0.12	0.29	wt.%	0.00	0.00	
Fe	Ka	9,896.05	1.43	3.93	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 30.0

EDS of the inner layer of sample N-1 showing a reduced calcium content.

Analysis Report: N-1 cross section-13-1



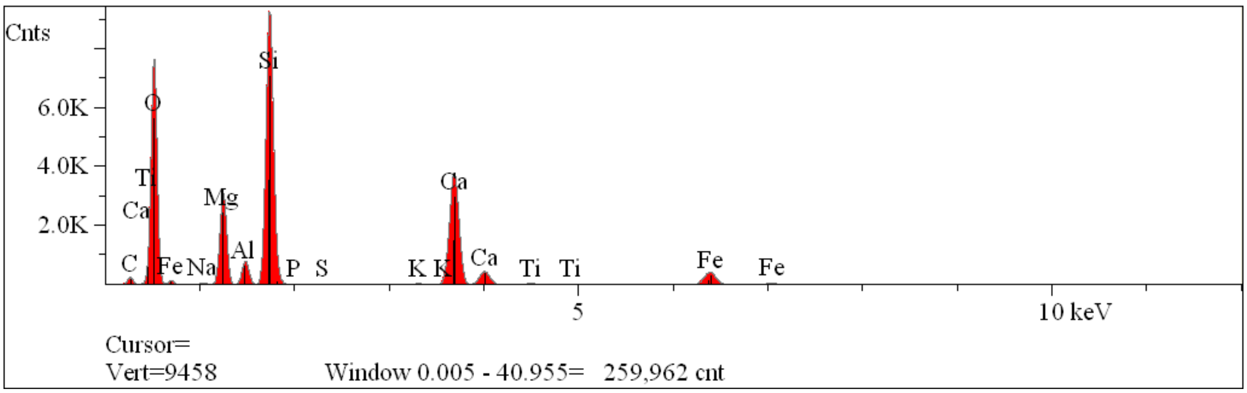


Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	3,758.45	10.37	5.96	wt.%	0.01	0.00	
O	Ka	42,778.38	58.66	44.91	wt.%	0.00	0.00	
Na	Ka	583.20	0.20	0.22	wt.%	0.00	0.00	
Mg	Ka	14,087.54	3.14	3.65	wt.%	0.00	0.00	
Al	Ka	4,551.29	0.79	1.02	wt.%	0.00	0.00	
Si	Ka	91,607.06	13.57	18.24	wt.%	0.00	0.00	
P	Ka	475.96	0.08	0.12	wt.%	0.00	0.00	
S	Ka	1,291.05	0.18	0.28	wt.%	0.00	0.00	
K	Ka	497.14	0.06	0.11	wt.%	0.00	0.00	
Ca	Ka	93,291.48	12.03	23.07	wt.%	0.00	0.00	
Ti	Ka	509.10	0.08	0.18	wt.%	0.00	0.00	
Fe	Ka	4,128.10	0.84	2.24	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the middle region of sample N-1. This gives a baseline calcium content of about 23%.

Analysis Report: N-1 cross section-15-1



Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,950.46	6.78	4.00	wt.%	0.01	0.01	
O	Ka	60,276.78	62.72	49.36	wt.%	0.00	0.00	
Na	Ka	706.12	0.24	0.28	wt.%	0.00	0.00	
Mg	Ka	27,220.86	6.26	7.48	wt.%	0.00	0.00	
Al	Ka	7,370.65	1.41	1.87	wt.%	0.00	0.00	
Si	Ka	89,540.19	14.61	20.18	wt.%	0.00	0.00	
P	Ka	114.86	0.02	0.03	wt.%	0.00	0.00	
S	Ka	245.83	0.04	0.06	wt.%	0.00	0.00	
K	Ka	527.60	0.07	0.14	wt.%	0.00	0.00	
Ca	Ka	46,247.68	6.33	12.48	wt.%	0.00	0.00	
Ti	Ka	765.94	0.12	0.28	wt.%	0.00	0.00	
Fe	Ka	6,666.42	1.40	3.85	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

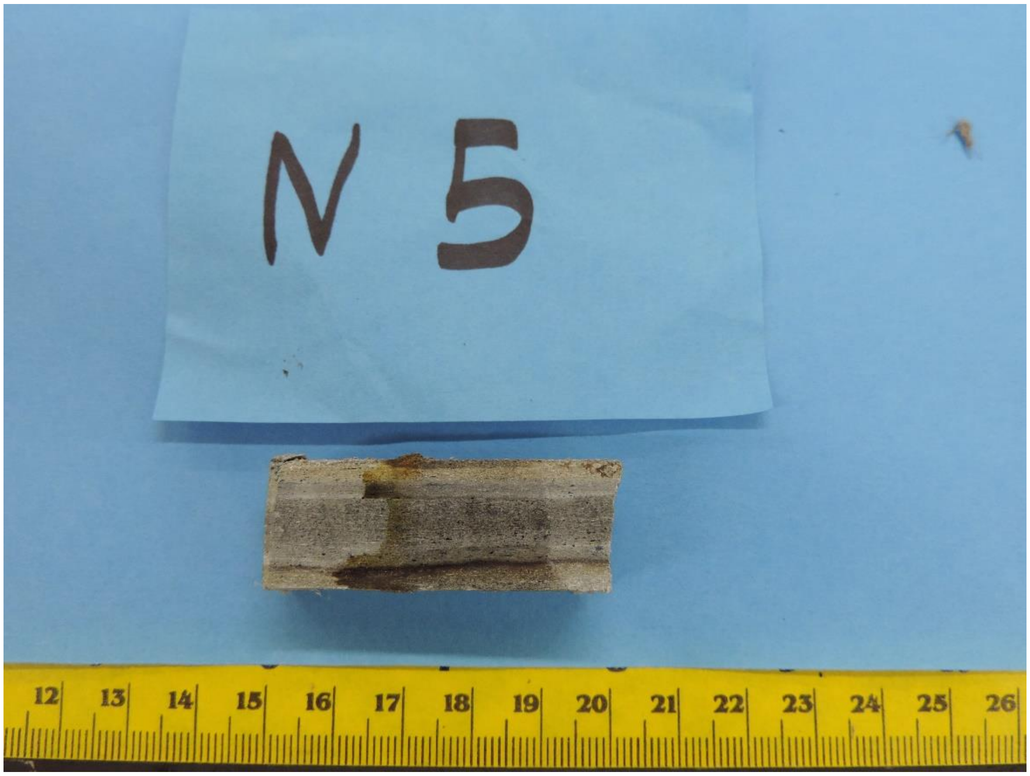
EDS of the outside layer of sample N-1. Note the reduced calcium content compared to the previous spectra.

Overall view of sample N-5.


Close up of an area of delamination at the inside layer of N-5.

Overall view of sample N-5 after sectioning.

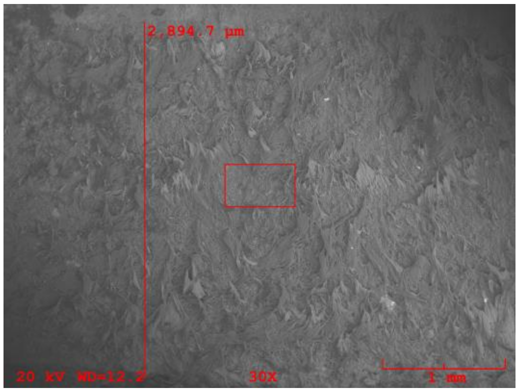
Close up view of the cross sections of sample N-5. Note the layers of attack are clearly visible at the inside and outside of the sample.

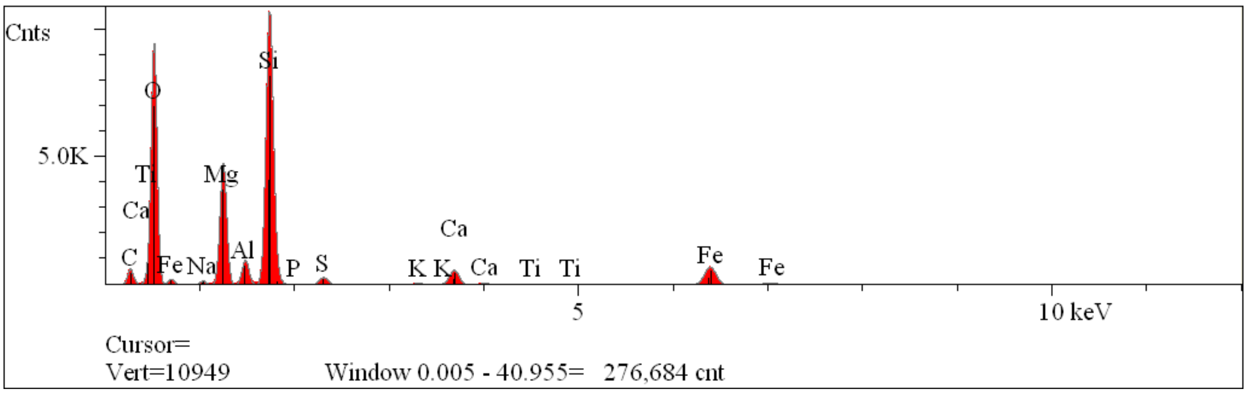


Close up of sample 5 after phenolphthalein and pH pencil testing, indicating a neutral/slightly alkaline pH in the center and slightly acidic at the inside and outside layers.

30x SEM image of the inside layer of sample N-5.

Analysis Report: N-5 cross section-1-1



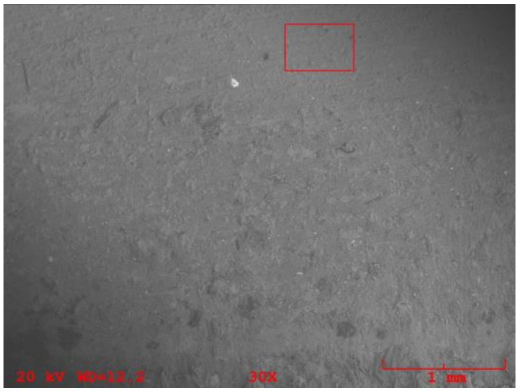


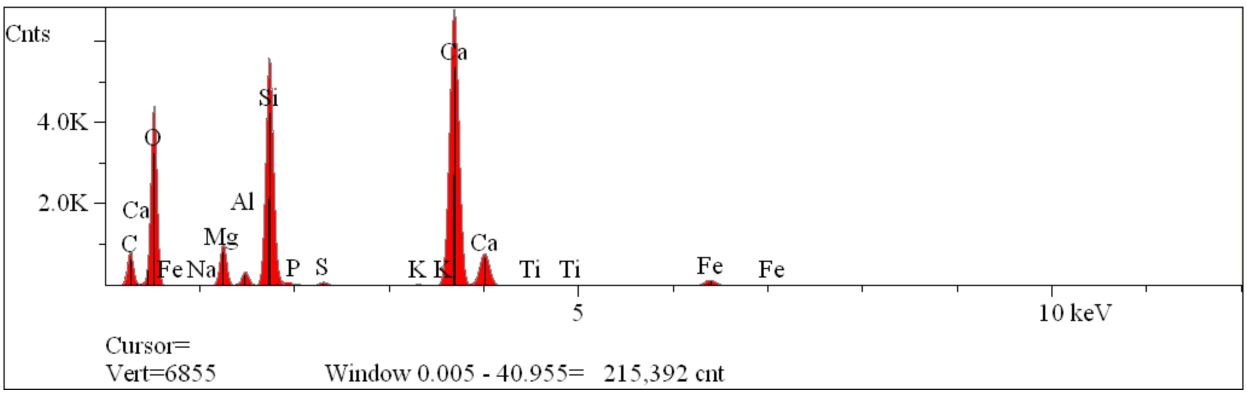
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	4,787.93	16.66	10.48	wt.%	0.01	0.01	
O	Ka	74,685.77	55.11	46.18	wt.%	0.00	0.00	
Na	Ka	1,384.22	0.39	0.47	wt.%	0.00	0.00	
Mg	Ka	41,951.94	8.00	10.19	wt.%	0.00	0.00	
Al	Ka	8,847.76	1.48	2.09	wt.%	0.00	0.00	
Si	Ka	104,280.23	14.88	21.88	wt.%	0.00	0.00	
P	Ka	362.92	0.06	0.09	wt.%	0.00	0.00	
S	Ka	3,236.02	0.45	0.75	wt.%	0.00	0.00	
K	Ka	806.81	0.10	0.20	wt.%	0.00	0.00	
Ca	Ka	7,311.23	0.87	1.84	wt.%	0.00	0.00	
Ti	Ka	603.88	0.08	0.19	wt.%	0.00	0.00	
Fe	Ka	10,744.52	1.93	5.63	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inside layer of N-5. Note the reduced calcium content.

Analysis Report: N-5 cross section-3-2



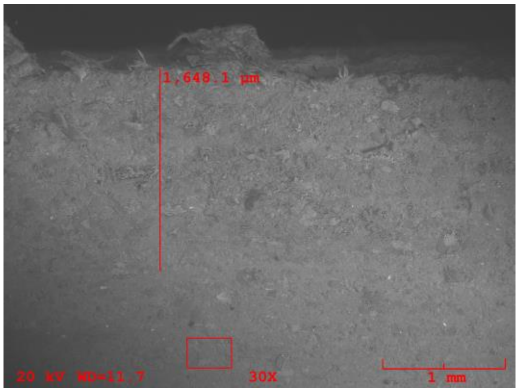


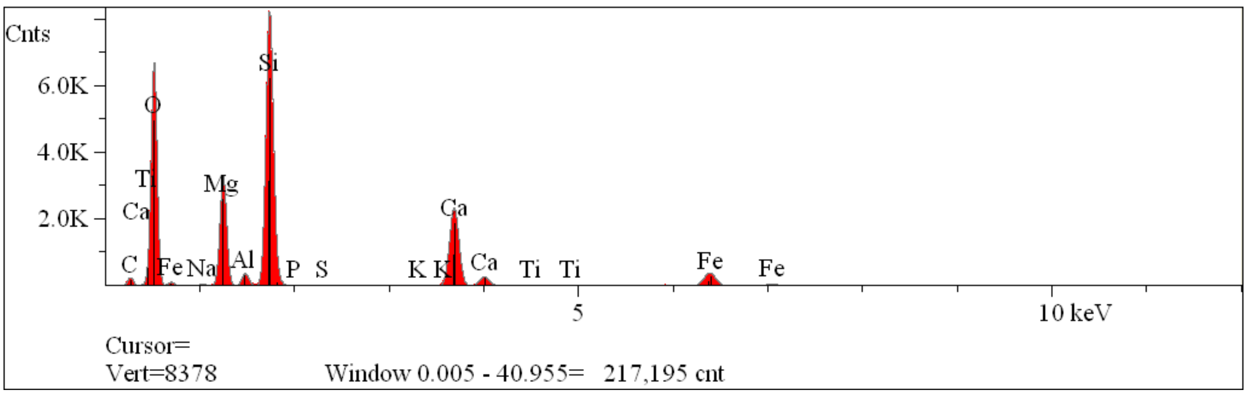
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	6,330.48	16.28	9.80	wt.%	0.01	0.00	
O	Ka	34,849.62	58.30	46.75	wt.%	0.00	0.00	
Na	Ka	168.25	0.07	0.08	wt.%	0.00	0.00	
Mg	Ka	9,115.20	2.38	2.90	wt.%	0.00	0.00	
Al	Ka	3,187.15	0.64	0.87	wt.%	0.00	0.00	
Si	Ka	54,358.84	9.27	13.05	wt.%	0.00	0.00	
P	Ka	616.82	0.11	0.17	wt.%	0.00	0.00	
S	Ka	1,046.67	0.16	0.26	wt.%	0.00	0.00	
K	Ka	399.68	0.05	0.11	wt.%	0.00	0.00	
Ca	Ka	82,720.35	12.14	24.38	wt.%	0.00	0.00	
Ti	Ka	344.42	0.06	0.14	wt.%	0.00	0.00	
Fe	Ka	2,271.00	0.53	1.49	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the middle region of N-5.

Analysis Report: N-5 cross section-6-1





Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,881.64	8.39	5.02	wt.%	0.01	0.01	
O	Ka	52,507.89	60.82	48.49	wt.%	0.00	0.00	
Na	Ka	484.60	0.20	0.22	wt.%	0.00	0.00	
Mg	Ka	28,908.49	7.80	9.45	wt.%	0.00	0.00	
Al	Ka	3,397.62	0.79	1.06	wt.%	0.00	0.00	
Si	Ka	80,015.42	15.64	21.89	wt.%	0.00	0.00	
P	Ka	244.71	0.05	0.08	wt.%	0.00	0.00	
S	Ka	105.99	0.02	0.03	wt.%	0.00	0.00	
K	Ka	338.60	0.05	0.11	wt.%	0.00	0.00	
Ca	Ka	28,626.41	4.72	9.42	wt.%	0.00	0.00	
Ti	Ka	206.82	0.04	0.09	wt.%	0.00	0.00	
Fe	Ka	5,941.20	1.49	4.14	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

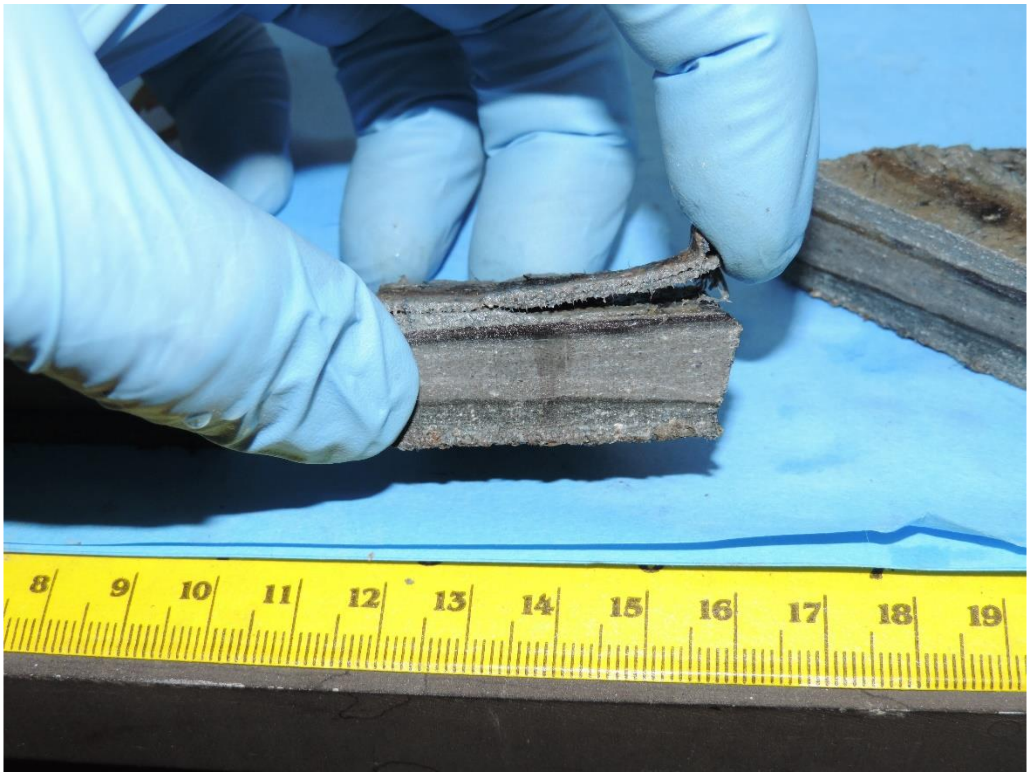
EDS of the outside layer of sample N-5.

Overall view of sample N-6.

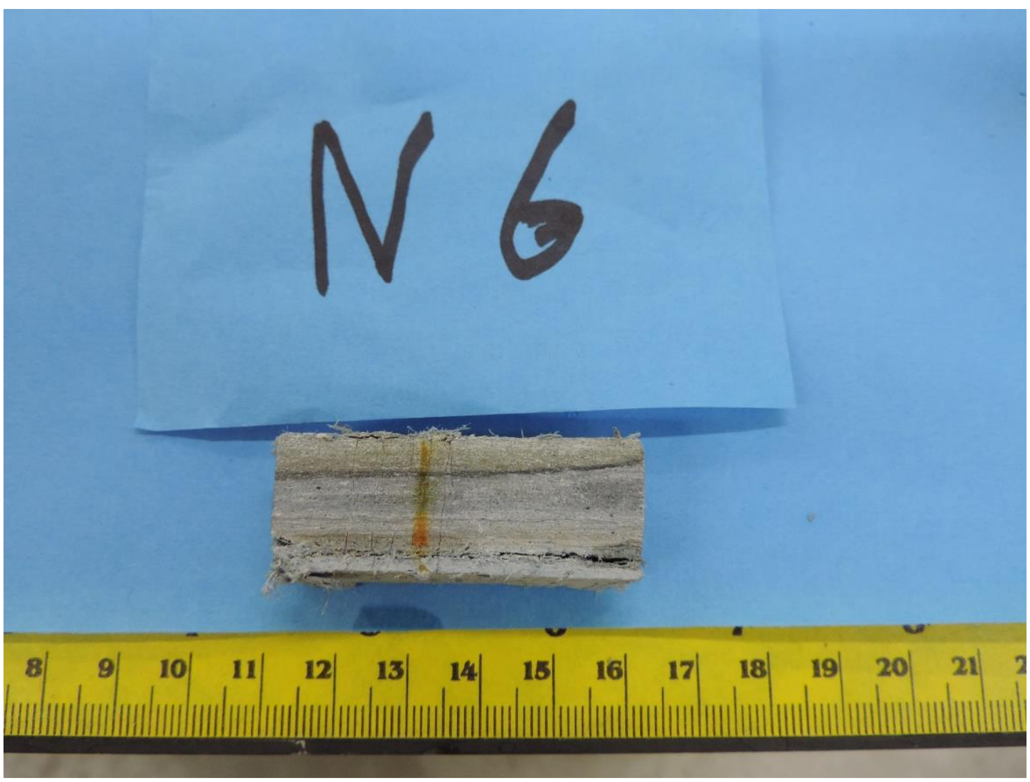

Close up of an area of delamination and thinned wall thickness on sample N-6.

Overall view of N-6 after sectioning.

Close up of the cross sections of N-6.

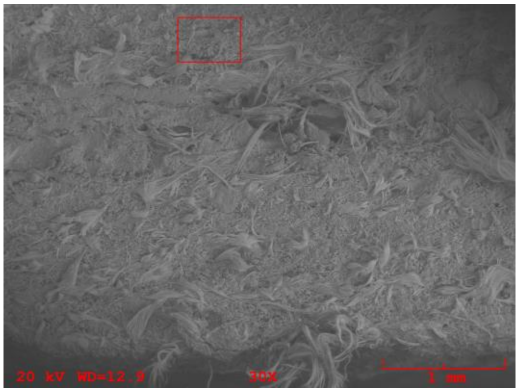


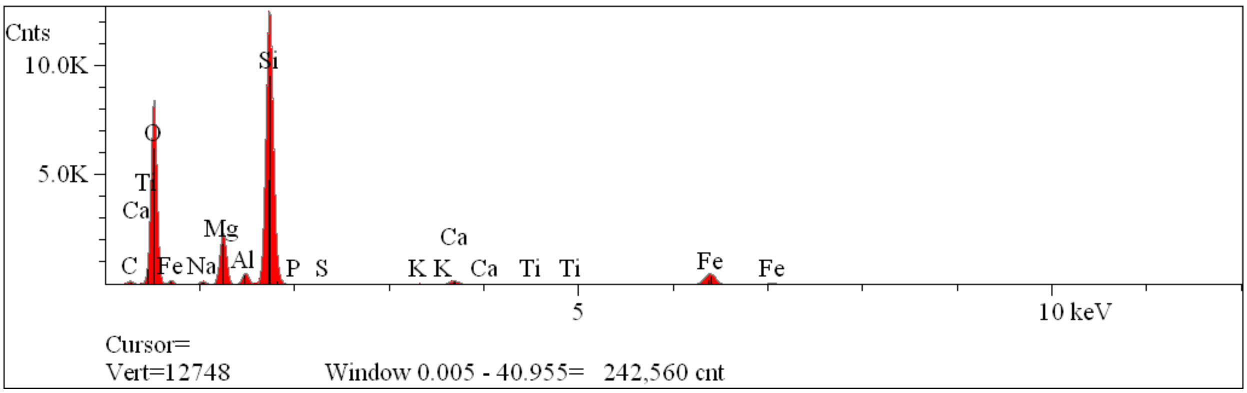
Close up of the delamination of N-6.



Close up of sample N-6 after pH and phenolphthalein testing. Note only a small middle region has a neutral/alkaline pH with acidic layers at the top and bottom.

Analysis Report: N-6 cross section-1-1



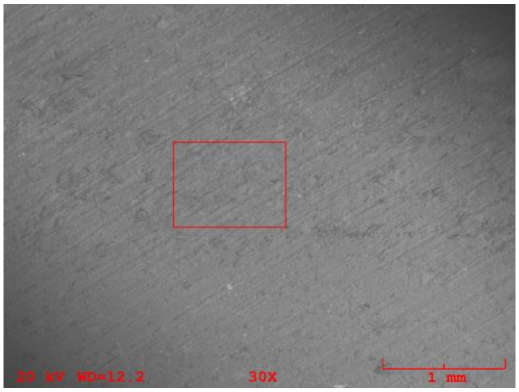


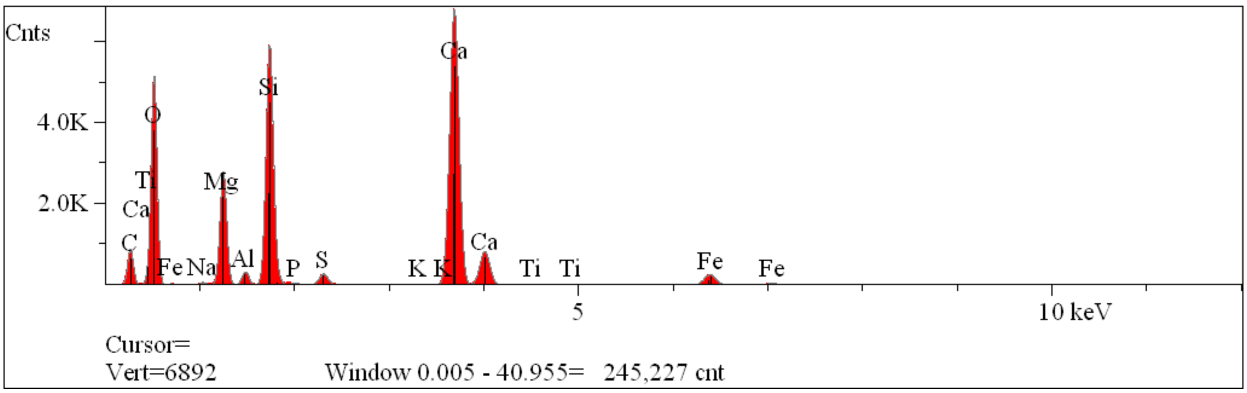
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,295.06	7.32	4.41	wt.%	0.01	0.01	
O	Ka	66,593.49	60.71	48.69	wt.%	0.00	0.00	
Na	Ka	1,410.07	0.54	0.62	wt.%	0.00	0.00	
Mg	Ka	20,892.85	5.41	6.59	wt.%	0.00	0.00	
Al	Ka	4,872.03	1.04	1.41	wt.%	0.00	0.00	
Si	Ka	121,056.80	22.34	31.45	wt.%	0.00	0.00	
P	Ka	97.41	0.02	0.04	wt.%	0.00	0.00	
S	Ka	167.81	0.03	0.05	wt.%	0.00	0.00	
K	Ka	740.78	0.12	0.24	wt.%	0.00	0.00	
Ca	Ka	2,501.13	0.41	0.83	wt.%	0.00	0.00	
Ti	Ka	787.19	0.14	0.33	wt.%	0.00	0.00	
Fe	Ka	7,815.44	1.91	5.34	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inner layer of N-6.

Analysis Report: N-6 cross section-3-1



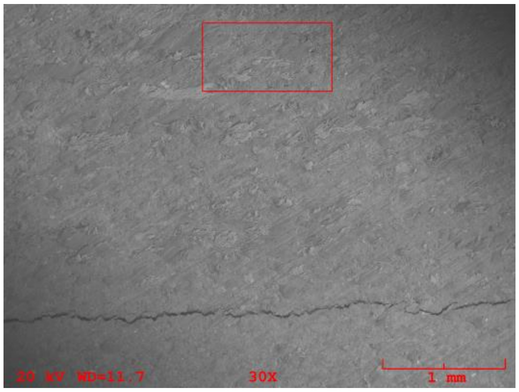


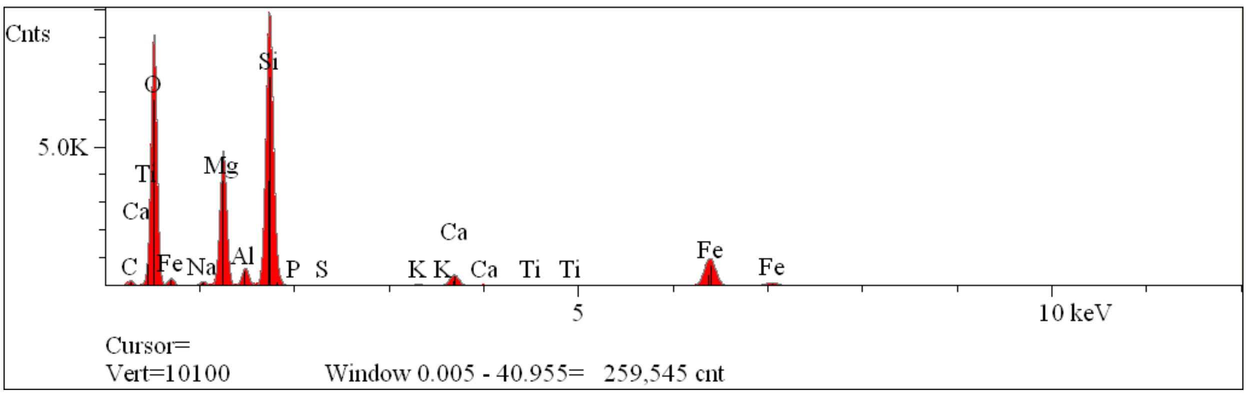
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	6,654.93	16.38	9.85	wt.%	0.00	0.00	
O	Ka	40,927.34	56.25	45.06	wt.%	0.00	0.00	
Na	Ka	531.79	0.18	0.21	wt.%	0.00	0.00	
Mg	Ka	24,705.56	5.58	6.80	wt.%	0.00	0.00	
Al	Ka	3,007.95	0.56	0.75	wt.%	0.00	0.00	
Si	Ka	57,244.17	8.89	12.50	wt.%	0.00	0.00	
P	Ka	515.07	0.08	0.13	wt.%	0.00	0.00	
S	Ka	3,085.94	0.43	0.69	wt.%	0.00	0.00	
K	Ka	293.48	0.04	0.07	wt.%	0.00	0.00	
Ca	Ka	82,968.28	10.76	21.59	wt.%	0.00	0.00	
Ti	Ka	286.19	0.04	0.10	wt.%	0.00	0.00	
Fe	Ka	3,900.03	0.80	2.24	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the center region of N-6.

Analysis Report: N-6 cross section-5-1



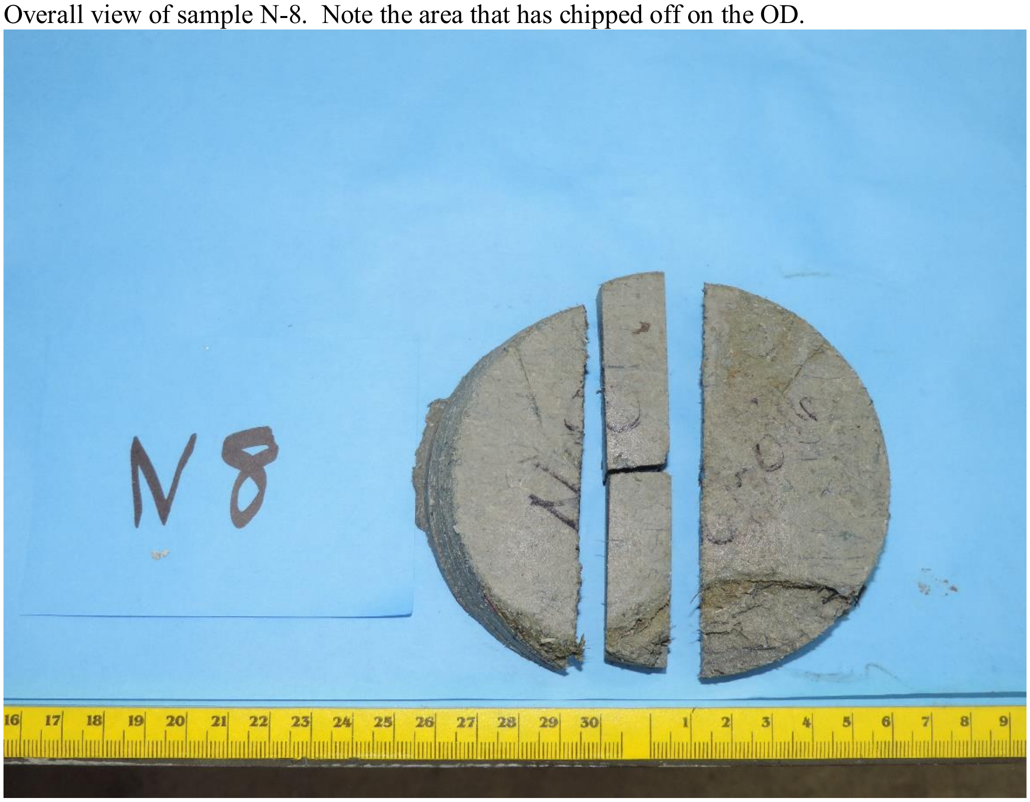


Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,369.14	6.61	3.85	wt.%	0.01	0.01	
O	Ka	71,730.26	58.38	45.36	wt.%	0.00	0.00	
Na	Ka	1,411.77	0.52	0.58	wt.%	0.00	0.00	
Mg	Ka	43,062.34	10.67	12.60	wt.%	0.00	0.00	
Al	Ka	5,918.13	1.32	1.73	wt.%	0.00	0.00	
Si	Ka	96,331.91	18.04	24.60	wt.%	0.00	0.00	
P	Ka	226.17	0.05	0.07	wt.%	0.00	0.00	
S	Ka	263.34	0.05	0.07	wt.%	0.00	0.00	
K	Ka	770.50	0.12	0.22	wt.%	0.00	0.00	
Ca	Ka	4,977.17	0.76	1.47	wt.%	0.00	0.00	
Ti	Ka	491.48	0.08	0.18	wt.%	0.00	0.00	
Fe	Ka	15,087.70	3.41	9.24	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

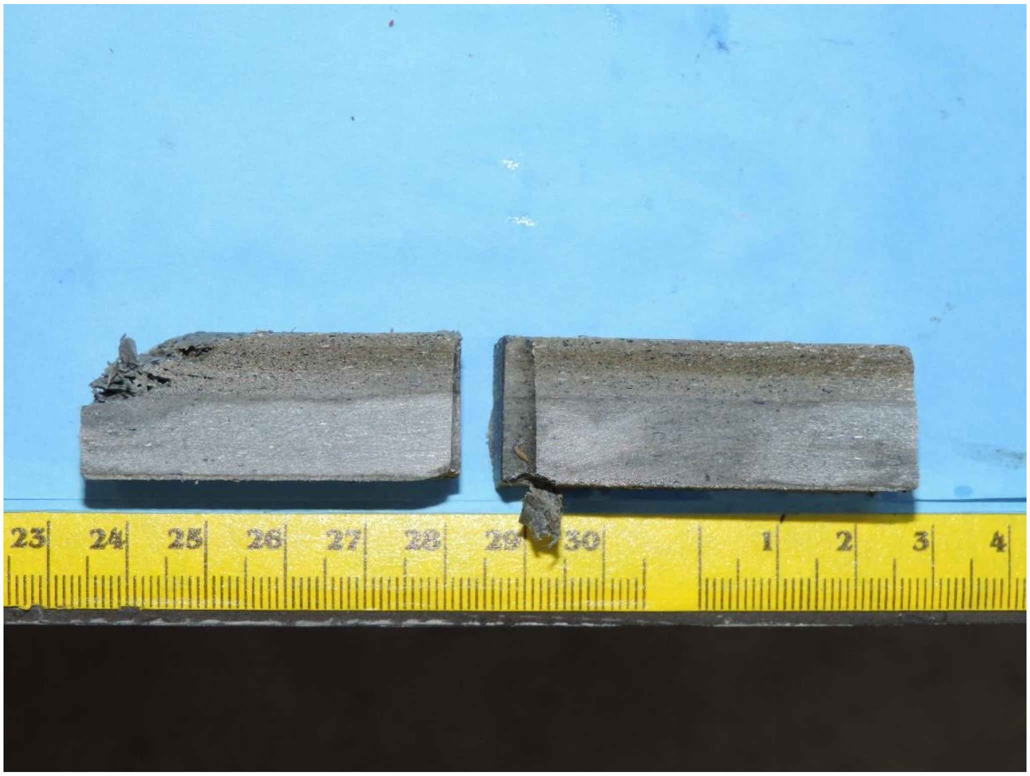
kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the outer layer on N-6.

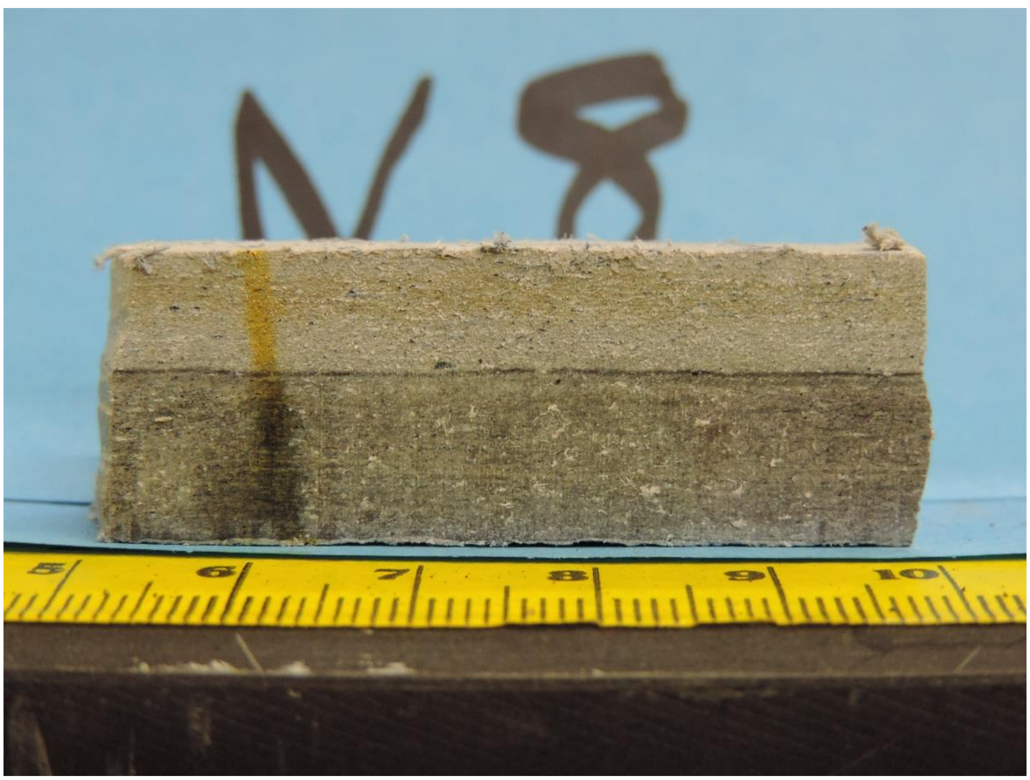
Overall view of sample N-8. Note the area that has chipped off on the OD.



Overall view of N-8 after sectioning.

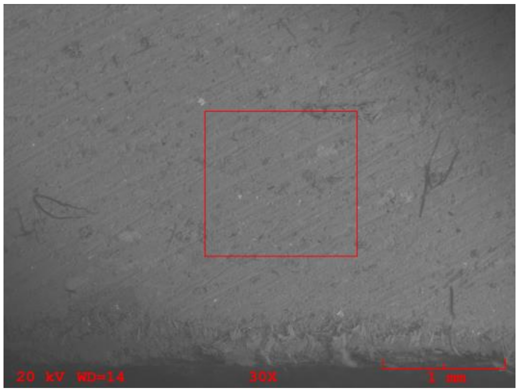


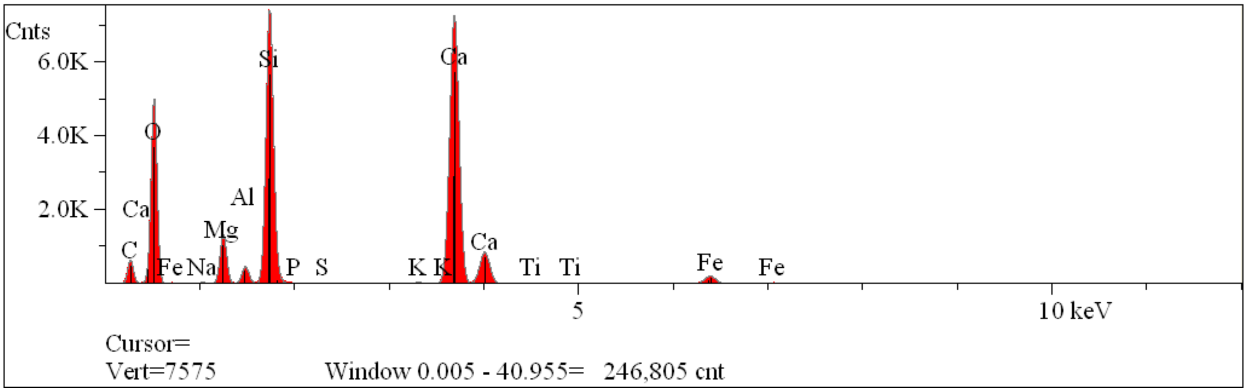
Overall view of the cross section of sample N-8. The inside is at the bottom.



Close up of the pH testing on N-8. Note the outside layer is neutral to slightly acidic.

Analysis Report: N-8 cross section-1-1



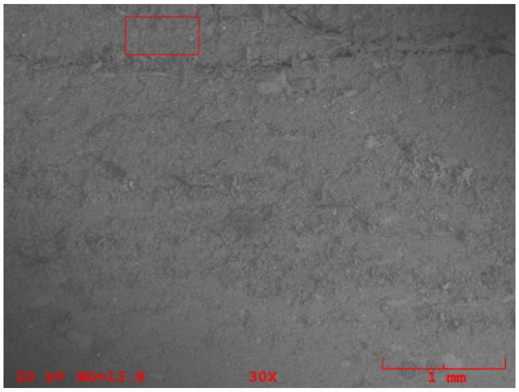


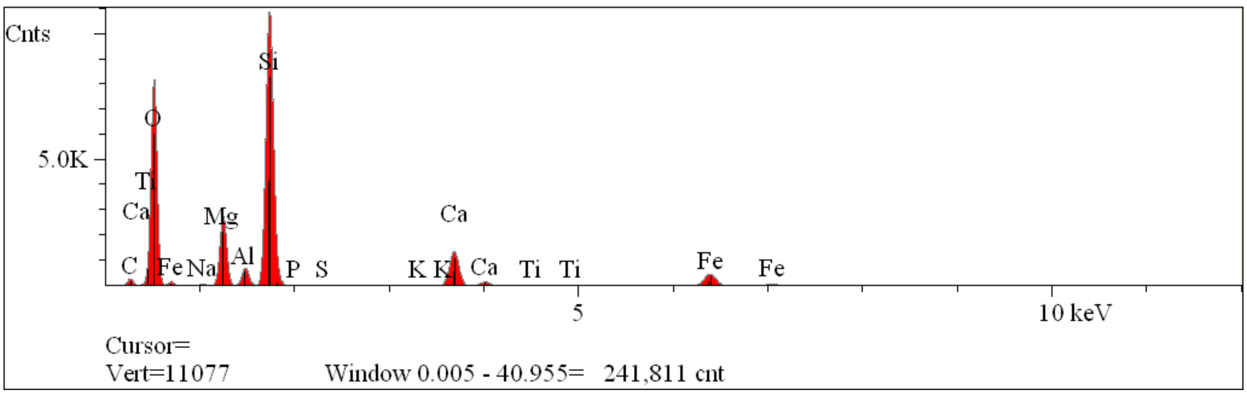
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	4,840.70	12.79	7.52	wt.%	0.01	0.00	
O	Ka	39,634.69	59.11	46.31	wt.%	0.00	0.00	
Na	Ka	352.40	0.13	0.14	wt.%	0.00	0.00	
Mg	Ka	11,678.41	2.80	3.33	wt.%	0.00	0.00	
Al	Ka	4,256.96	0.79	1.05	wt.%	0.00	0.00	
Si	Ka	72,254.73	11.43	15.73	wt.%	0.00	0.00	
P	Ka	308.45	0.05	0.08	wt.%	0.00	0.00	
S	Ka	111.88	0.02	0.03	wt.%	0.00	0.00	
K	Ka	460.33	0.06	0.11	wt.%	0.00	0.00	
Ca	Ka	88,596.72	12.10	23.74	wt.%	0.00	0.00	
Ti	Ka	357.14	0.06	0.13	wt.%	0.00	0.00	
Fe	Ka	3,069.71	0.66	1.82	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inside layer of N-8. Note there was just a thin layer of degradation at the inside surface.

Analysis Report: N-8 cross section-3-1



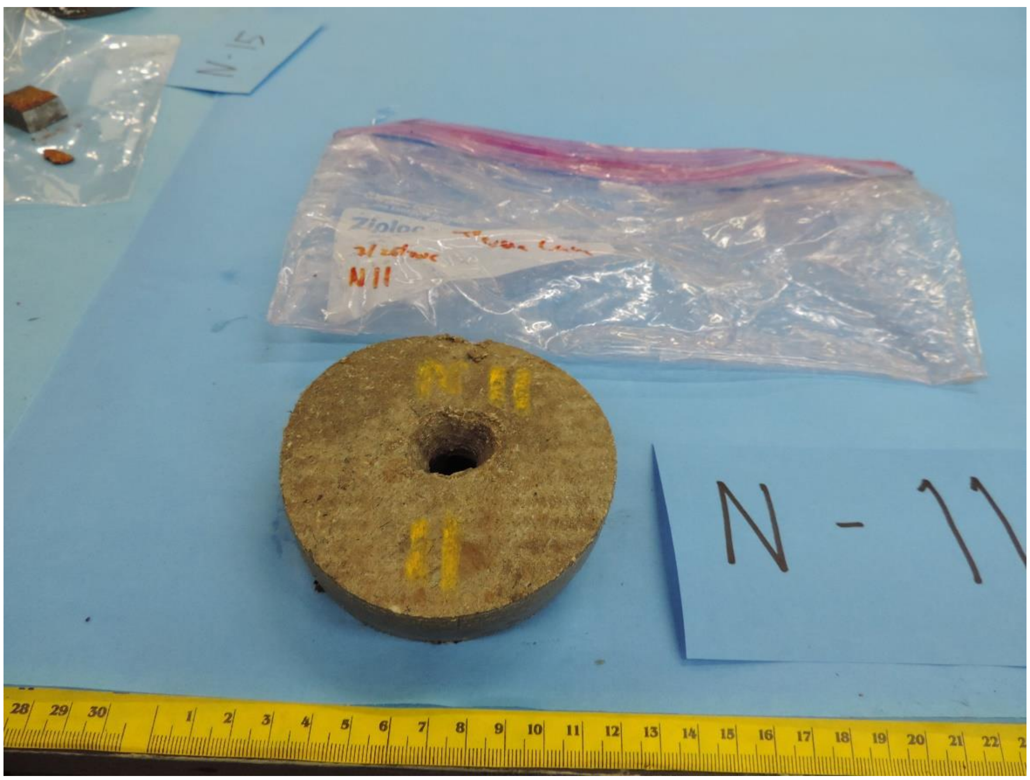


Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,996.52	9.01	5.46	wt.%	0.01	0.01	
O	Ka	64,352.98	60.92	49.22	wt.%	0.00	0.00	
Na	Ka	698.10	0.25	0.29	wt.%	0.00	0.00	
Mg	Ka	24,148.79	5.86	7.19	wt.%	0.00	0.00	
Al	Ka	6,526.11	1.32	1.80	wt.%	0.00	0.00	
Si	Ka	105,366.01	18.32	25.99	wt.%	0.00	0.00	
P	Ka	13.06	0.00	0.00	wt.%	0.00	0.00	
S	Ka	173.58	0.03	0.05	wt.%	0.00	0.00	
K	Ka	557.93	0.08	0.16	wt.%	0.00	0.00	
Ca	Ka	16,602.57	2.51	5.07	wt.%	0.00	0.00	
Ti	Ka	371.72	0.06	0.15	wt.%	0.00	0.00	
Fe	Ka	7,198.81	1.63	4.60	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

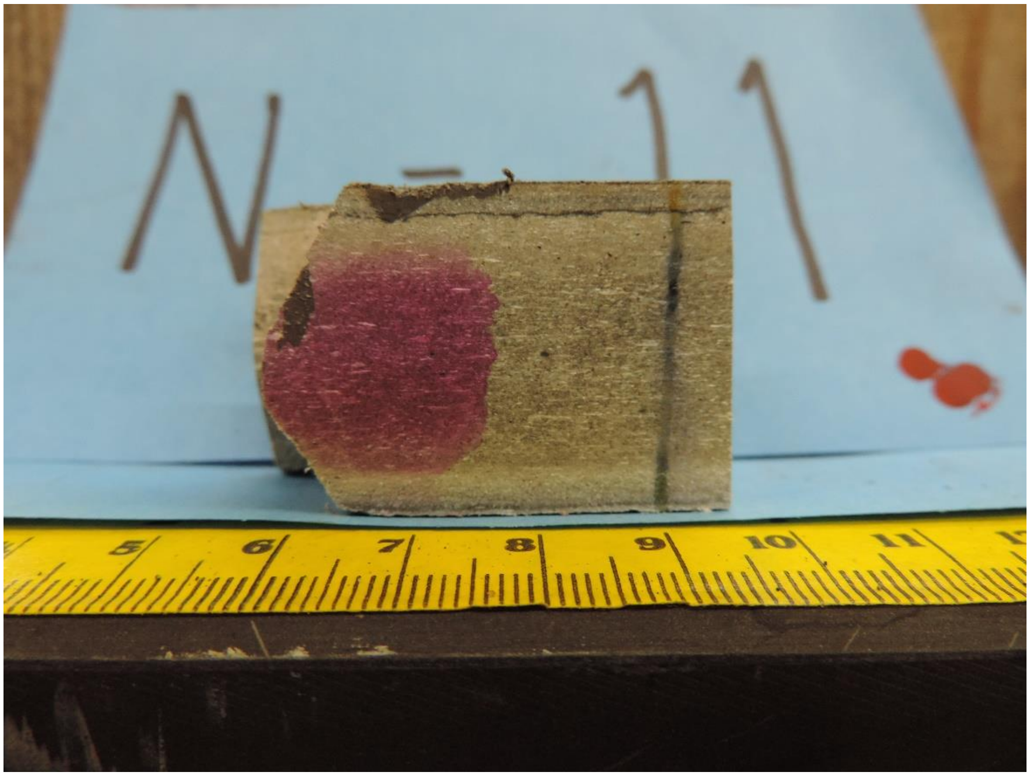
kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the outer layer of sample N-8.

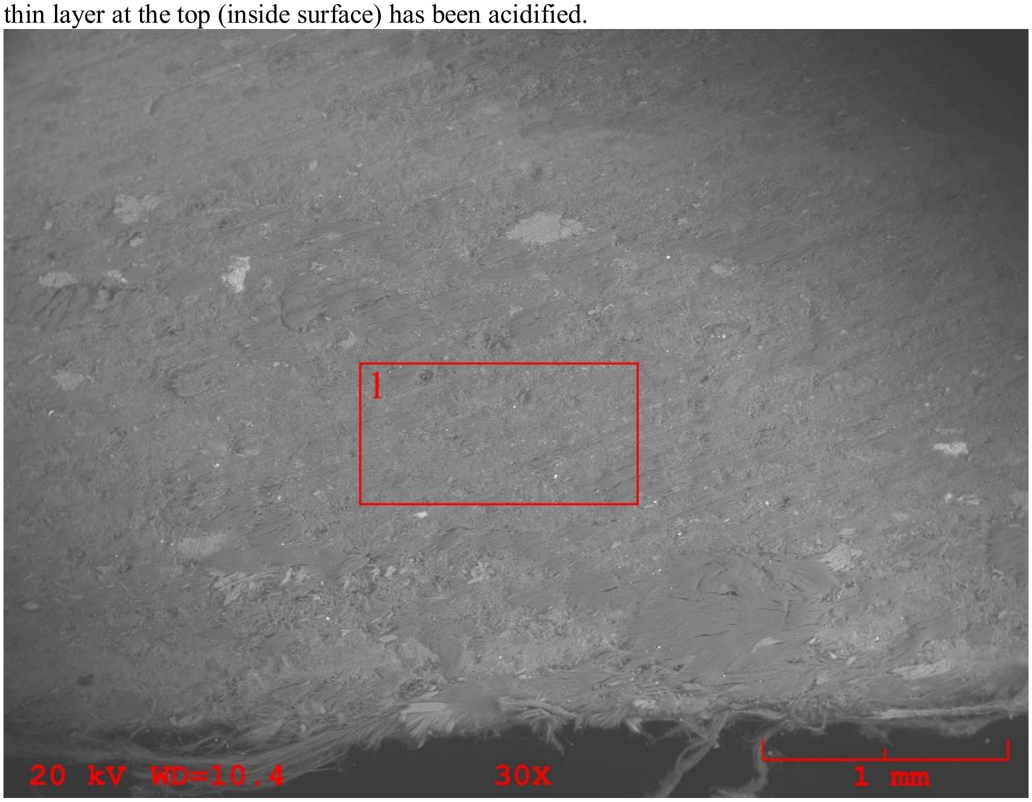
Overall view of sample N-11.



Same as above, except the outside surface is viewed.

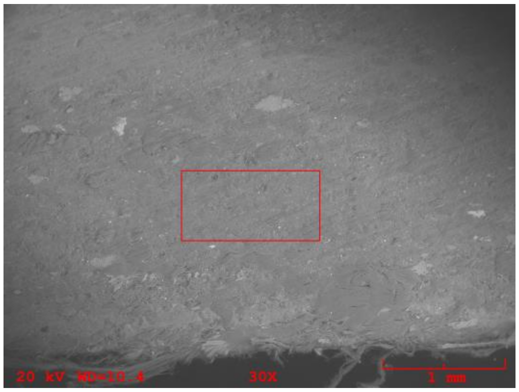


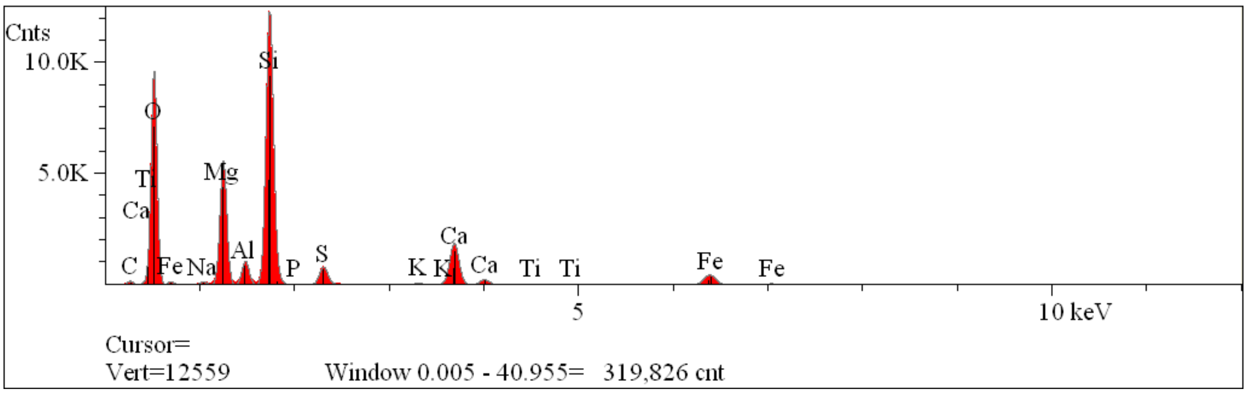
Close up view of the cross section of N-11 after pH and phenolphthalein testing. This indicates that just a thin layer at the top (inside surface) has been acidified.



30x SEM image of the inside layer of N-11.

Analysis Report: N-11 cross section-1-1



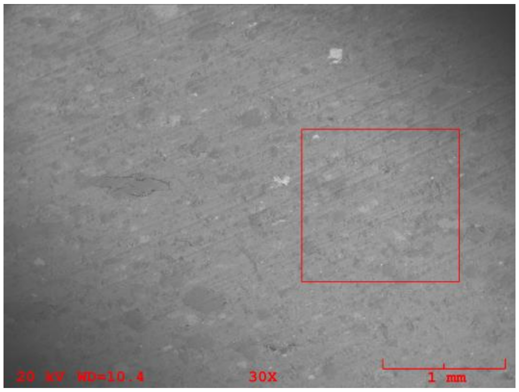


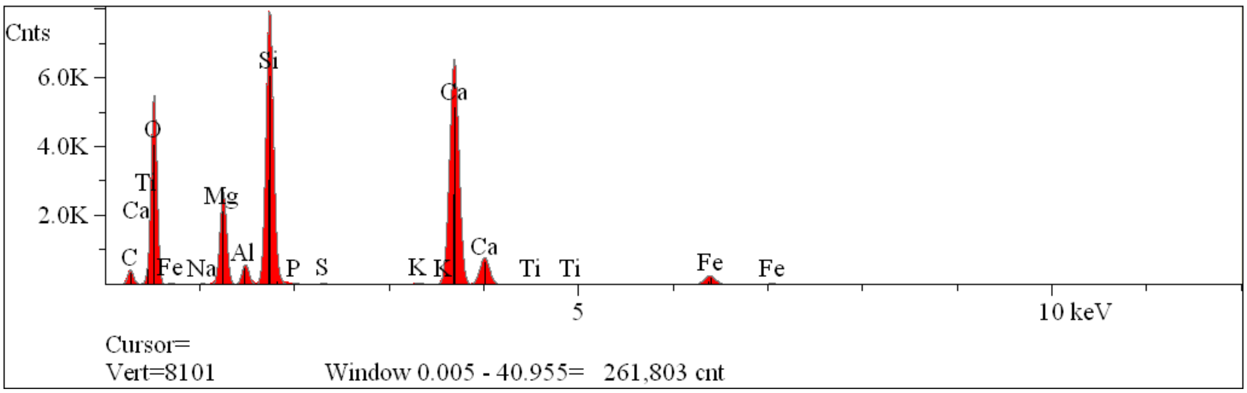
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,269.82	5.20	3.06	wt.%	0.01	0.01	
O	Ka	75,871.27	59.82	46.92	wt.%	0.00	0.00	
Na	Ka	1,307.36	0.37	0.42	wt.%	0.00	0.00	
Mg	Ka	49,708.05	9.50	11.32	wt.%	0.00	0.00	
Al	Ka	9,911.29	1.70	2.25	wt.%	0.00	0.00	
Si	Ka	120,759.70	17.71	24.38	wt.%	0.00	0.00	
P	Ka	548.68	0.09	0.14	wt.%	0.00	0.00	
S	Ka	9,140.09	1.33	2.09	wt.%	0.00	0.00	
K	Ka	920.85	0.11	0.22	wt.%	0.00	0.00	
Ca	Ka	22,721.98	2.83	5.55	wt.%	0.00	0.00	
Ti	Ka	467.76	0.06	0.15	wt.%	0.00	0.00	
Fe	Ka	6,944.15	1.28	3.52	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inner layer of N-11.

Analysis Report: N-11 cross section-3-1



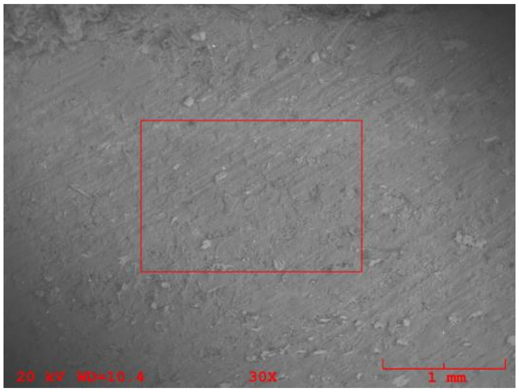


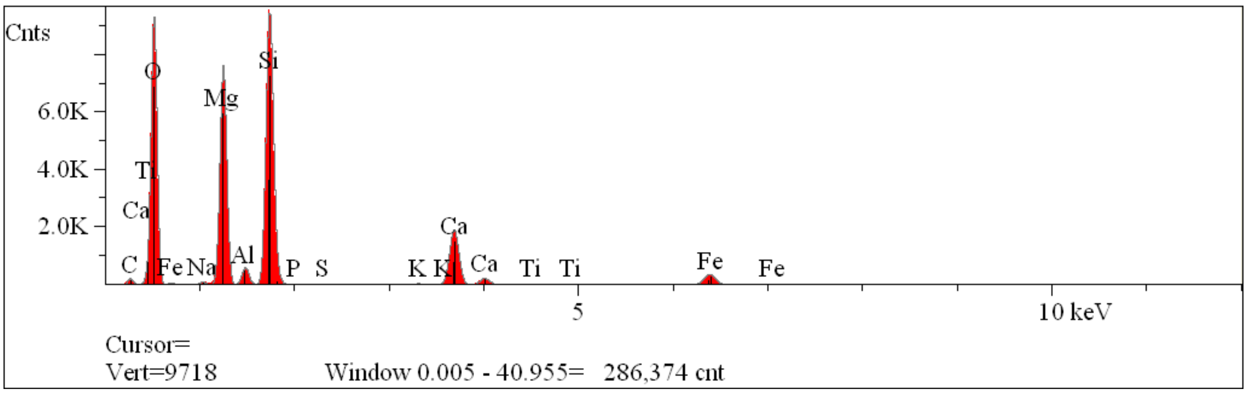
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	3,262.01	9.70	5.61	wt.%	0.01	0.00	
O	Ka	43,341.13	58.99	45.48	wt.%	0.00	0.00	
Na	Ka	375.74	0.13	0.15	wt.%	0.00	0.00	
Mg	Ka	23,781.82	5.54	6.49	wt.%	0.00	0.00	
Al	Ka	5,442.98	1.04	1.35	wt.%	0.00	0.00	
Si	Ka	77,380.76	12.50	16.92	wt.%	0.00	0.00	
P	Ka	485.76	0.08	0.13	wt.%	0.00	0.00	
S	Ka	576.74	0.09	0.14	wt.%	0.00	0.00	
K	Ka	656.67	0.09	0.16	wt.%	0.00	0.00	
Ca	Ka	79,894.34	10.90	21.05	wt.%	0.00	0.00	
Ti	Ka	438.50	0.07	0.16	wt.%	0.00	0.00	
Fe	Ka	4,112.06	0.88	2.37	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the middle layer of N-11.

Analysis Report: N-11 cross section-5-1

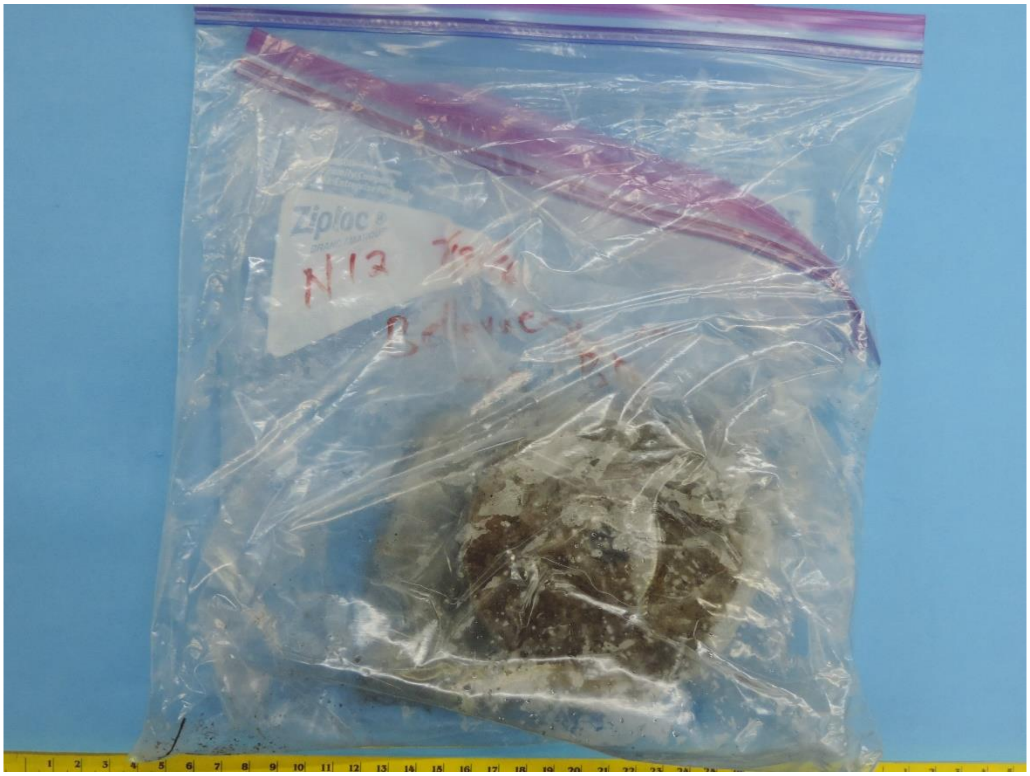




Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	1,592.41	6.25	3.74	wt.%	0.01	0.01	
O	Ka	73,580.16	59.51	47.52	wt.%	0.00	0.00	
Na	Ka	836.46	0.25	0.28	wt.%	0.00	0.00	
Mg	Ka	67,520.88	13.58	16.48	wt.%	0.00	0.00	
Al	Ka	5,465.68	1.07	1.44	wt.%	0.00	0.00	
Si	Ka	92,643.19	15.07	21.12	wt.%	0.00	0.00	
P	Ka	41.85	0.01	0.01	wt.%	0.00	0.00	
S	Ka	303.88	0.05	0.07	wt.%	0.00	0.00	
K	Ka	507.99	0.07	0.13	wt.%	0.00	0.00	
Ca	Ka	23,199.12	3.03	6.06	wt.%	0.00	0.00	
Ti	Ka	283.09	0.04	0.10	wt.%	0.00	0.00	
Fe	Ka	5,561.02	1.09	3.04	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the outer layer on sample N-11.

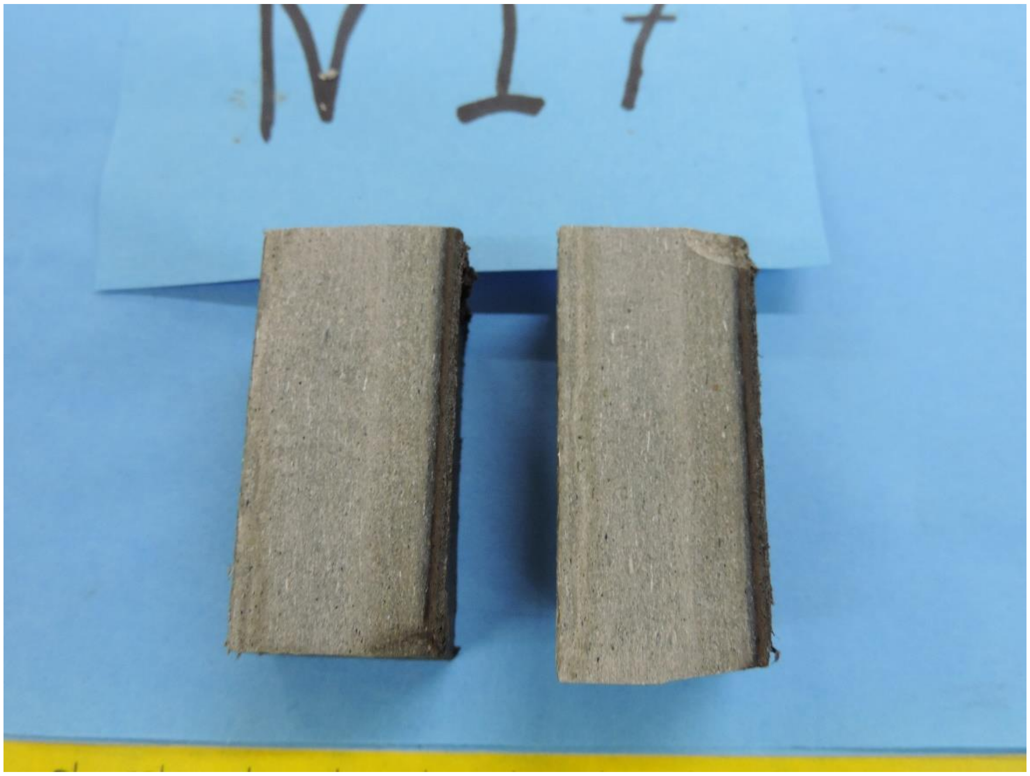


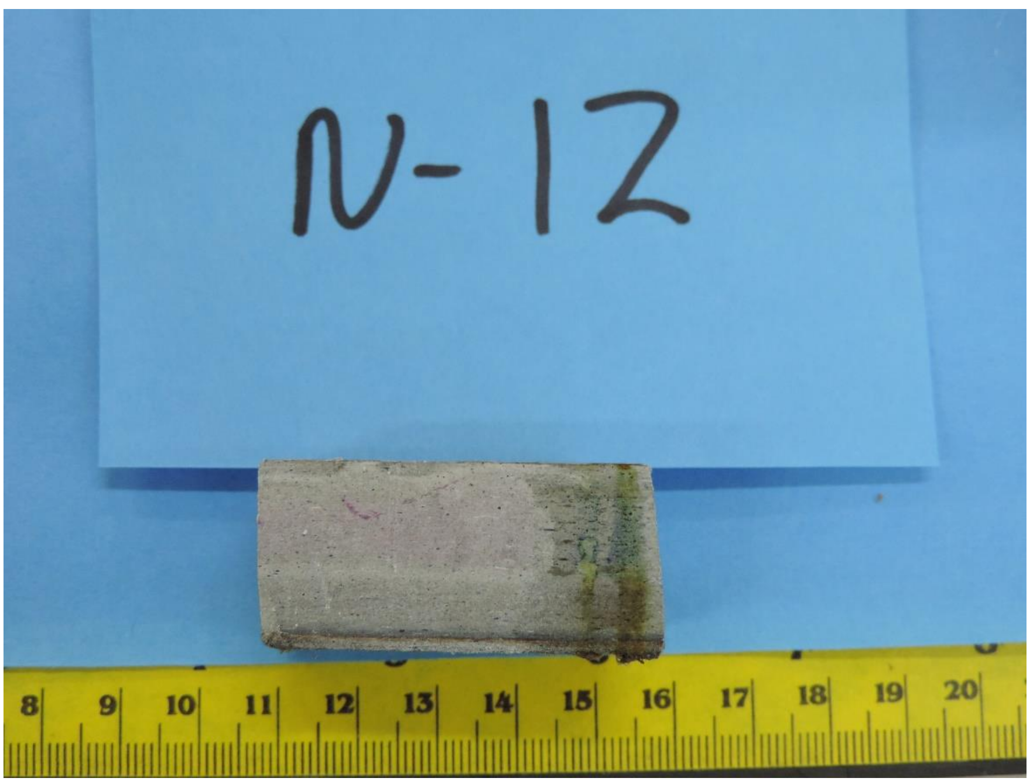
Overall view of sample N-12. Note this sample initially was misidentified as N-17.

Close up of sample N-12 (not N-17).

Overall view of the outside of N-12 (not N-17).

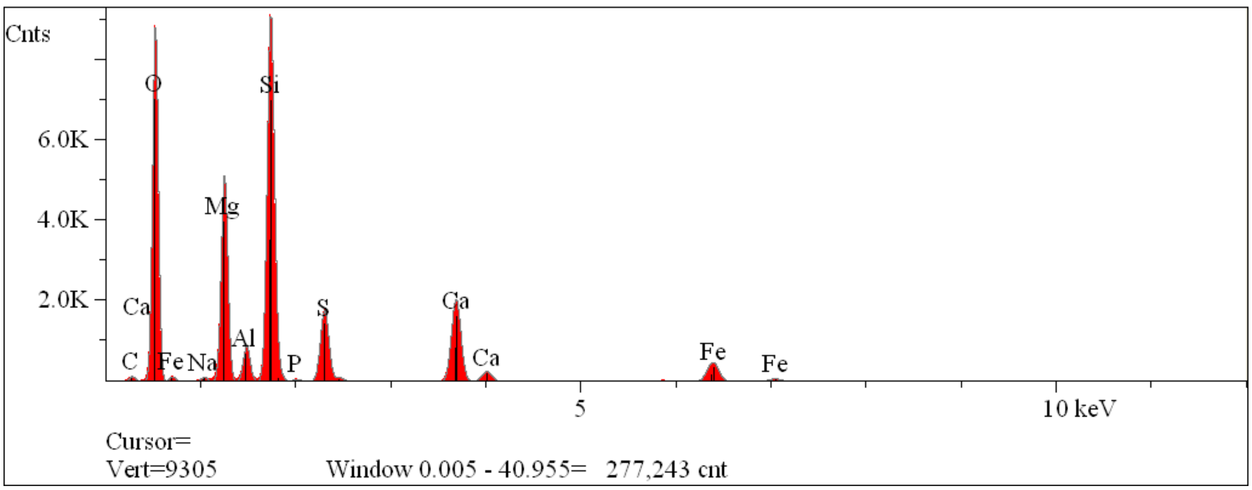
Overall view of sample N-12 (not N-17) after sectioning.


Close up view of the cross section of N-12. Note the inside is the dark layer.



Close up of the cross section of sample N-12 after testing for pH.

Analysis Report: Sample 12 cross section-1-1

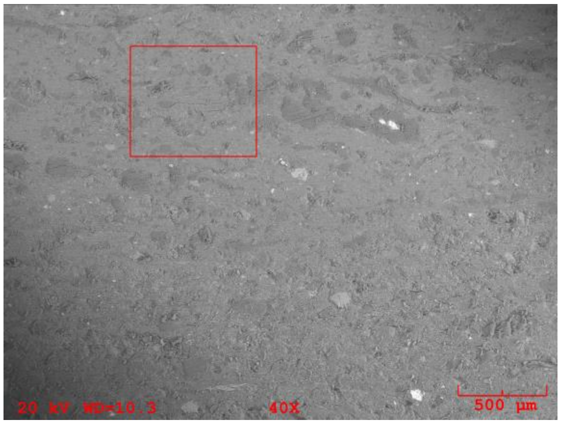


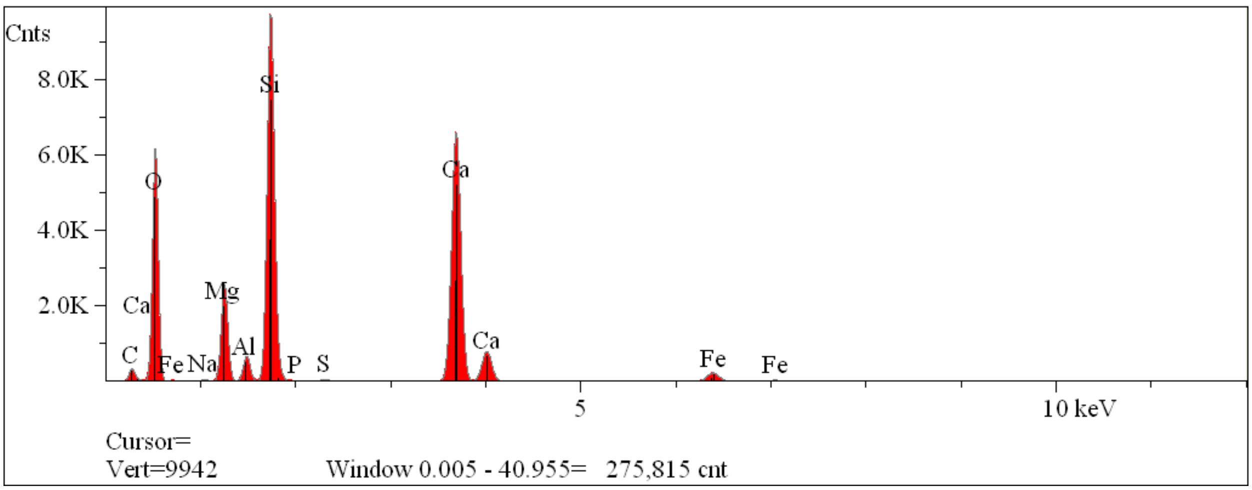
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	927.44	4.19	2.45	wt.%	0.01	0.01	
O	Ka	67,530.84	61.46	47.85	wt.%	0.00	0.00	
Na	Ka	908.26	0.30	0.33	wt.%	0.00	0.00	
Mg	Ka	44,250.70	9.79	11.58	wt.%	0.00	0.00	
Al	Ka	7,761.24	1.53	2.02	wt.%	0.00	0.00	
Si	Ka	86,641.06	14.53	19.86	wt.%	0.00	0.00	
P	Ka	595.55	0.11	0.16	wt.%	0.00	0.00	
S	Ka	19,269.88	3.07	4.79	wt.%	0.00	0.00	
Ca	Ka	24,955.07	3.50	6.83	wt.%	0.00	0.00	
Fe	Ka	7,248.25	1.52	4.13	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inside layer of N-12.

Analysis Report: Sample 12 cross section-3-1



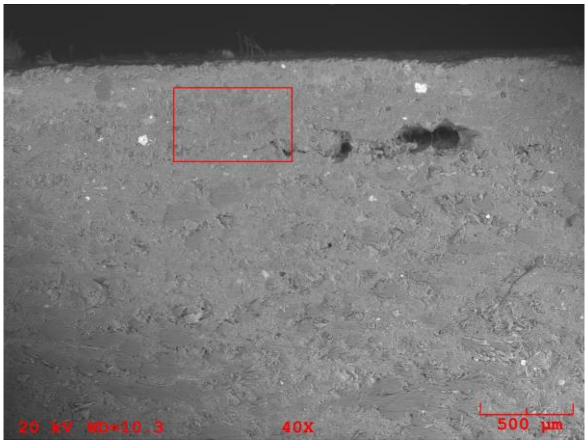


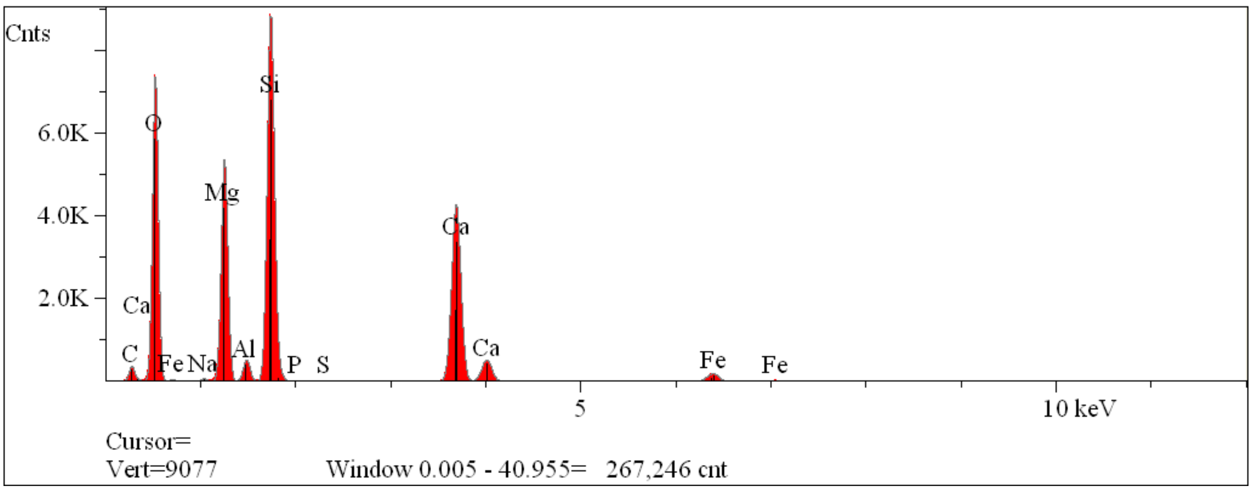
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	2,324.46	7.32	4.21	wt.%	0.01	0.01	
O	Ka	46,757.70	60.49	46.37	wt.%	0.00	0.00	
Na	Ka	430.71	0.15	0.16	wt.%	0.00	0.00	
Mg	Ka	22,054.98	4.99	5.81	wt.%	0.00	0.00	
Al	Ka	5,975.18	1.10	1.42	wt.%	0.00	0.00	
Si	Ka	92,528.70	14.49	19.49	wt.%	0.00	0.00	
P	Ka	198.42	0.03	0.05	wt.%	0.00	0.00	
S	Ka	676.99	0.10	0.16	wt.%	0.00	0.00	
Ca	Ka	78,912.12	10.61	20.37	wt.%	0.00	0.00	
Fe	Ka	3,498.41	0.73	1.96	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the middle layer of N-12.

Analysis Report: Sample 12 cross section-5-1





Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	2,595.48	8.76	5.24	wt.%	0.01	0.01	
O	Ka	56,340.18	59.41	47.33	wt.%	0.00	0.00	
Na	Ka	534.48	0.17	0.19	wt.%	0.00	0.00	
Mg	Ka	46,484.38	9.85	11.92	wt.%	0.00	0.00	
Al	Ka	4,639.40	0.89	1.19	wt.%	0.00	0.00	
Si	Ka	84,509.35	13.52	18.91	wt.%	0.00	0.00	
P	Ka	69.38	0.01	0.02	wt.%	0.00	0.00	
S	Ka	119.45	0.02	0.03	wt.%	0.00	0.00	
Ca	Ka	51,388.48	6.78	13.54	wt.%	0.00	0.00	
Fe	Ka	2,886.60	0.59	1.63	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

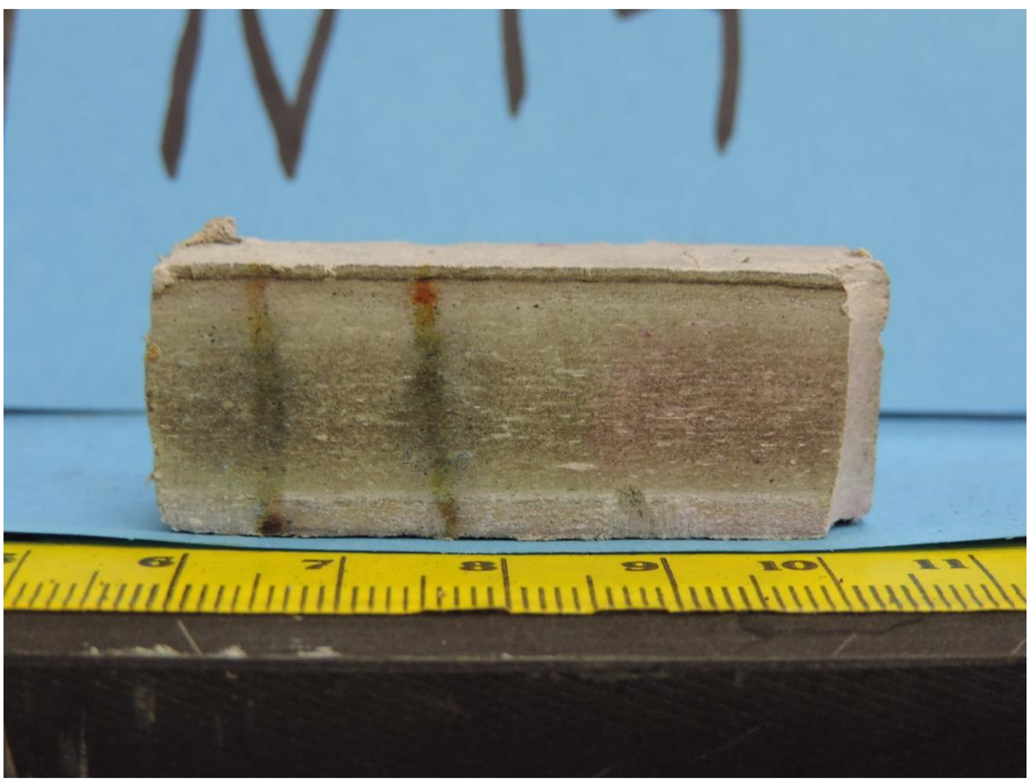
kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the outer layer of sample N-12.

Overall view of the outside of sample N-14.

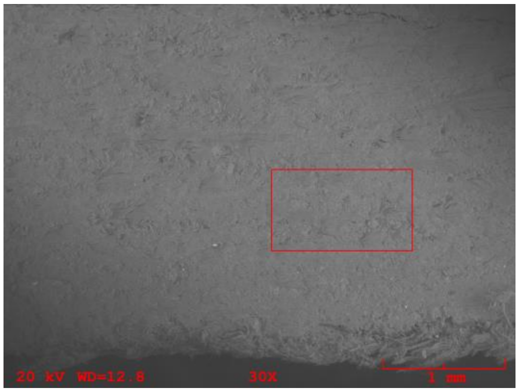
Same as above, except the inside surface is viewed.

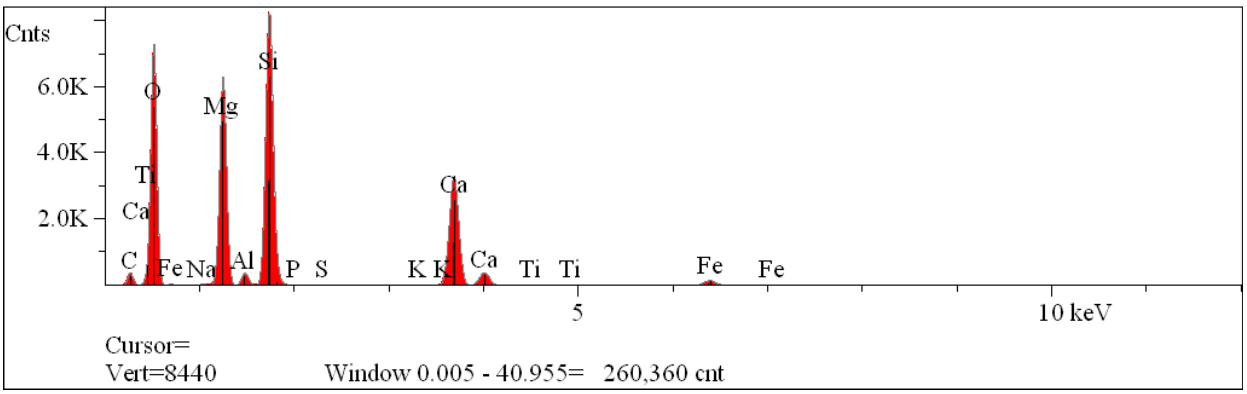
Close up of the cross sections of sample N-14. Note the inside surfaces are adjacent to each other.



Close up of N-14 after pH and phenolphthalein testing showing acidic layer on both the inside and outside layers.

Analysis Report: N-14 cross section-1-1



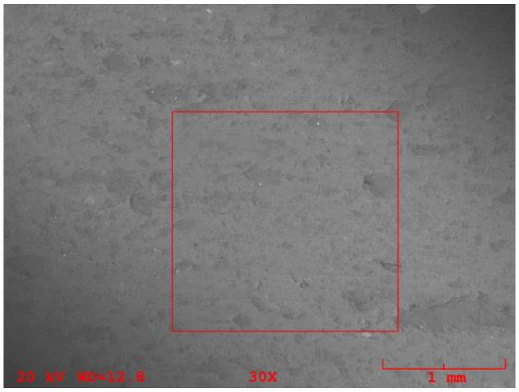


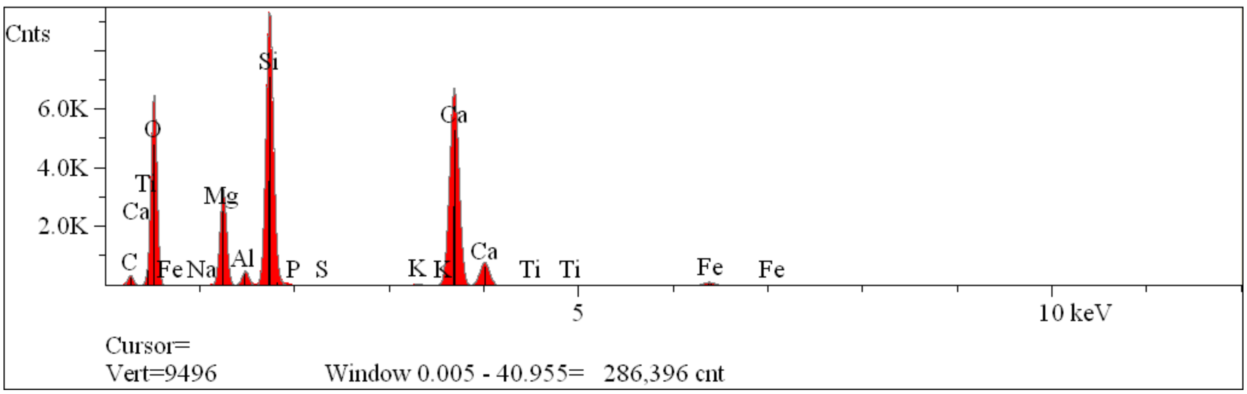
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	2,880.79	10.25	6.23	wt.%	0.01	0.01	
O	Ka	57,305.67	57.90	46.84	wt.%	0.00	0.00	
Na	Ka	419.44	0.13	0.15	wt.%	0.00	0.00	
Mg	Ka	56,045.81	11.78	14.48	wt.%	0.00	0.00	
Al	Ka	3,425.89	0.68	0.92	wt.%	0.00	0.00	
Si	Ka	80,719.00	13.27	18.85	wt.%	0.00	0.00	
P	Ka	146.71	0.03	0.04	wt.%	0.00	0.00	
S	Ka	137.76	0.02	0.03	wt.%	0.00	0.00	
K	Ka	302.21	0.04	0.08	wt.%	0.00	0.00	
Ca	Ka	39,976.93	5.36	10.87	wt.%	0.00	0.00	
Ti	Ka	272.19	0.04	0.10	wt.%	0.00	0.00	
Fe	Ka	2,442.48	0.50	1.41	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the inside layer of N-14.

Analysis Report: N-14 cross section-3-1



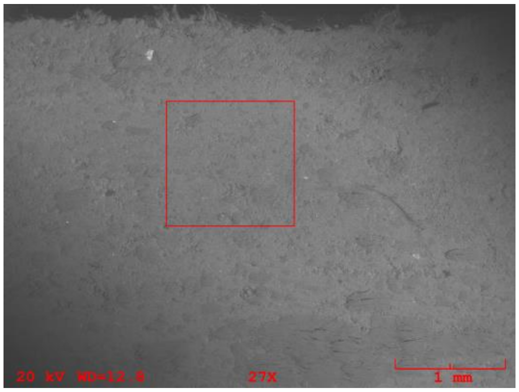


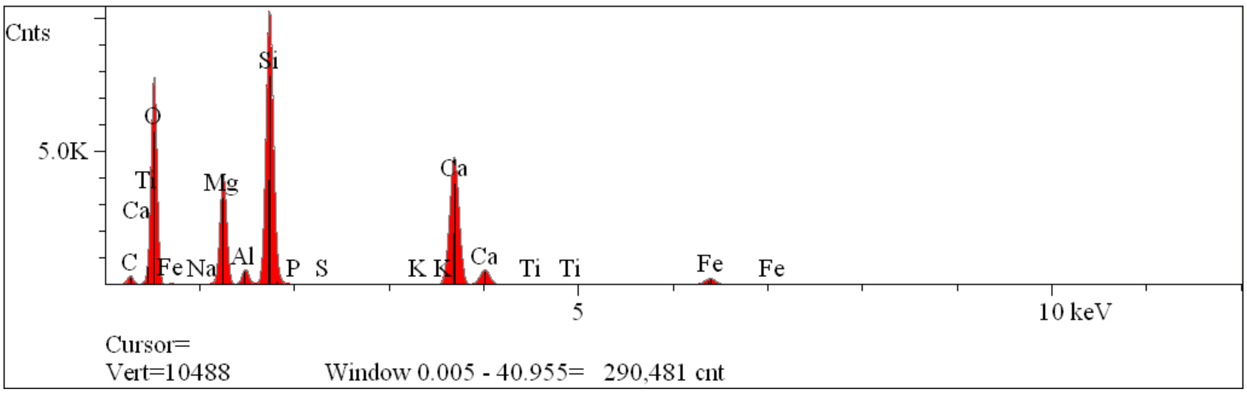
Elt.	**Line**	**Intensity (c/s)**	**Atomic %**	**Conc**	**Units**	**Error 2-sig**	**MDL 3-sig**	
C	Ka	2,659.82	7.58	4.42	wt.%	0.01	0.00	
O	Ka	51,255.79	61.29	47.64	wt.%	0.00	0.00	
Na	Ka	317.66	0.10	0.11	wt.%	0.00	0.00	
Mg	Ka	28,865.82	6.04	7.14	wt.%	0.00	0.00	
Al	Ka	4,586.02	0.80	1.05	wt.%	0.00	0.00	
Si	Ka	90,515.61	13.30	18.15	wt.%	0.00	0.00	
P	Ka	401.11	0.06	0.10	wt.%	0.00	0.00	
S	Ka	279.92	0.04	0.06	wt.%	0.00	0.00	
K	Ka	739.27	0.09	0.17	wt.%	0.00	0.00	
Ca	Ka	81,859.19	10.24	19.95	wt.%	0.00	0.00	
Ti	Ka	425.25	0.06	0.14	wt.%	0.00	0.00	
Fe	Ka	2,025.26	0.40	1.07	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

EDS of the middle layer of sample N-14.

Analysis Report: N-14 cross section-5-1





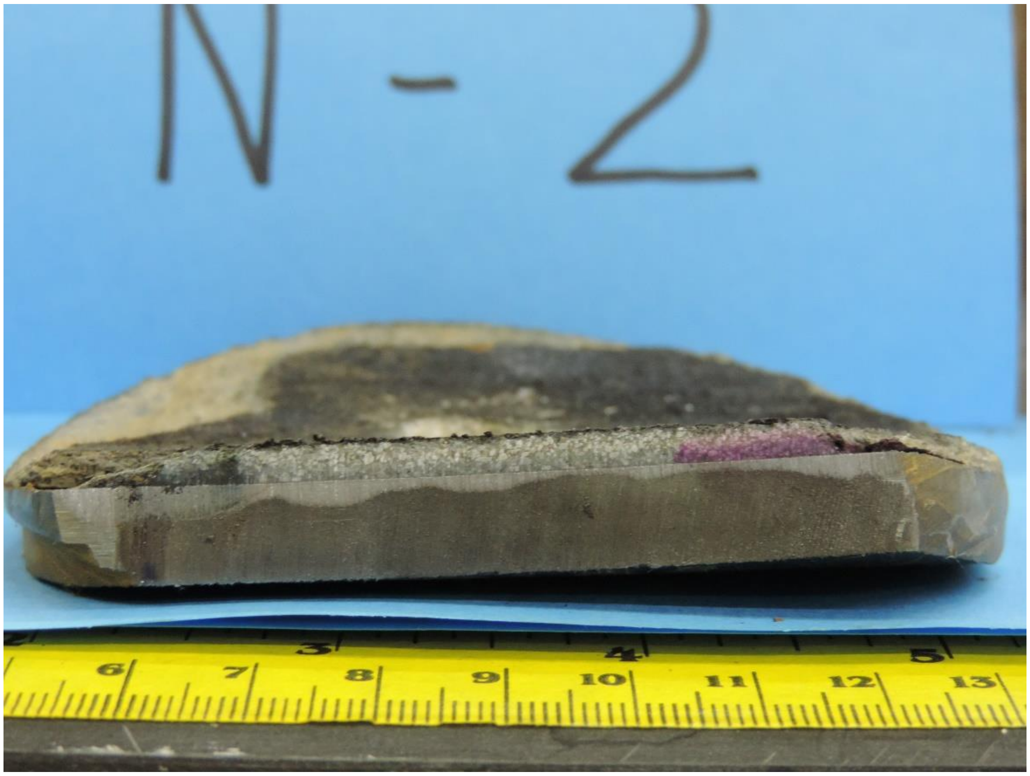
Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	Error 2-sig	MDL 3-sig	
C	Ka	2,643.15	8.10	4.82	wt.%	0.01	0.00	
O	Ka	61,564.71	61.13	48.48	wt.%	0.00	0.00	
Na	Ka	363.27	0.11	0.12	wt.%	0.00	0.00	
Mg	Ka	36,739.96	7.32	8.82	wt.%	0.00	0.00	
Al	Ka	5,420.76	0.92	1.23	wt.%	0.00	0.00	
Si	Ka	99,892.93	14.38	20.02	wt.%	0.00	0.00	
P	Ka	222.69	0.04	0.05	wt.%	0.00	0.00	
S	Ka	257.69	0.04	0.06	wt.%	0.00	0.00	
K	Ka	503.65	0.06	0.12	wt.%	0.00	0.00	
Ca	Ka	58,825.34	7.16	14.23	wt.%	0.00	0.00	
Ti	Ka	348.88	0.05	0.11	wt.%	0.00	0.00	
Fe	Ka	3,739.78	0.70	1.94	wt.%	0.00	0.00	
			100.00	100.00	wt.%			Total

kV 20.0
Takeoff Angle 35.0°
Elapsed Livetime 20.0

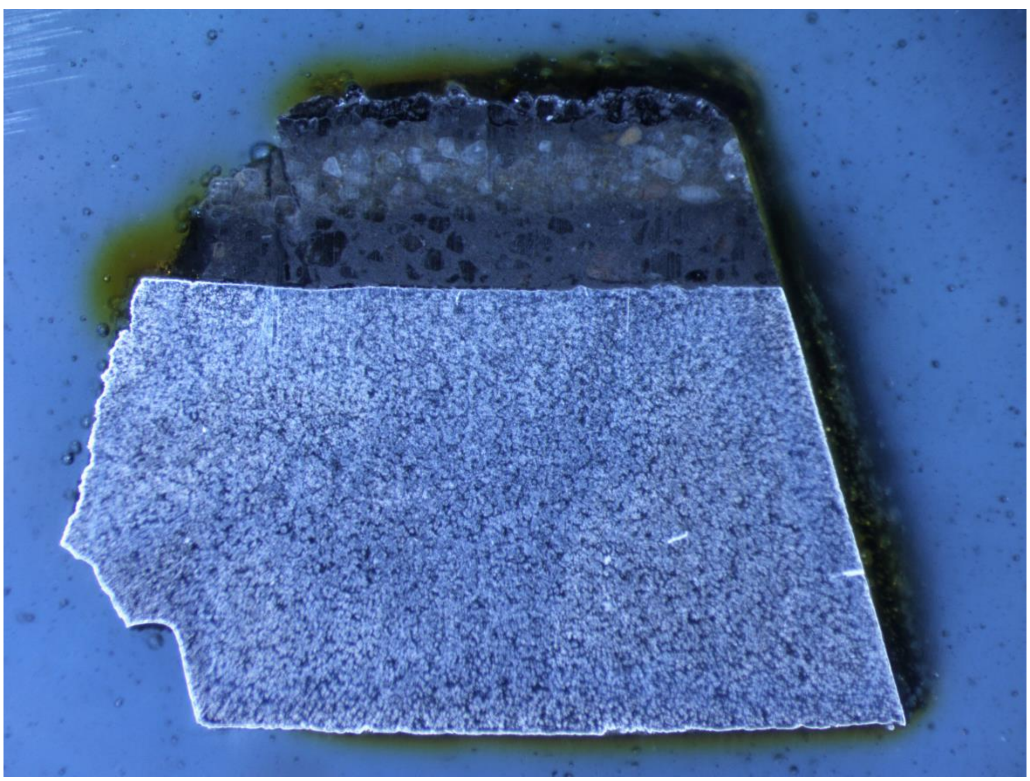
EDS of the outside layer of sample N-14.

Overall view of the outside of N-2.

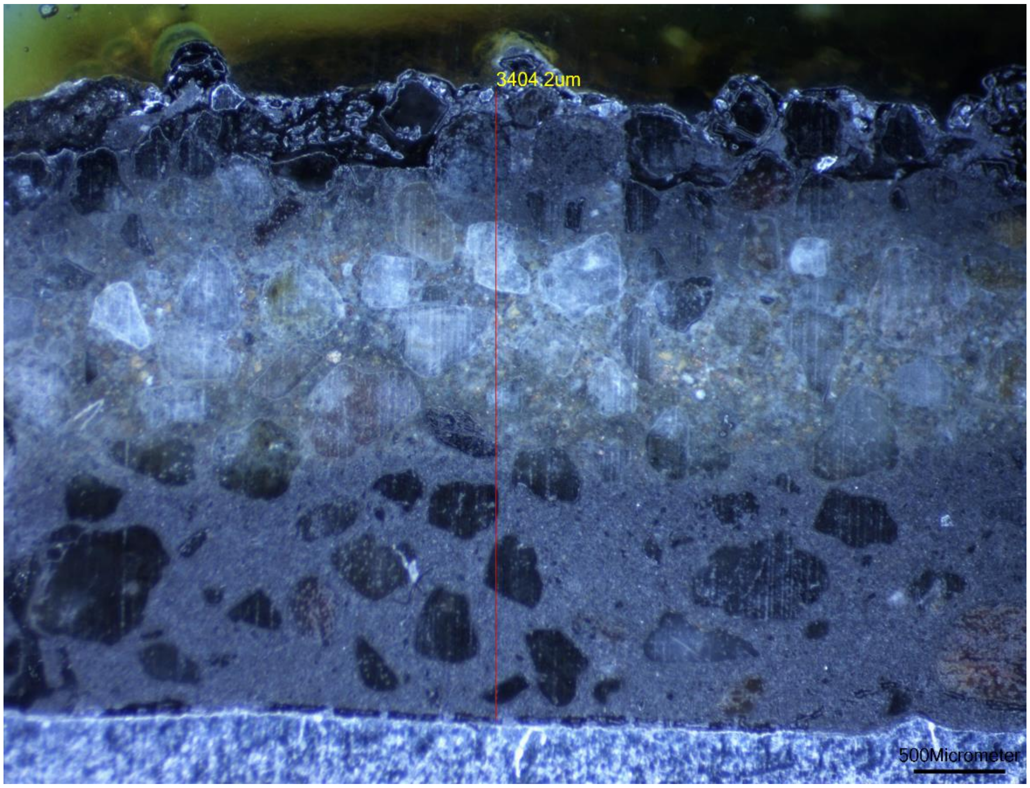

Close up of the inside surface of sample N-2. Note a layer of cement is present.



Close up of sample N-2 after pH (left side) and phenolphthalein (right side) testing showing alkalinity at the metal surface.



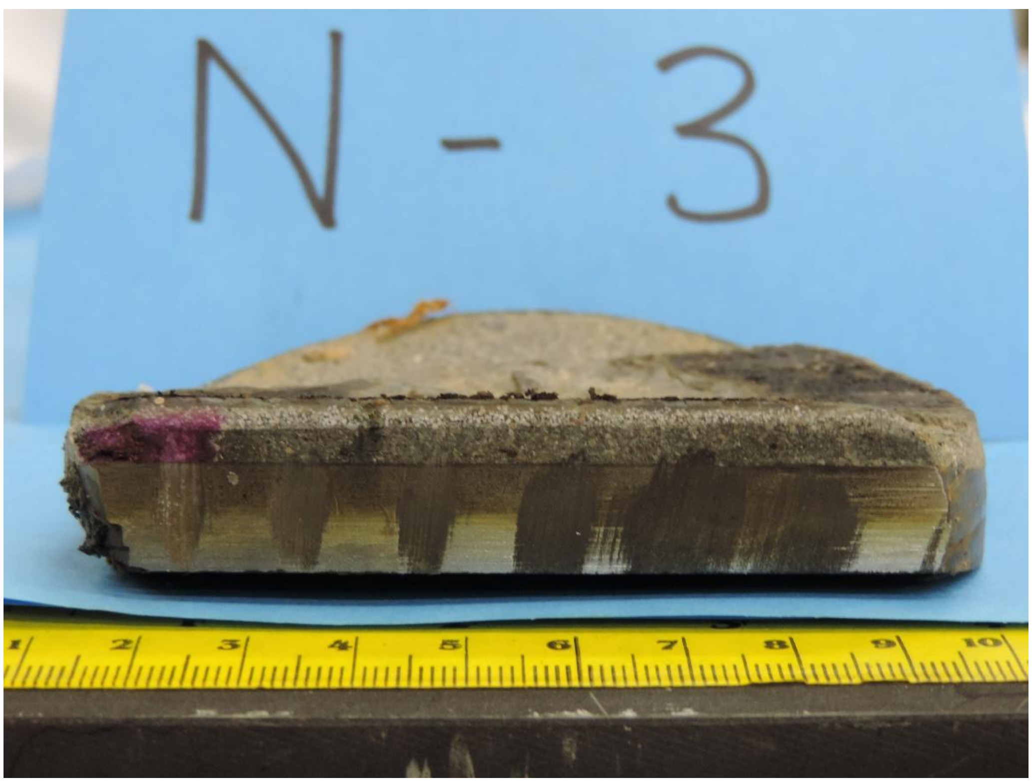
7X view of the cross section of sample N2. There is no corrosion observed on the base metal.



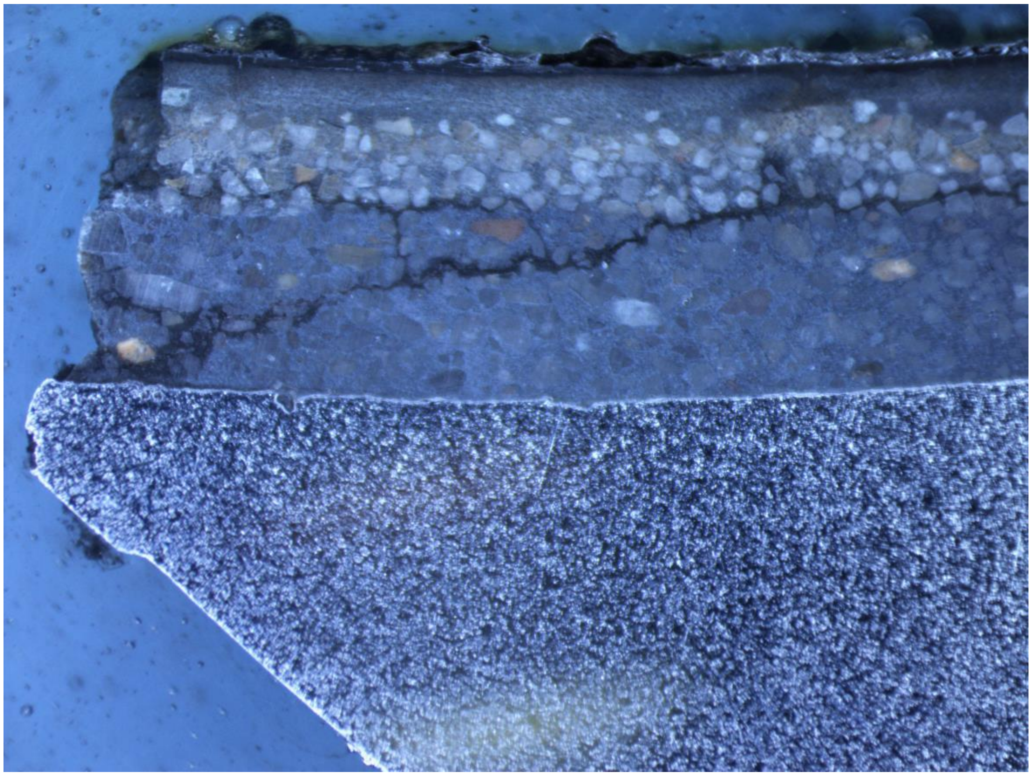
20x view of sample N-2 with the thickness of the cement layer measured at 3.4 mm.

Overall view of sample N-3.

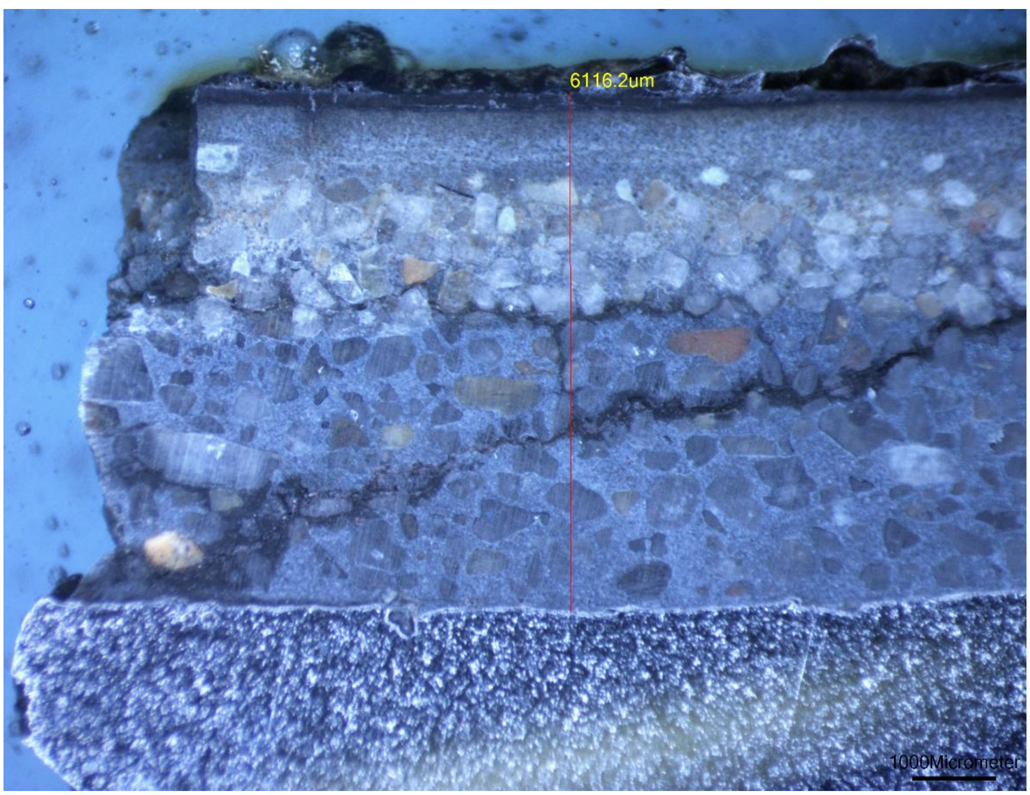
Close up of the inside of sample N-3 with a chipped cement layer.



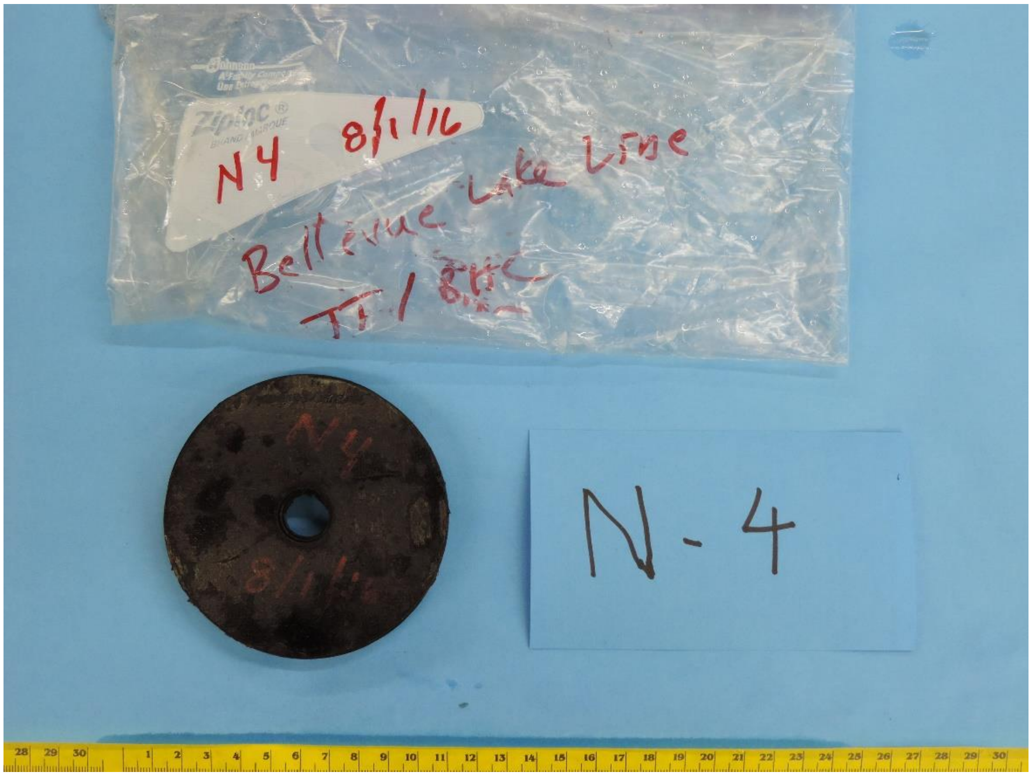
Close up of sample N-3 cross section after pH and phenolphthalein testing.



7x view of the cross section of N-3.



10x view of sample N-3 with the thickness of the cement layer measured.

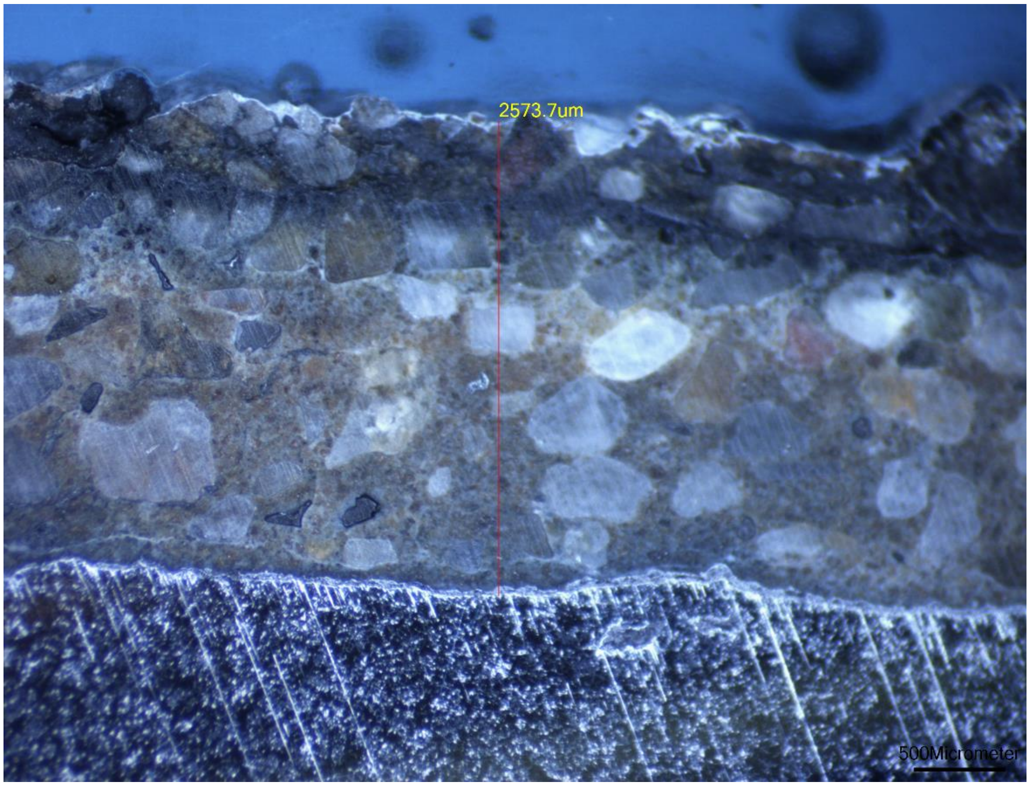


Overall view of sample N-4.

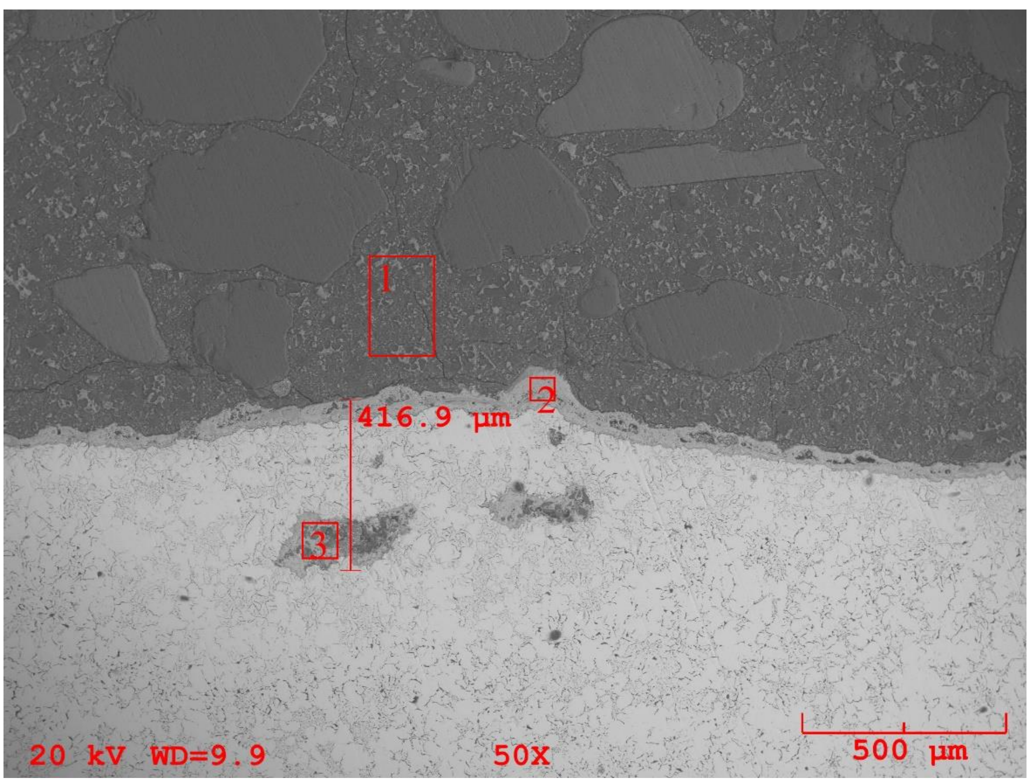

Close up of the inside of sample N-4.

Close up of the Ph and phenolphthalein tested cross section form N-4. An acidic pH was detected, except directly above the cast iron pH was neutral.

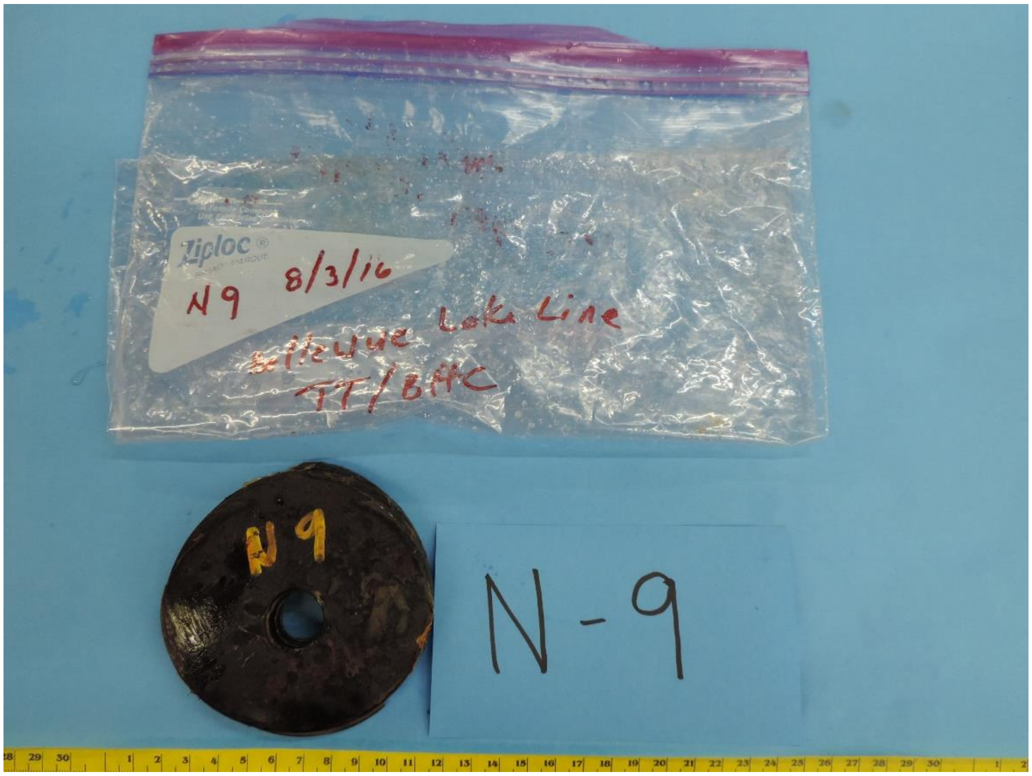
7x view of the cross section from N-4. Note there is a small amount of corrosion observed near the cement cast iron interface.



20x view of N-4 with the thickness of the cement layer measured.

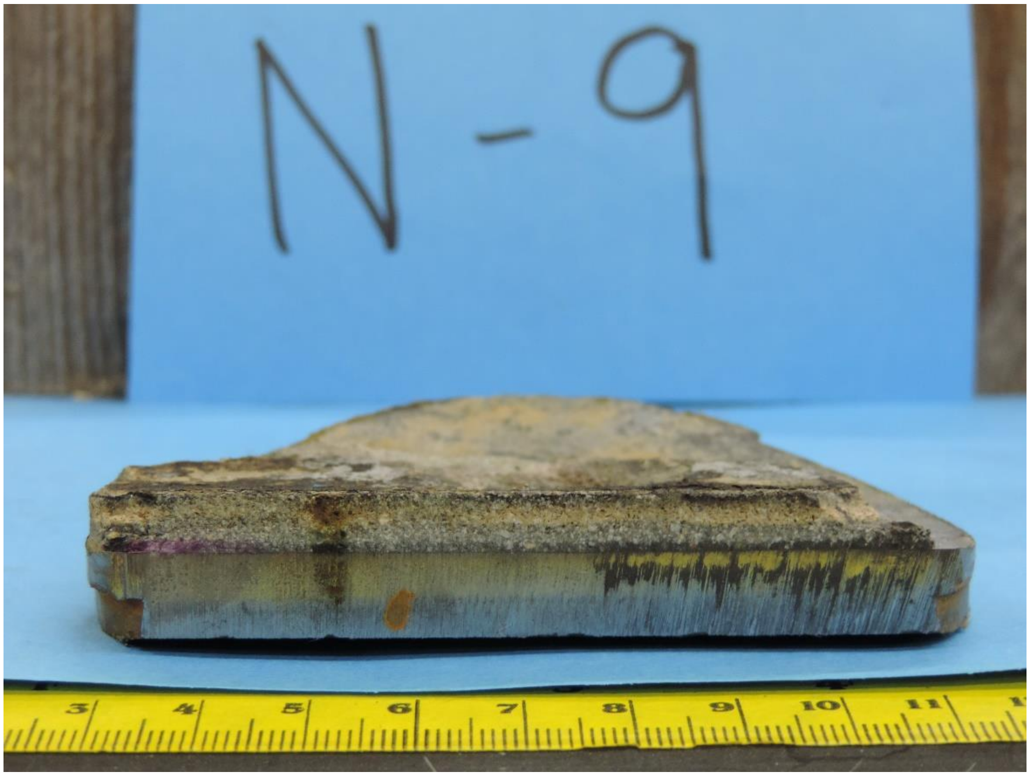


50x SEM image of the cross section of sample N-4 with the depth of corrosion measured.

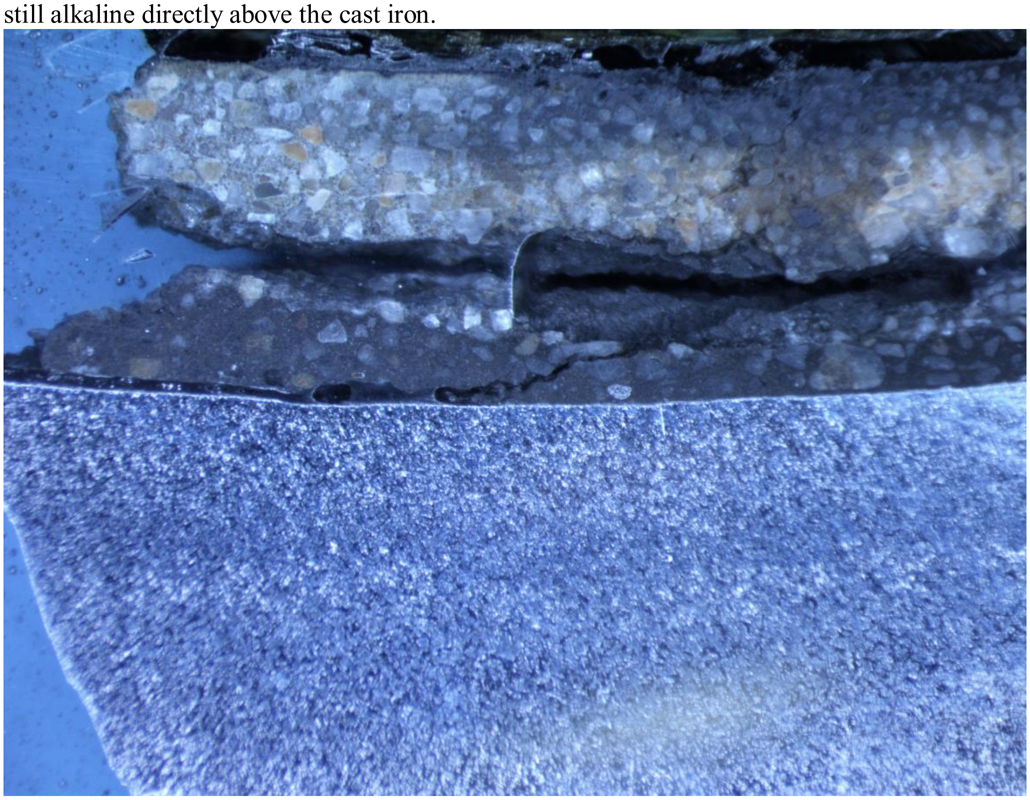


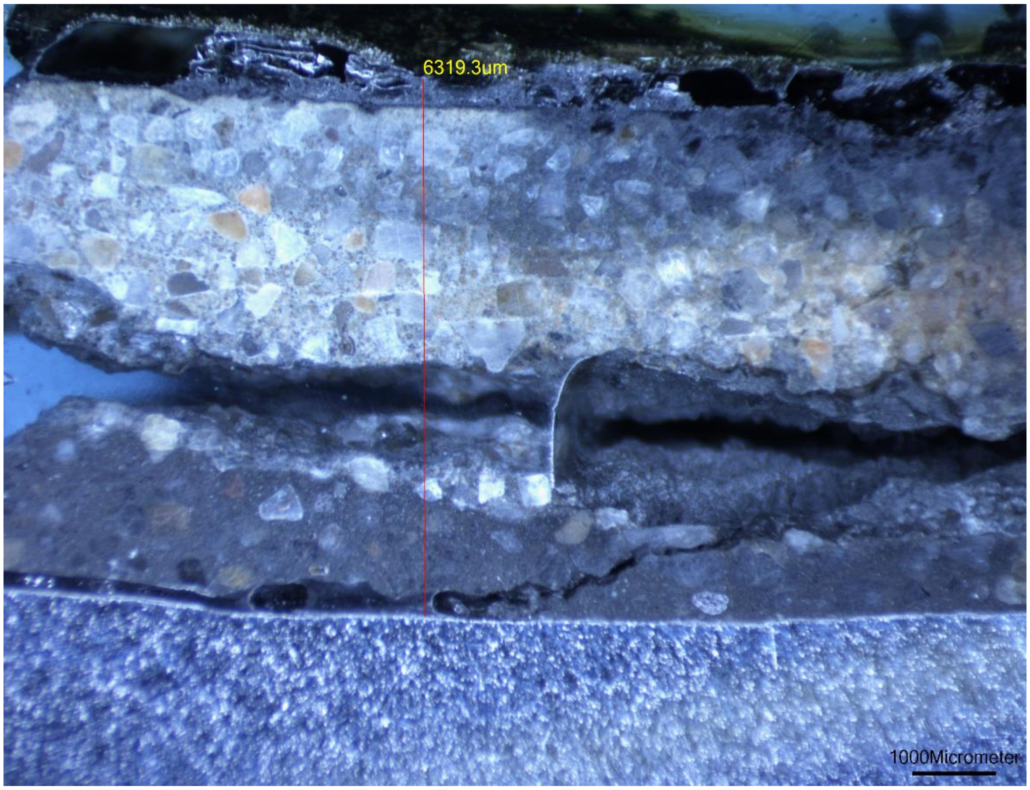
Overall view of sample N-9.

Close up of the inside of sample N-9.

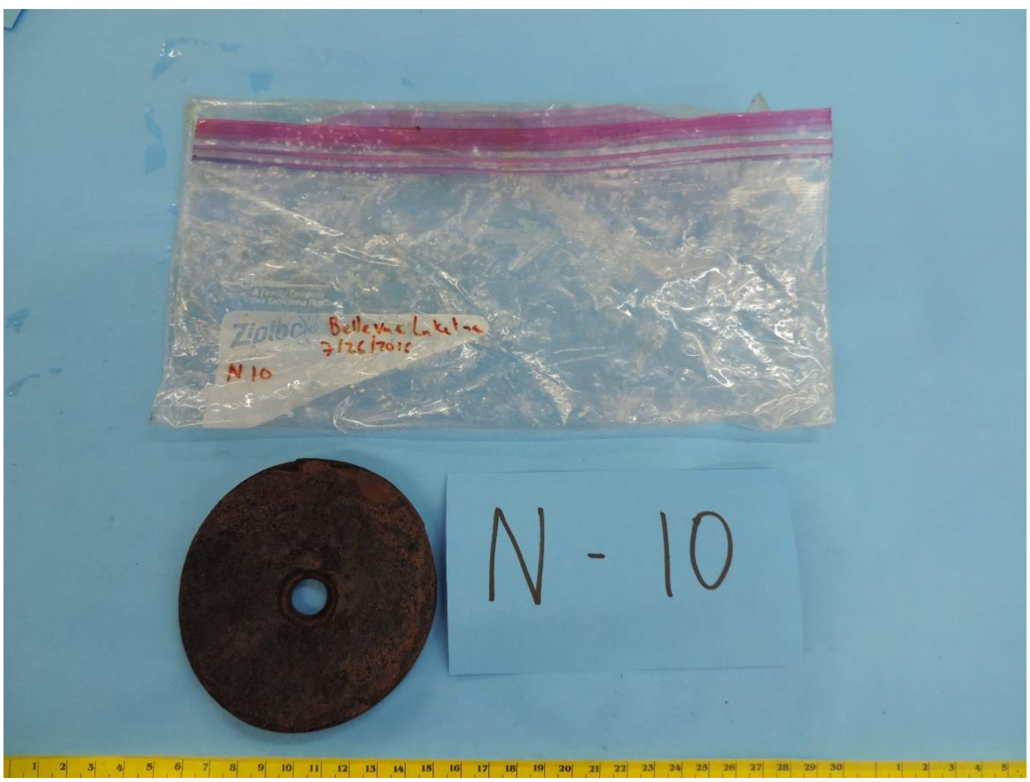


Close up of the cross section from sample N-9 showing the cement has acidified at the upper region, but is still alkaline directly above the cast iron.

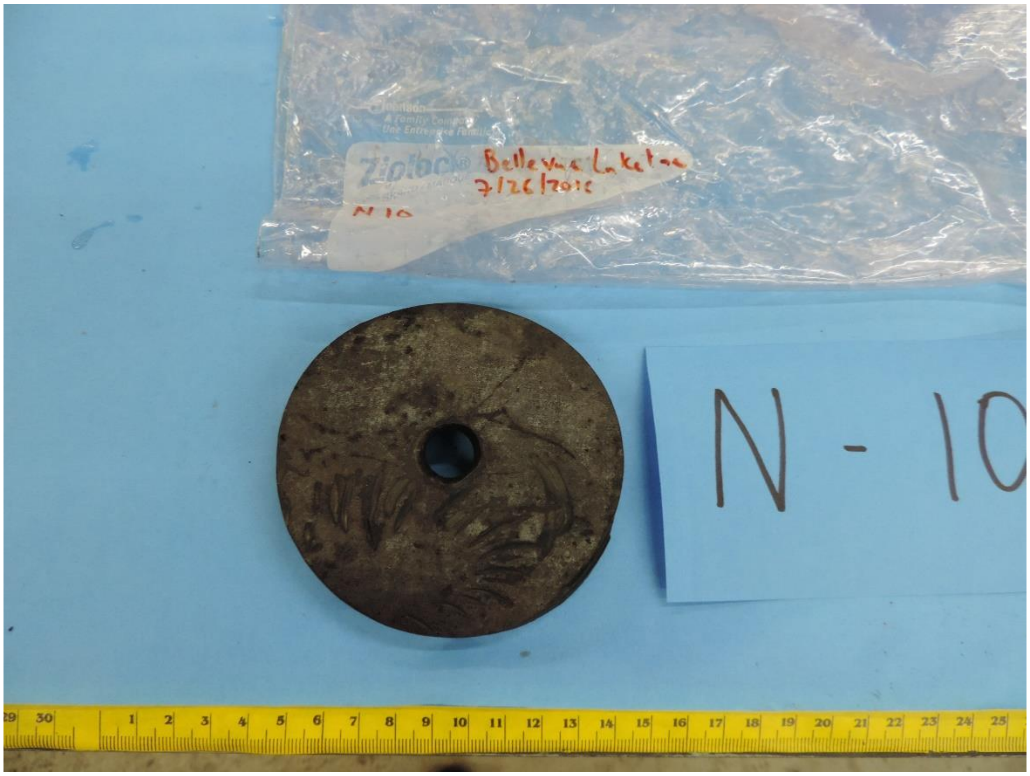

7x view of the cross section of N-9.



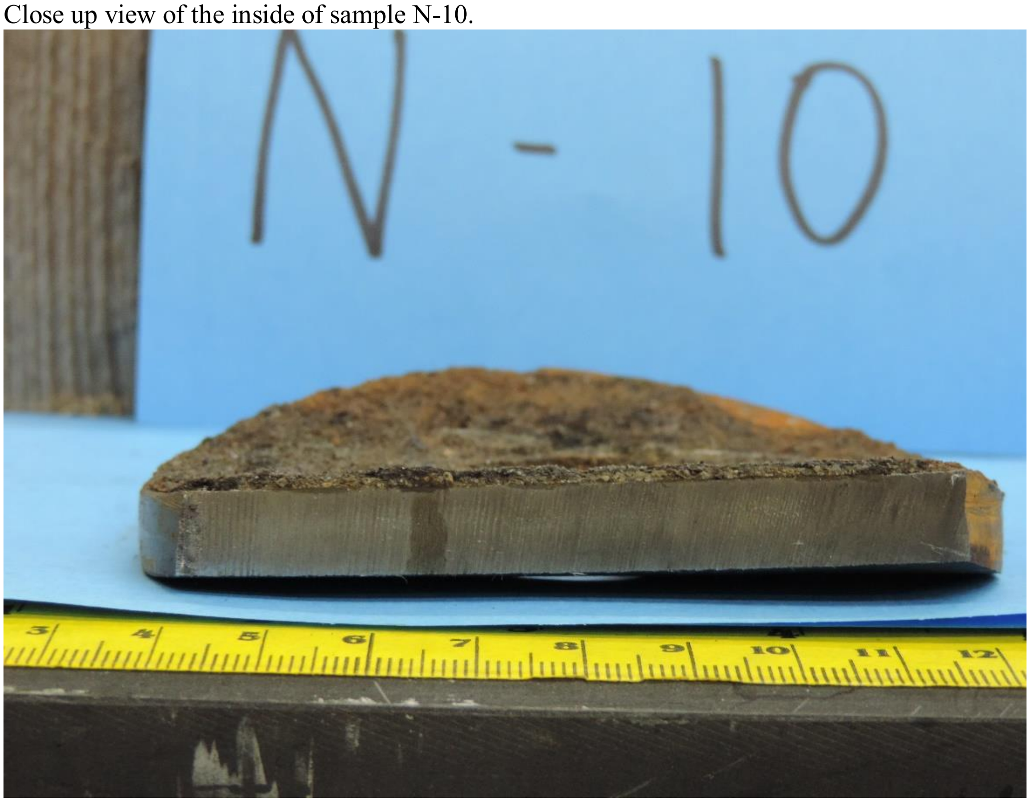
10x view of the cement layer on sample N-9 measured. There was no corrosion attack in the base metal.



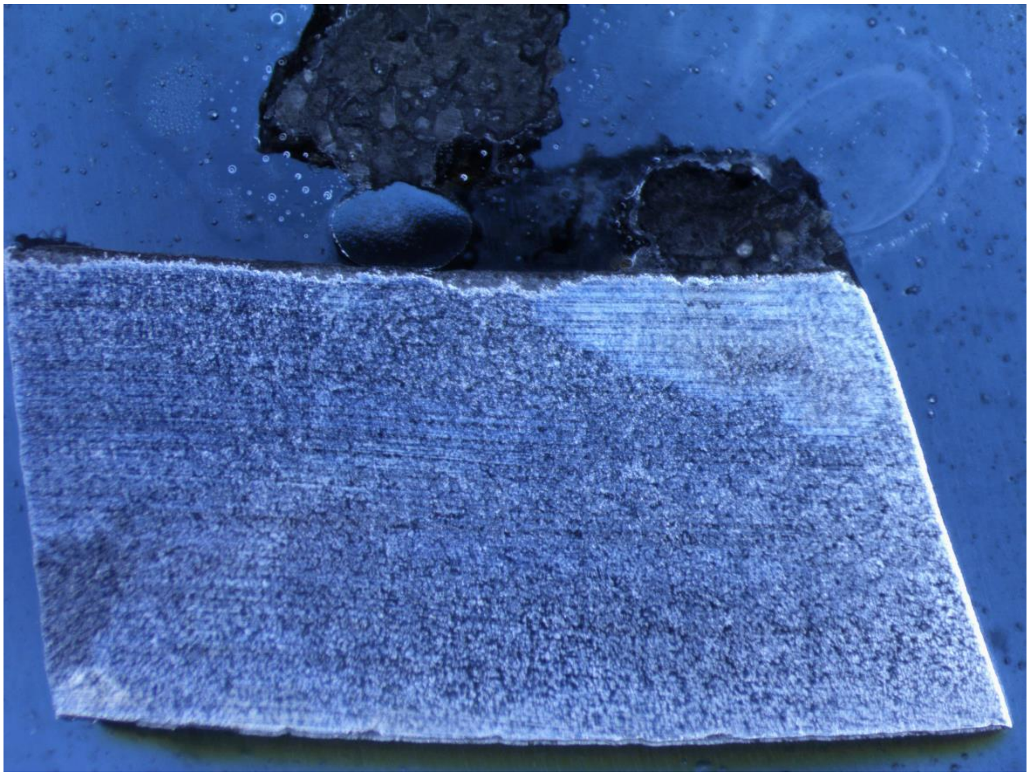
Overall view of sample N-10.



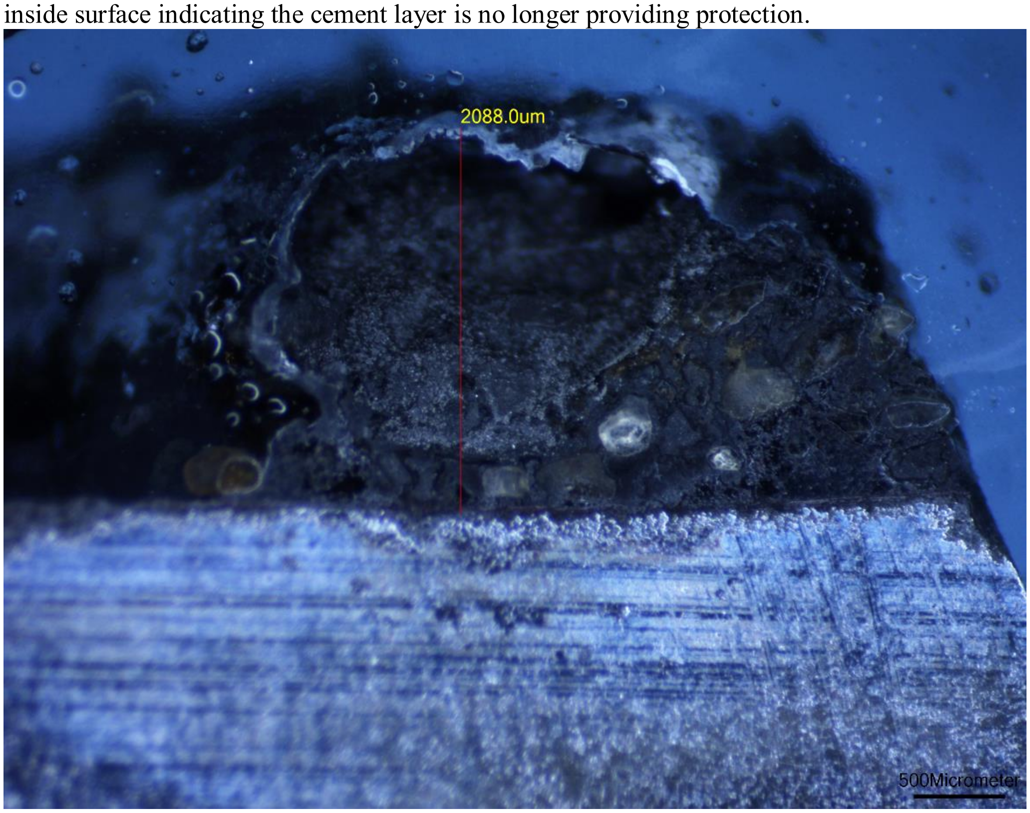
Close up view of the inside of sample N-10.



Cross section of N-10 after pH and phenolphthalein testing. Note due to the heavy discoloration and staining the pH was indeterminate.



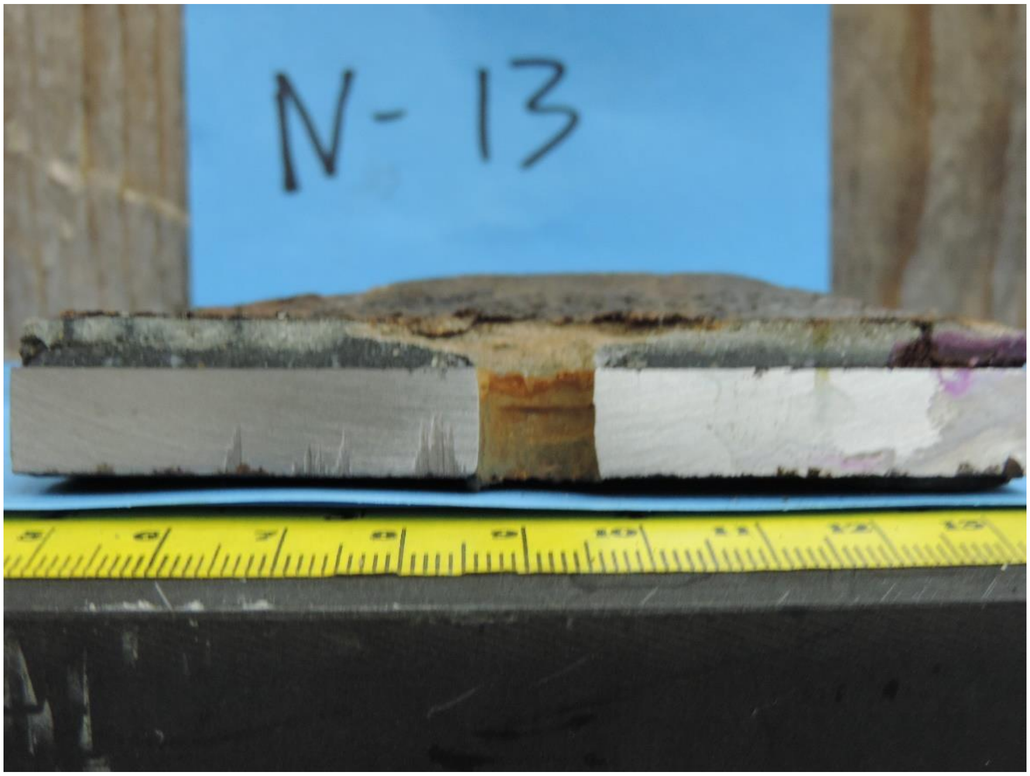
7x view of the cross section from sample N-10. Note there is a small amount of corrosion attack on the inside surface indicating the cement layer is no longer providing protection.



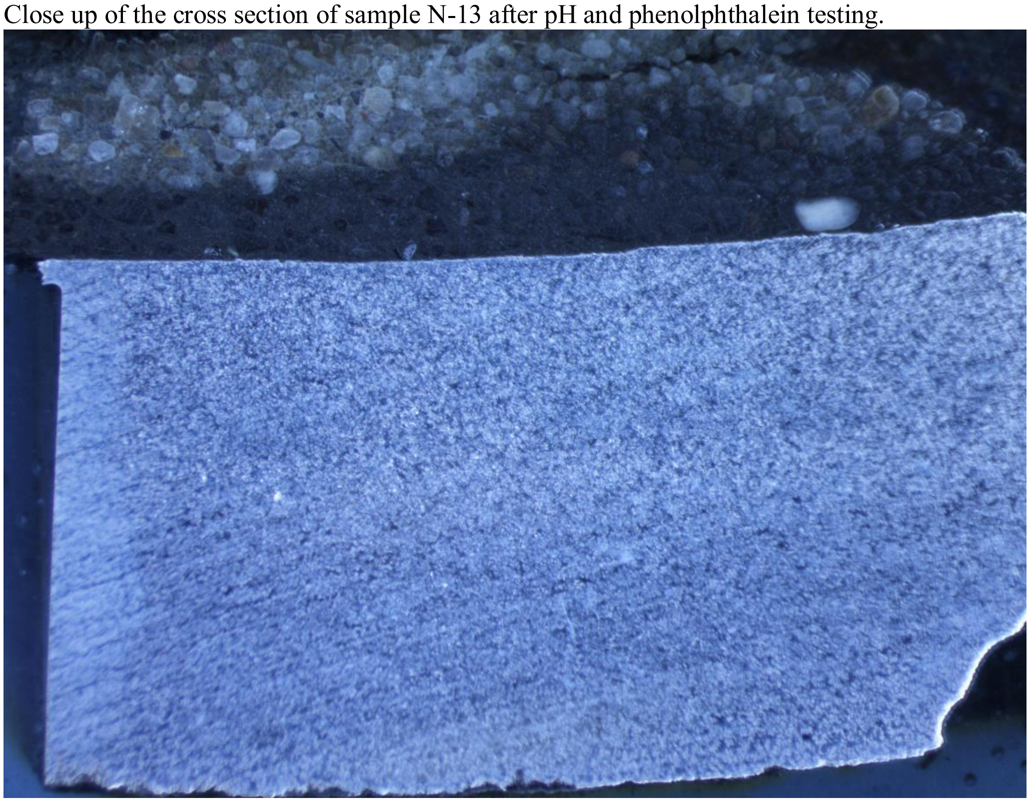
20x view of N-10 with the layer of cement measured. Note the dark coloration indicates it has degraded.

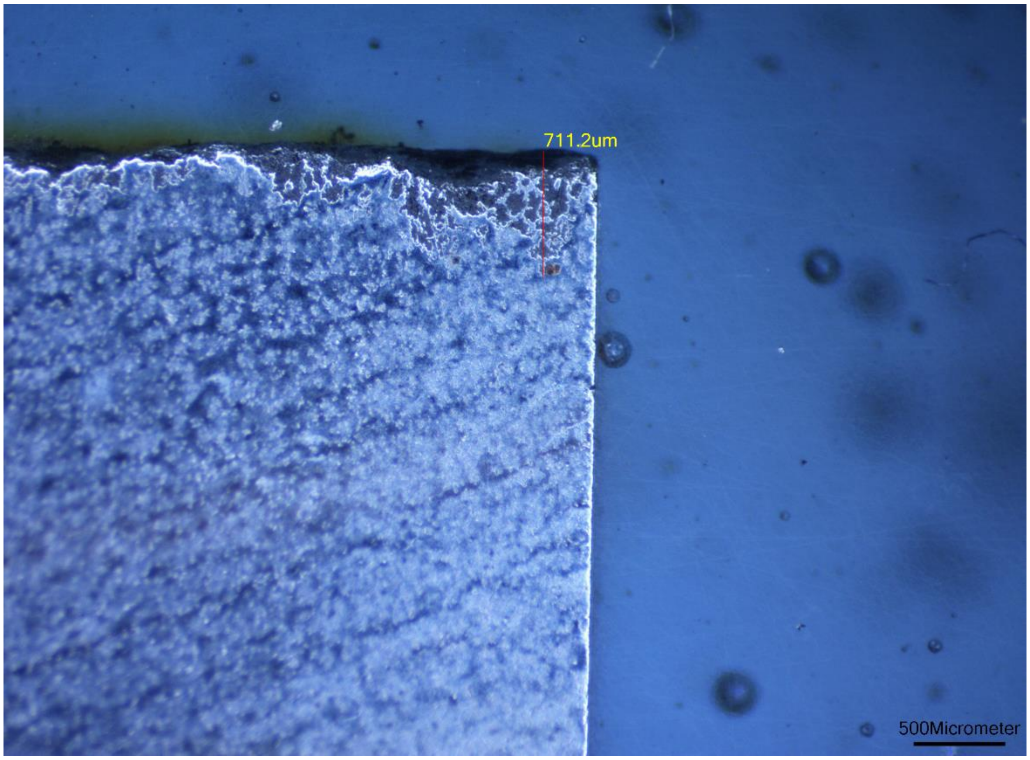
Overall view of the outside of sample N-13.

Overall view of the inside of sample N-13.



Close up of the cross section of sample N-13 after pH and phenolphthalein testing.

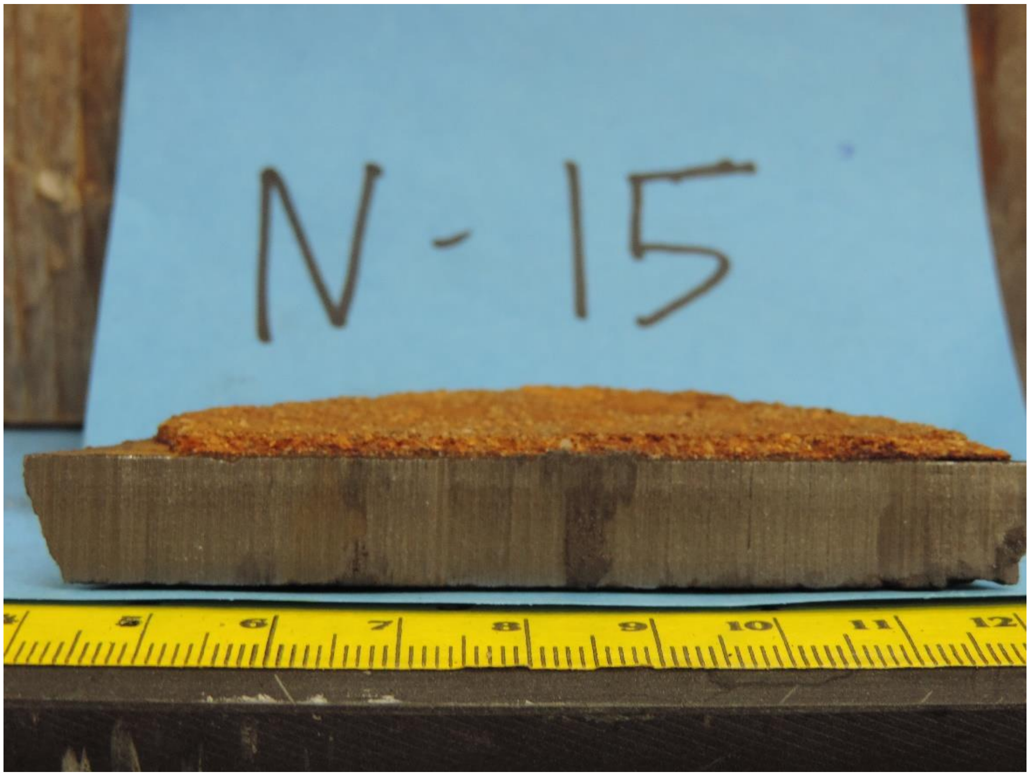

7x view of the cross section of sample N-13.



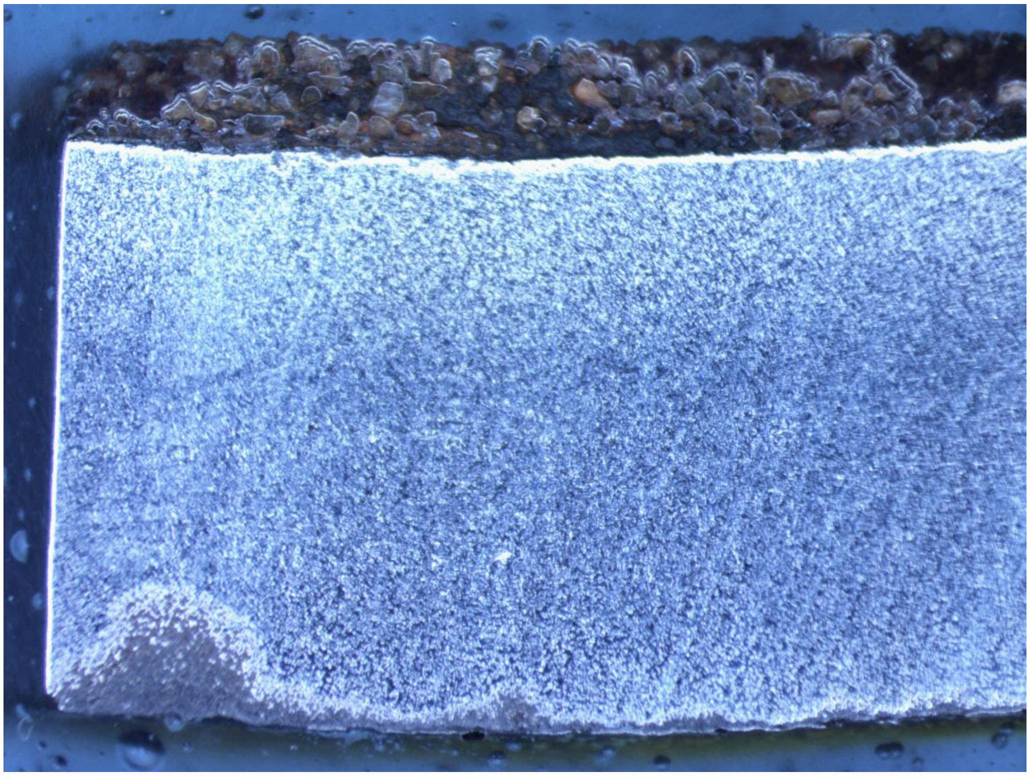
20x view of sample N-13 with the depth of corrosion from the inside measured.

Overall view of the inside of sample N-15.

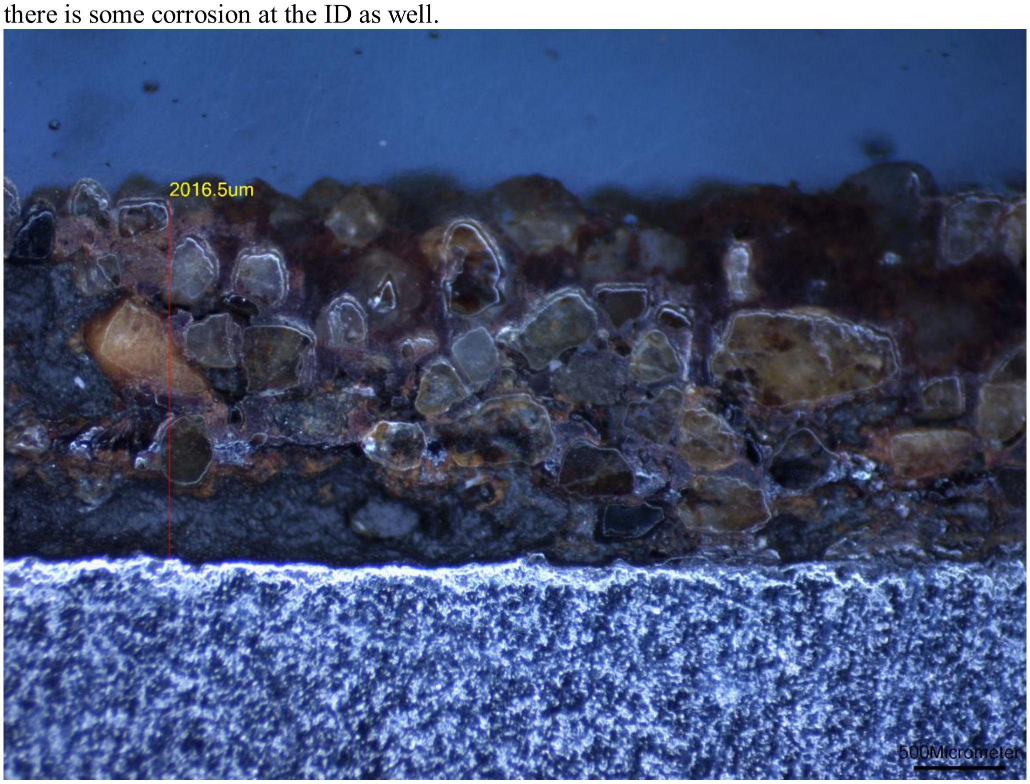
Overall view of the outside of sample N-15.



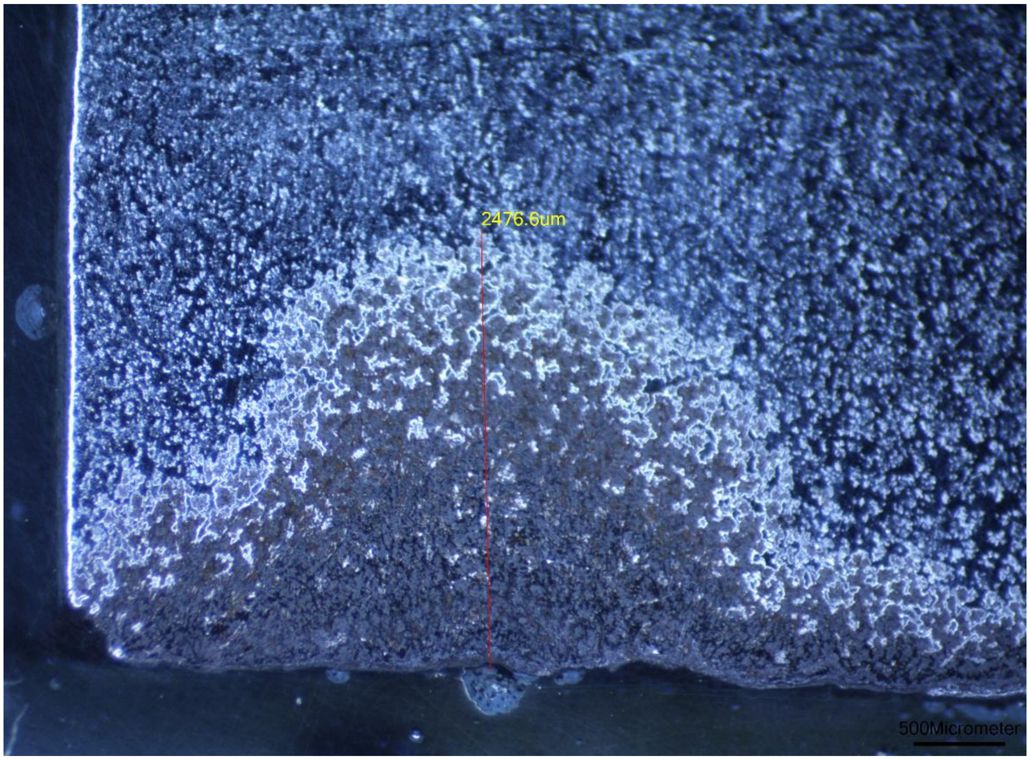
Close up of the cross section of sample N-15. The pH testing indicated the cement layer was acidic, but due to the heavy iron staining an accurate reading could not be obtained.



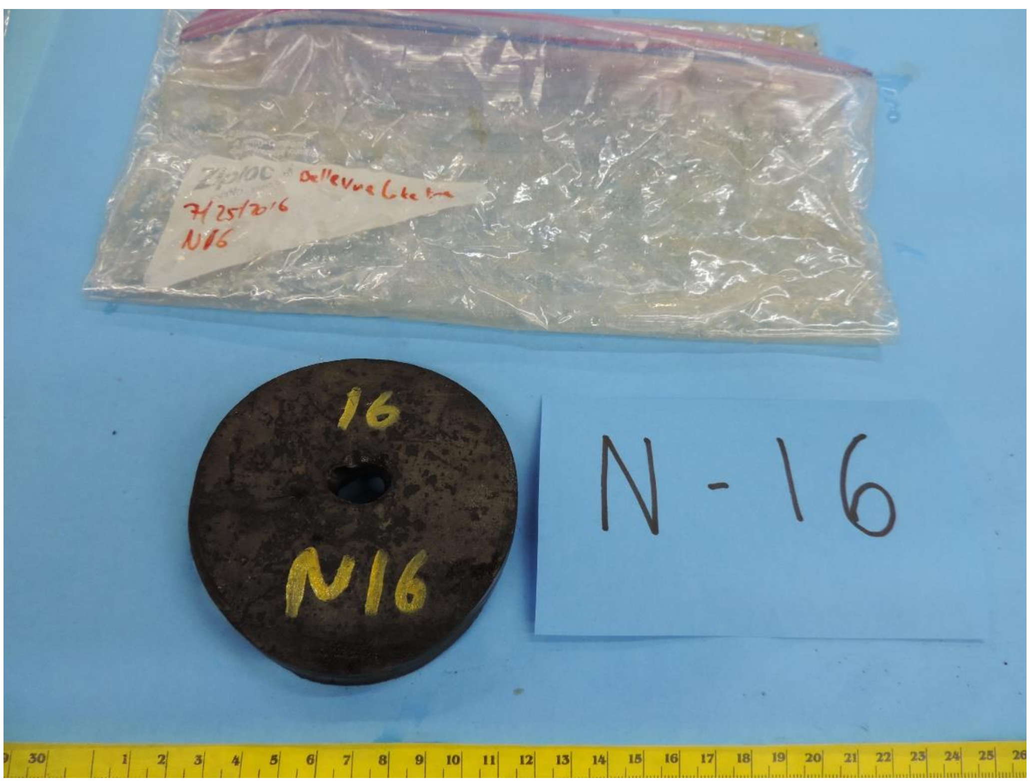
7x view of eth cross section of sample N-15. Note the corrosion attack is mainly from the OD, although there is some corrosion at the ID as well.



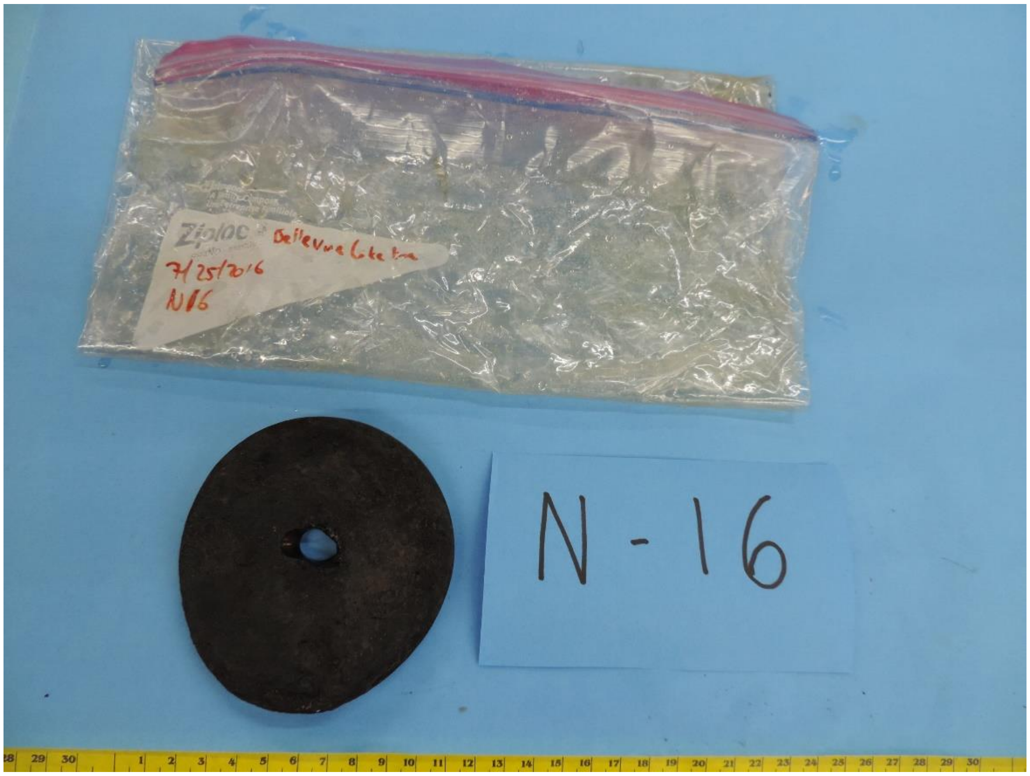
20x view of the cement layer on sample N-15. Note there is some uniform surface corrosion along the inside surface.



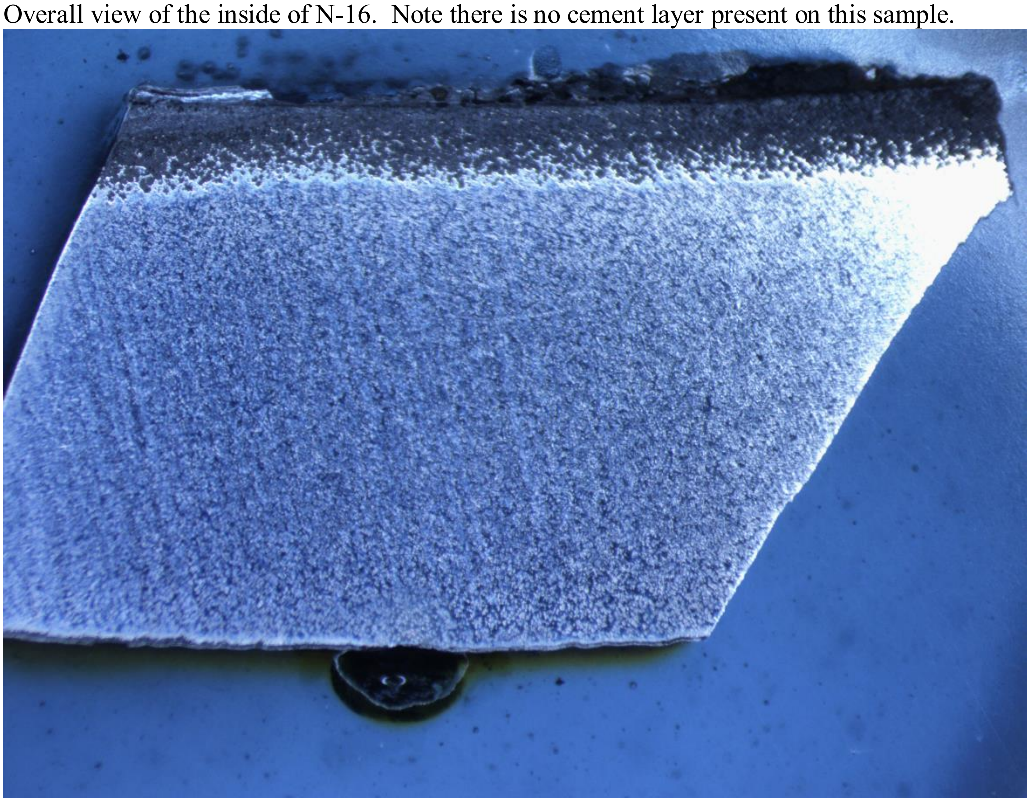
20x view of the depth of corrosion from the outside surface on sample N-15.

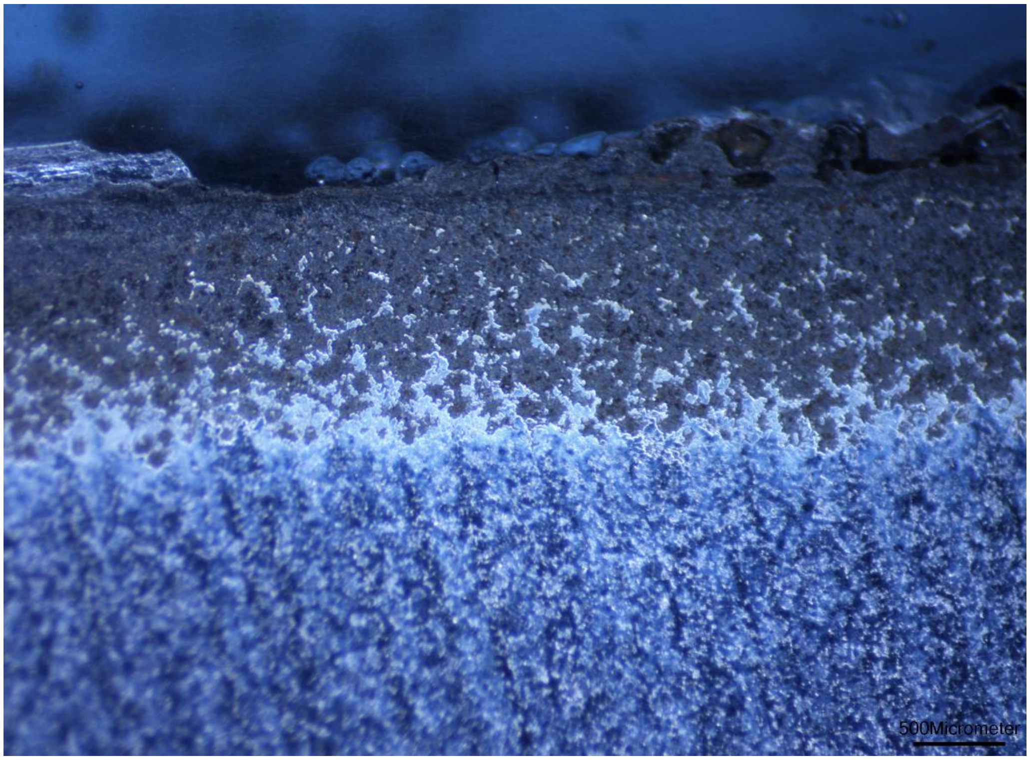


Overall view of the outside of N-16.

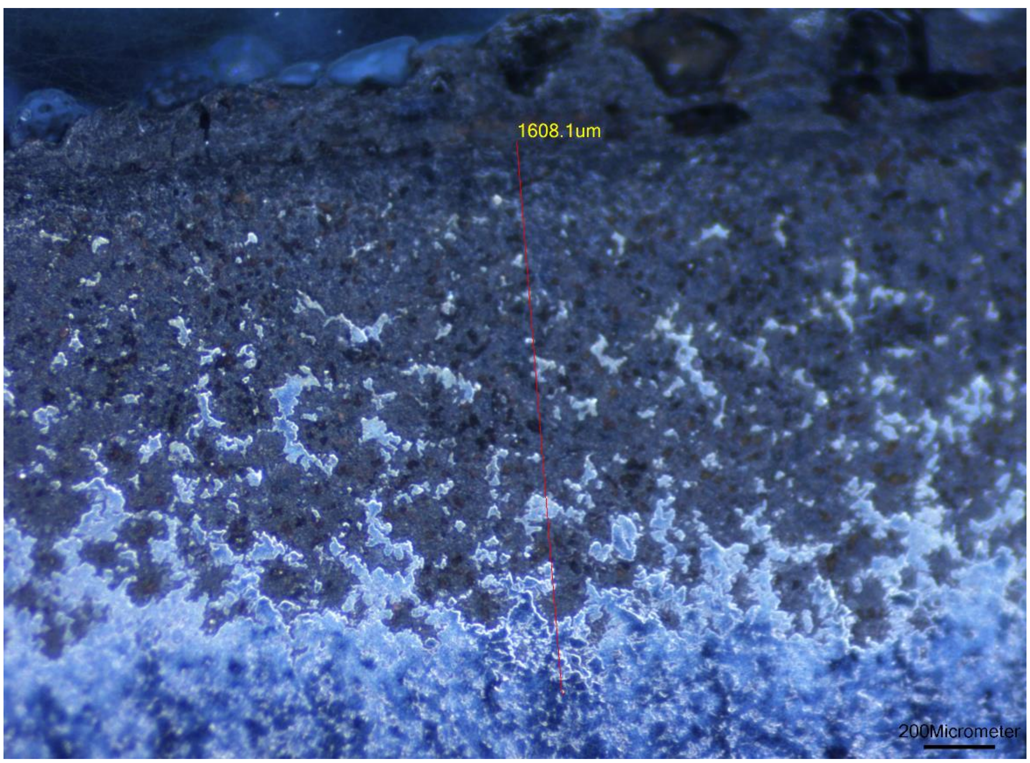


Overall view of the inside of N-16. Note there is no cement layer present on this sample.

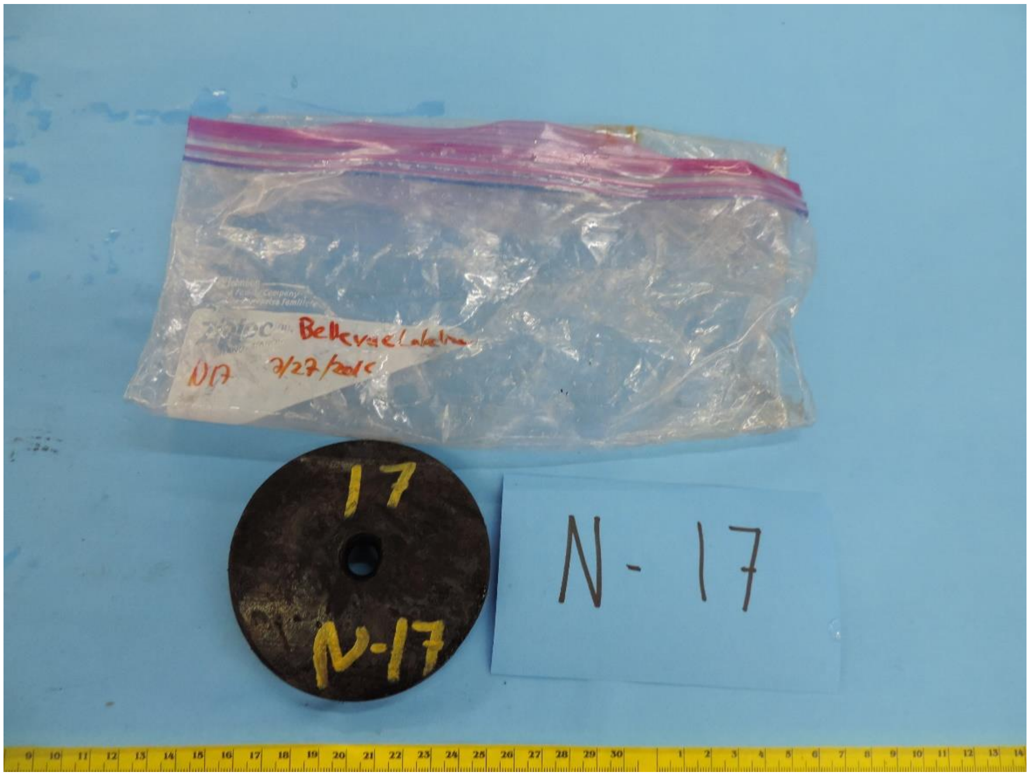

7x view of the cross section from sample N-16. Note corrosion has initiated at the inside surface in the absence of cement.



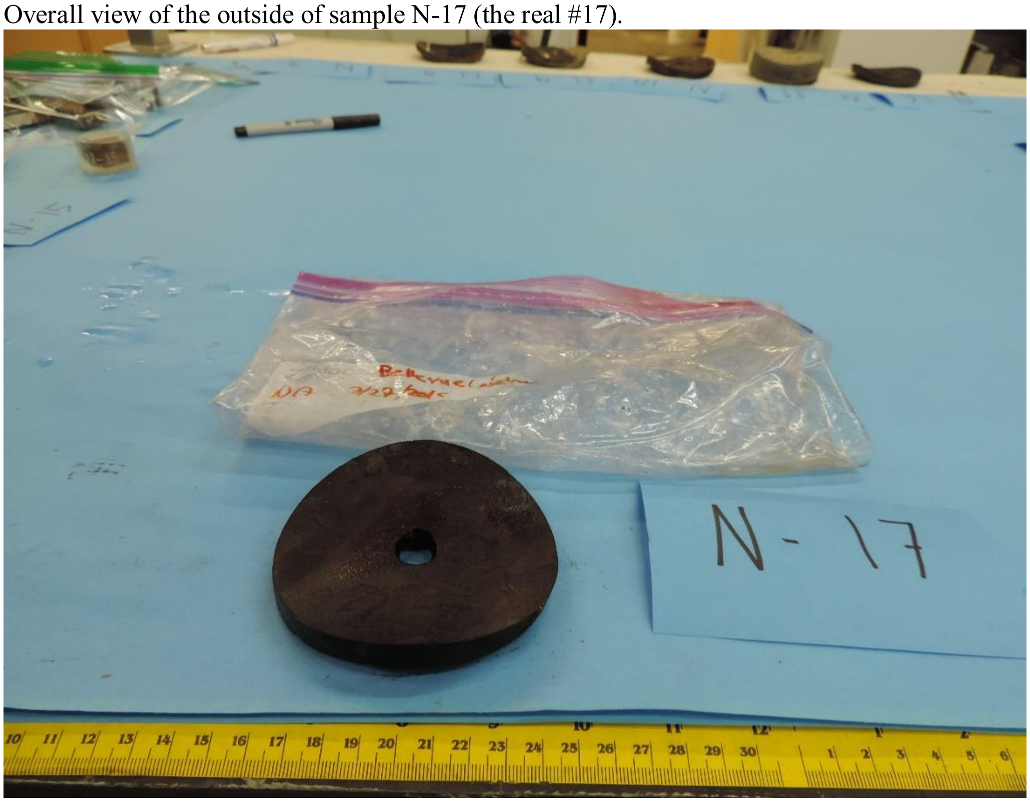
20x view of the corrosion on sample N-16.



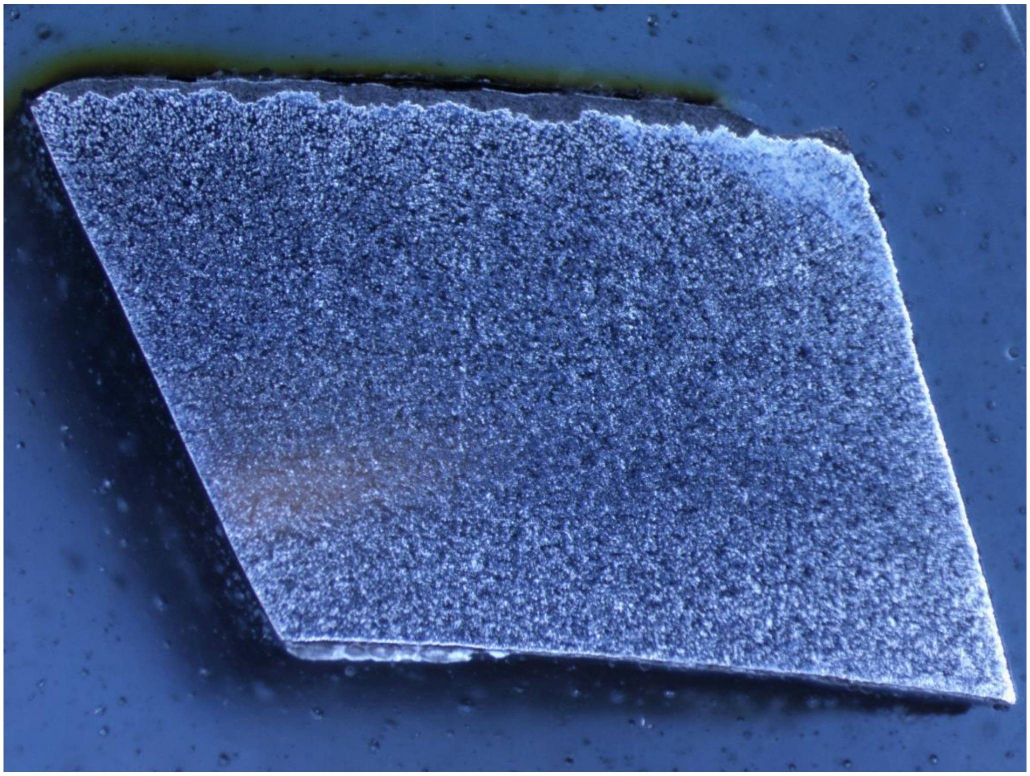
40x view of sample N-16 with the depth of the corrosion measured.



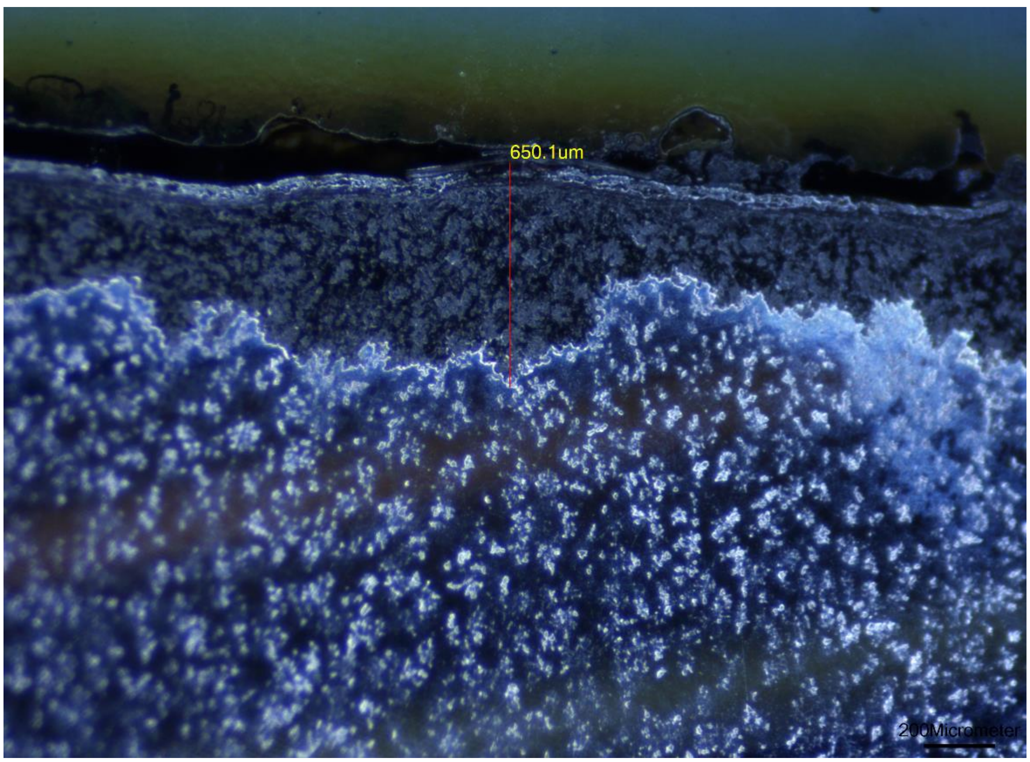
Overall view of the outside of sample N-17 (the real #17).



Overall view of the inside surface of N-17. Note there is no cement layer present.



7x view of N-17. Note the corrosion is mainly occurring at the outside layer.

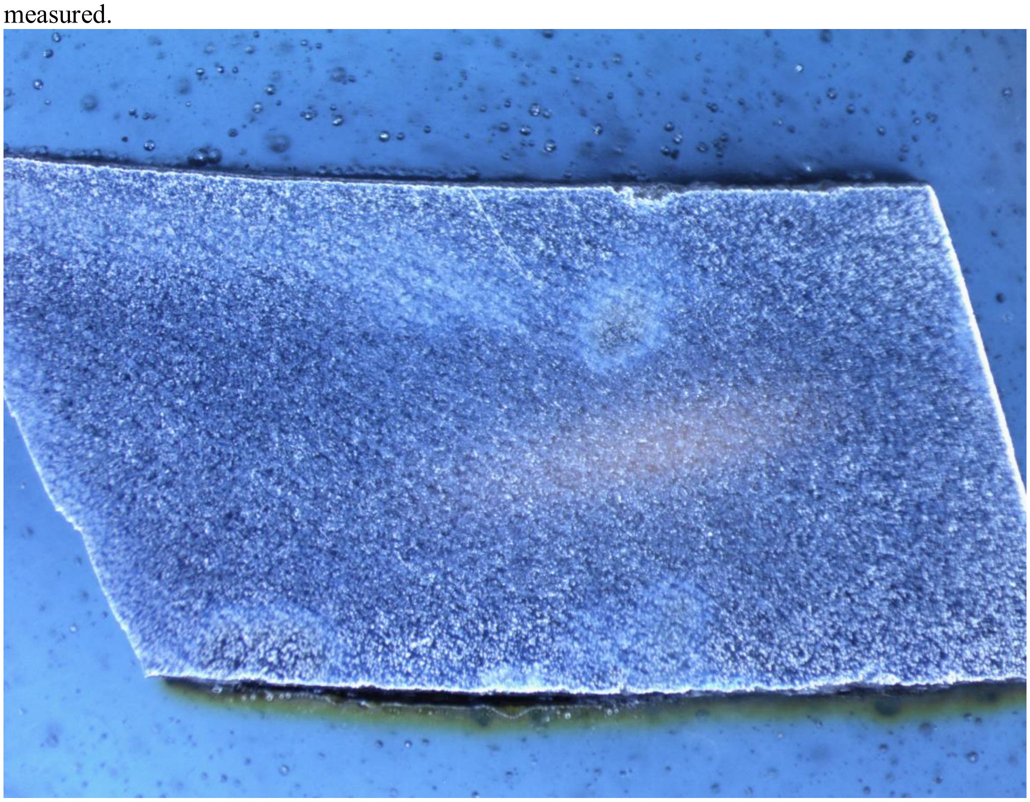


40x view of N-17 with the depth of pitting measured.

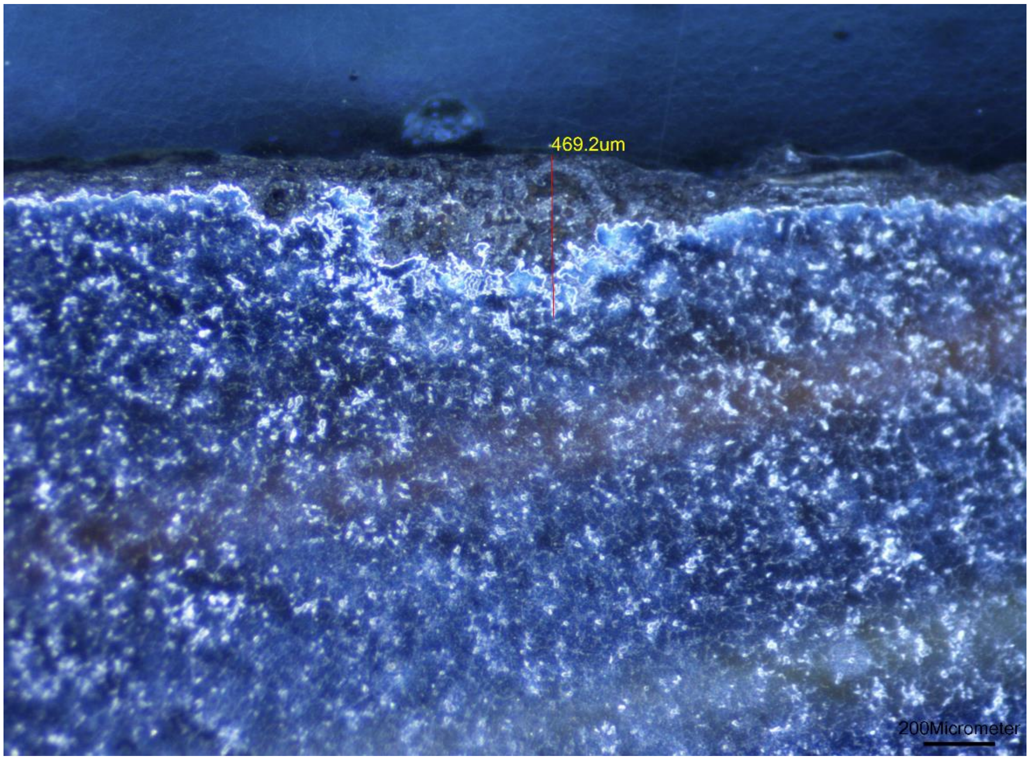
Overall view of sample of the outside of N-18

Overall view of the inside of sample N-18.

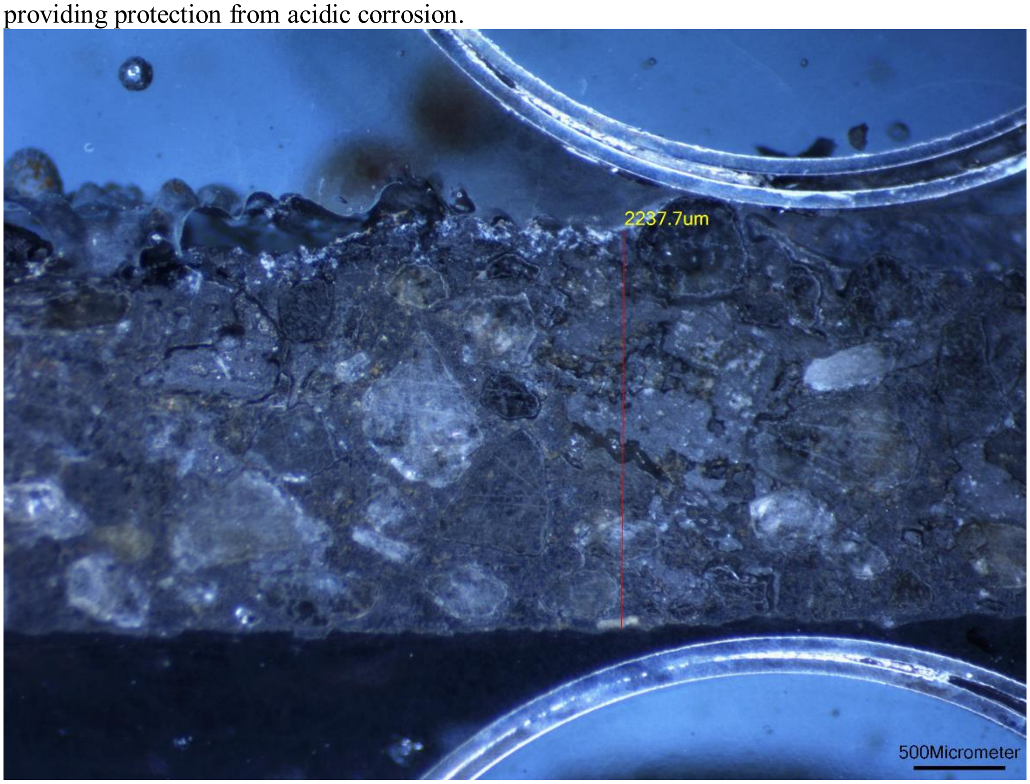
Cross section of sample N-18. The cement layer had darkened sufficiently so an accurate pH could not be measured.



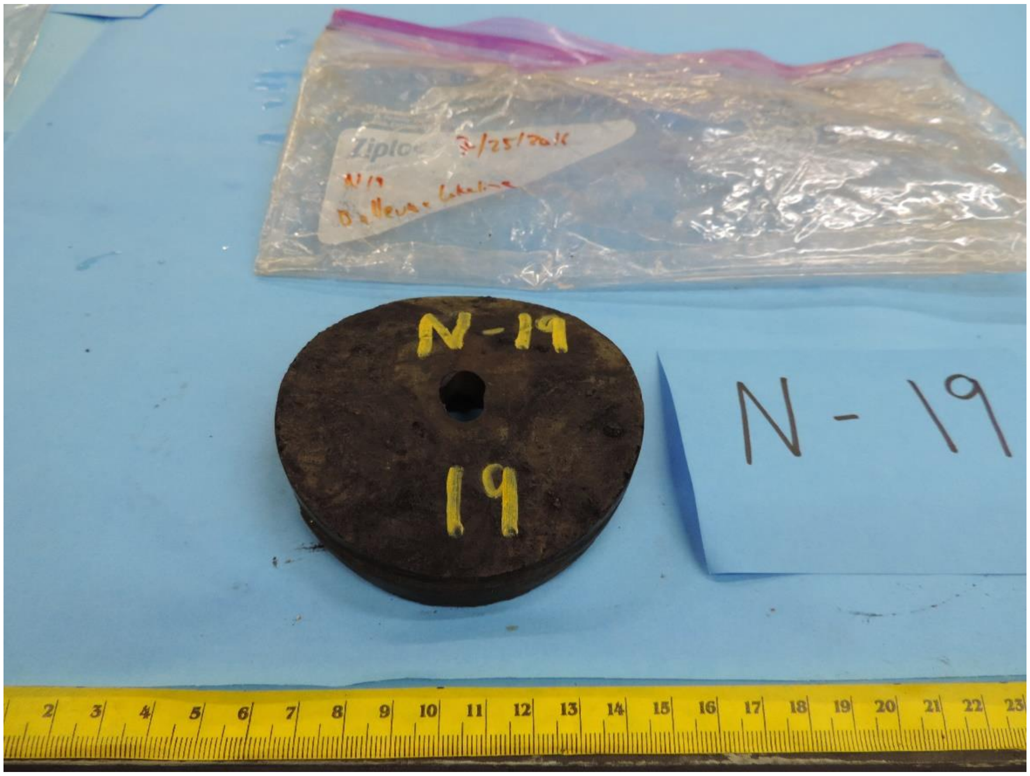
7x view of sample N-18 cross section mount. Note the cement layer separated during sectioning and was mounted separately.



40x view of the depth of corrosion on the inside of N-18. This indicates that the cement layer is no longer providing protection from acidic corrosion.

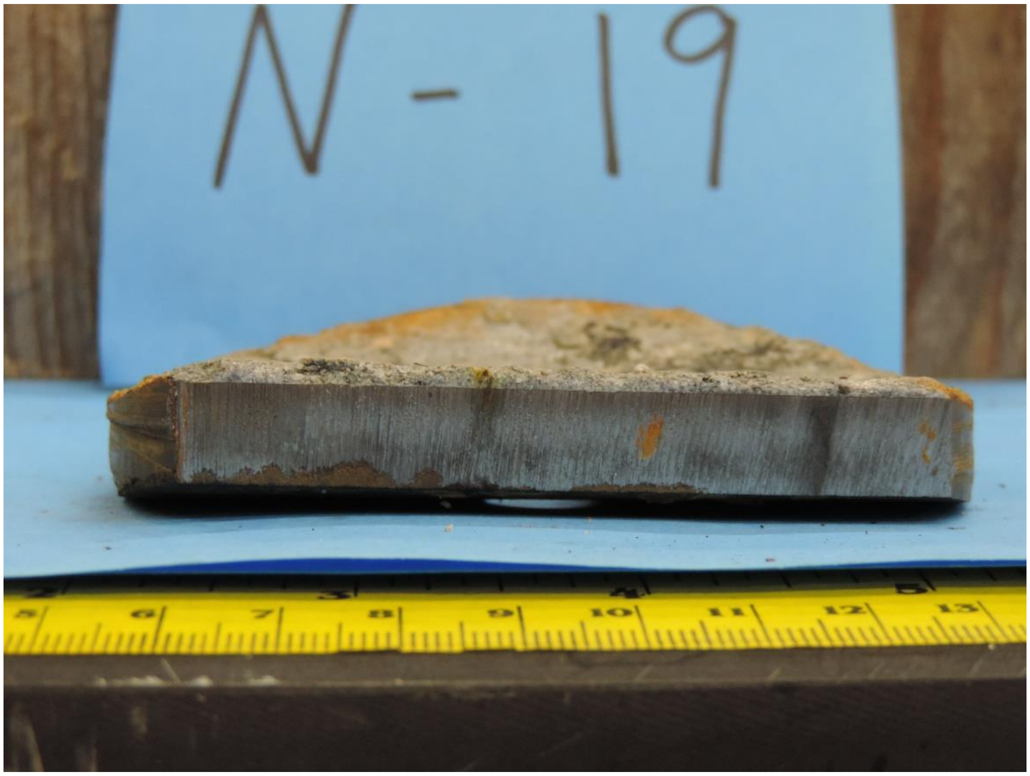


20x view of the thickness of the cement layer from N-18.

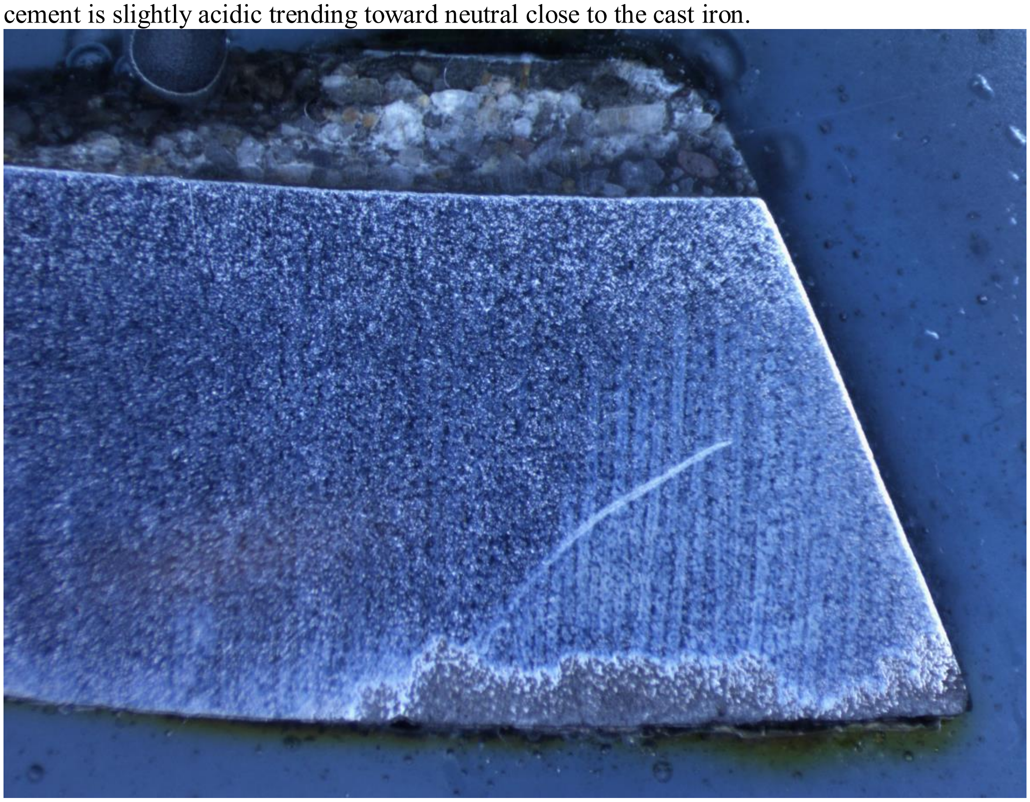


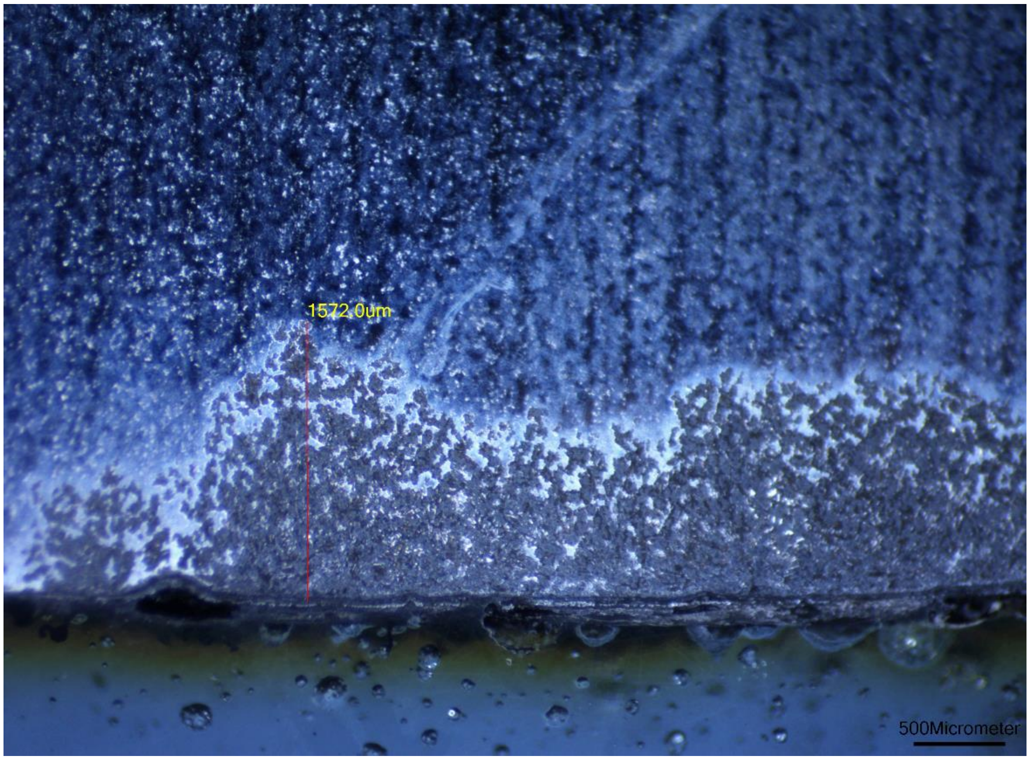
Overall view of the outside of sample N-19.

Overall view of the inside of sample N-19.

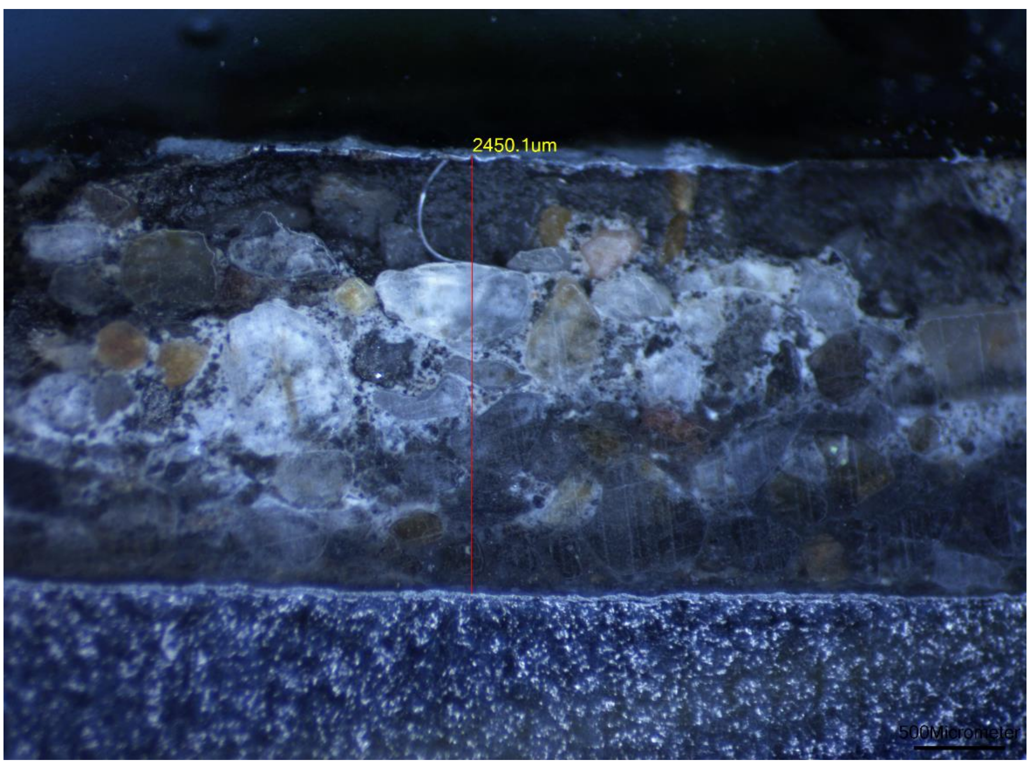


Cross section of sample N-19 after pH and phenolphthalein testing. This indicates that the upper layer of cement is slightly acidic trending toward neutral close to the cast iron.

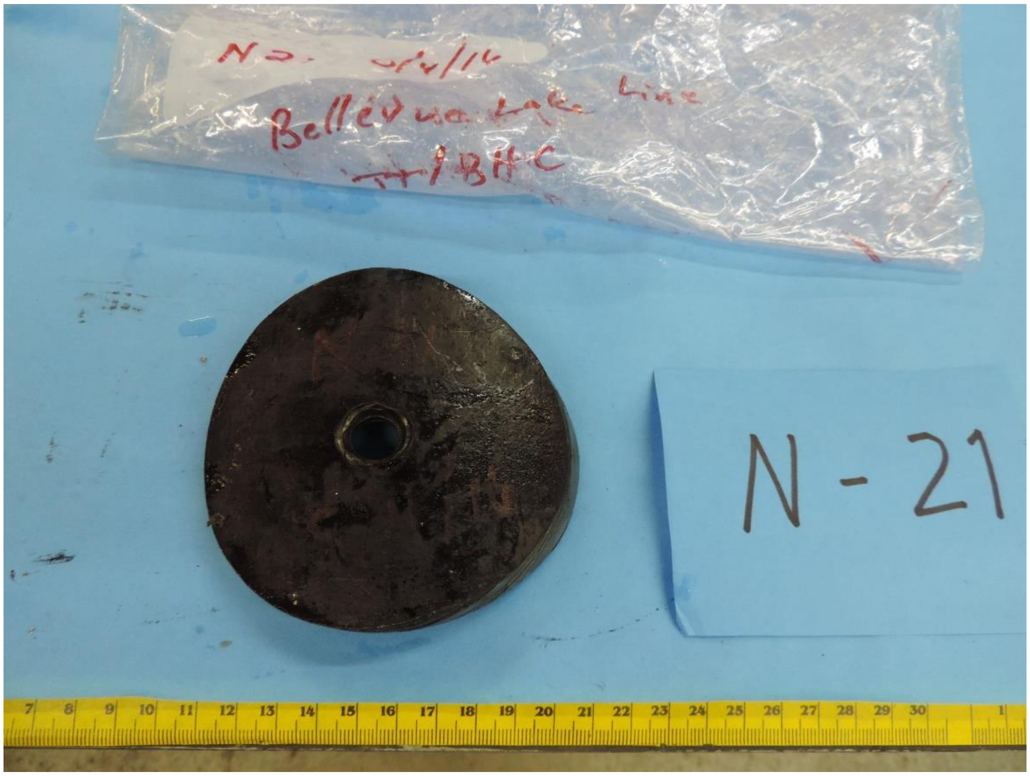

7x view of the cross section from sample N-19. Note the corrosion is mainly occurring from the outside.



20x view of the depth of pitting on sample N-19.

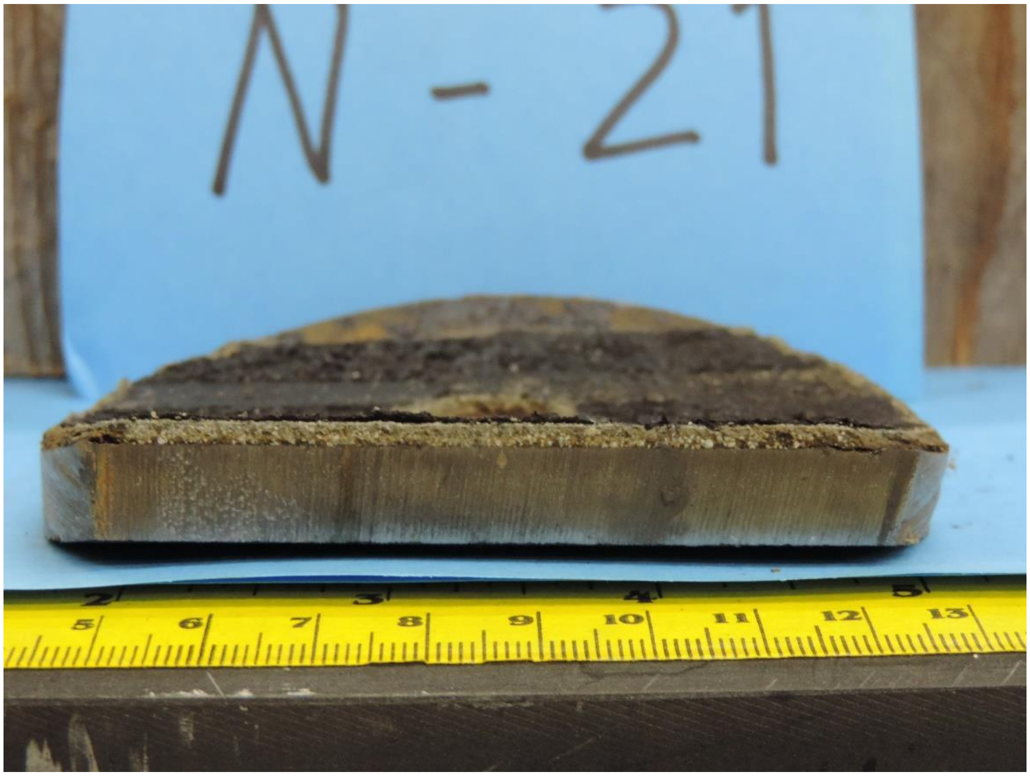


20x view of the cement layer on sample N-19. There is minimal corrosion at the inside surface indicating the cement is still offering some protection.

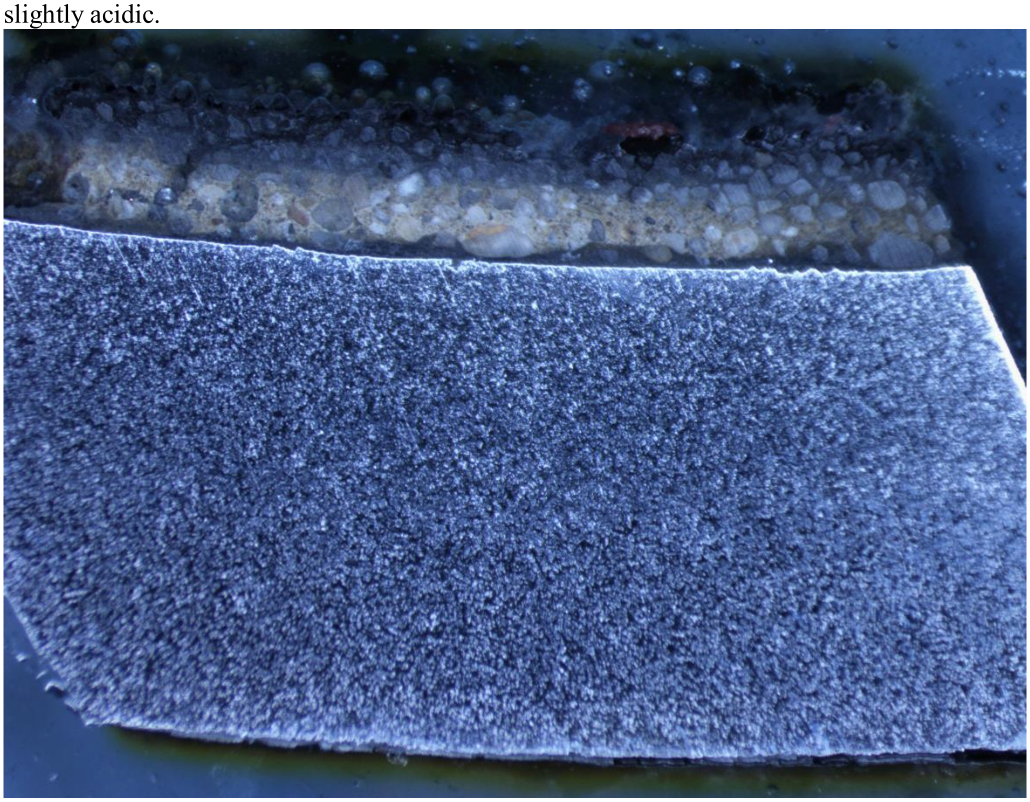


Overall view of the outside sample N-21.

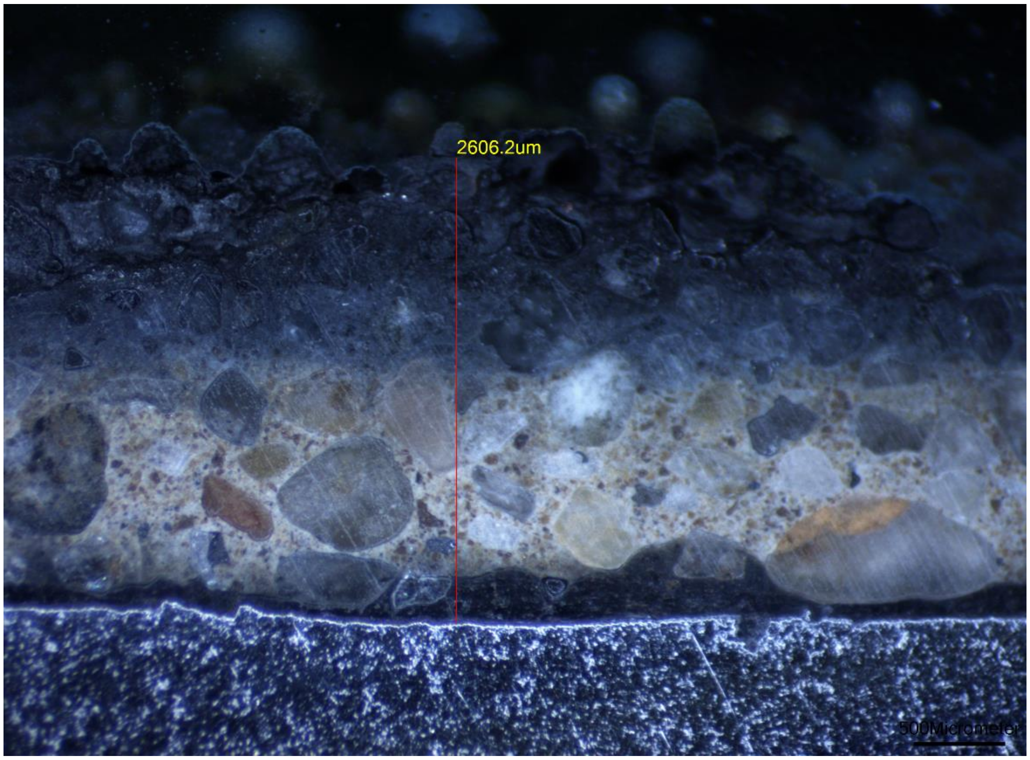

Overall view of the inside of sample N-21.



Cross section of sample N-21 after pH and phenolphthalein sampling. That indicated that the cement was slightly acidic.



Overall view of sample N-21 cross section.



20x view of sample N-21 with the thickness of the cement layer measured. There are just small areas of pitting at the ID, indicating that the cement layer is reaching or has reached is corrosion inhibiting limit.

Sincerely,
SIMON FORENSIC, LLC

Omar Simon
Forensic Chemist
Email: omar@simonforensic.com
Web: www.simonforensic.com

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix E. References for Service Life

AGING PIPE PROVES EXPENSIVE FOR MUNICIPALITIES

A 42-in. cast iron pipe, installed 103 years ago, broke last summer in Boston, causing disastrous flooding which ruined some books at the Boston Public Library.

Thin-walled "victory pipe" installed in Niagara Falls, N.Y., during World Water II constitutes only 3 percent of the total pipe in the city, but represents one-quarter of the City's costs for water main repair and replacement.

Steel pipe installed in the late 1800s in Butte, Mt., during the mining boom days is one reason the city has a four-person "leak gang" working six days a week.

Such stories help to illustrate the challenges municipalities face in keeping the aging water and sewer infrastructure of North America in good condition.

Across the United States, municipal operators face the problems of an aging pipe network: leaks, infiltration, low pressure, tuburculation and even collapse. This is made even more challenging by the fact that older pipe often runs under crowded, well-developed, sometimes historic neighborhoods, necessitating careful planning for repairs and replacement.

The U.S. Environmental Protection Agency recently began collecting information for its second Drinking Water Infrastructure Needs Survey, as required by the Safe Drinking Water Act. During the first survey, the single largest category of infrastructure need was for the installation and rehabilitation of transmission and distribution systems. The survey found that municipalities expected to spend some $77.2 billion over the next 20 years to satisfy that need.

In a similar survey conducted on the wastewater side of the industry, the Clean Water Needs Survey found that over the next 20 years cities need to spend $10 billion on upgrading existing wastewater collection systems, nearly $22 billion for new sewer construction and $45 billion for controlling combined sewer overflows. Another $7 billion is needed to control municipal stormwater.

Small communities have a large need in proportion to their size, according to the survey. New collector sewers account for only 6 percent of the total Clean Water Needs for larger communities, but represent 29 percent for small communities. This reflects, in part, the continuing effort to extend wastewater collection and treatment to the smaller communities.

According to EPAs surveys, corrosion is one of the major culprits in pipe failure, causing some materials to fail in as little as 10 years. An EPA survey of 89 cities showed that 32 of them had reported sewer collapses, most from hydrogen sulfide corrosion.

Site visits from the EPA revealed that corrosion problems are not limited to warm climates. Severe corrosion was observed in Seattle, Wash.; Milwaukee, Wis.; Boise, Idaho; Casper, Wyo.; Albuquerque, N.M.; Baton Rouge, La.; Fort Worth, Texas; Los Angeles County, Calif.; and Tampa, Fla.

Pipe Characteristics

The average life span of pipe depends on a wide variety of factors including the type of pipe, soil and air characteristics and installation. Network designers often use 50 years as the average life expectancy for most pipe types. That estimate may be too conservative, depending on the materials and techniques used.

Pipe Characteristics

Corrosion caused by hydrogen sulfide gas or other sources of acid is the most frequent cause for pipe deterioration. Production of H2S can be hastened by low velocities in a sewer line, longer detention times, and higher temperatures within the pipe. Other factors involved in corrosion include stray electrical currents in the surrounding soil, the presence of toxic materials (metals can reduce bacterial activity), acidity of the sewage, and turbulence.

Pipe Characteristics

Soil movement, improper installation, construction activities and water hammer also can lead to pipe failure. Organic growths and inorganic chemical deposits also can affect performance of piping systems.

Pipe Characteristics

The following is a discussion of pipe technologies on the market today and some of the challenges they face:

Concrete Pipe

Precast, gravity-flow concrete pipe is manufactured in a number of different forms: precast round concrete pipe, elliptical pipe, arch pipe (has arch on top), and precast concrete box culverts (square or rectangular configurations). Pressure pipe is a smaller classification of concrete pipe, often used for drinking water. The majority of concrete pipe is reinforced with steel mesh or cages.

Concrete Pipe

Concrete pipe lasts between 50 and 75 years, said Mike Saubert, Director of Marketing for the American Concrete Pipe Association. In many cases, concrete pipe can last longer than 100 years. It is considered a rigid structure, which means it can serve as a conveyance device and a structure.

Concrete Pipe

"Concrete pipe does not rely upon the soil to impart any type of strength and durability to it," Saubert said.

Concrete Pipe

Concrete pipe can be designed to specific installations, soil requirements, pressures, joint requirements, etc. It is considered to be cost-effective when the overall cost of the project is taken into consideration, because of requirements for proper installation of other pipe materials.

Concrete Pipe

In 1997 the Concrete Pressure Pipe Association conducted a survey of 25 states and provinces in the U.S. and Canada to estimate average costs per mile of pipe over a five-year period, including capital and maintenance costs.

Concrete Pipe

The survey found that Prestressed Concrete Cylinder Pipe, AWWA C301, had the lowest average O&M cost per mile ($117.80); followed closely by Concrete Pressure Pipe overall ($158.60); Bar-Wrapped Concrete Cylinder Pipe, AWWA C303 ($162.60) and Reinforced Concrete Cylinder Pipe, AWWA C300 ($167.00). Ductile iron was the next closest, with an average cost of $326. Cast iron and steel posted the highest average costs, each above $602.00 per mile.

Concrete Pipe

One of the biggest problems with concrete pipe is that it is vulnerable to H2S attack, Saubert said. In an extremely acidic environment, it can fail in as little as 15 years. However, steps can be taken in the preparation of concrete to minimize H2S formation.

Concrete Pipe

The U.S. Army Corps of Engineers regulations, based on a least cost analysis of various pipe materials, list the life expectancy of concrete pipe at 75 to 100 years.

Ductile Iron Pipe and Steel Pipe

A recent study determined that 531 utilities in the United States and Canada have cast-iron pipe that has been in service more than 100 years. Thirteen of those utilities have cast iron pipe still serving after 150 years, according to Larry Dunn of U.S. Pipe & Foundry Co.

Ductile Iron Pipe and Steel Pipe

When the 42-in. cast iron pipe broke in Boston (mentioned earlier in this article), an analysis determined there was nothing actually wrong with the pipe, said John Sullivan, Bostons water and sewer chief engineer.

Ductile Iron Pipe and Steel Pipe

"The cause is of an unknown nature, but were confident an external force was involved because of all the construction in that area." Sullivan said. "We have now rehabbed that 42-inch pipe, and we expect another 50 to 100 years out of it."

Ductile Iron Pipe and Steel Pipe

A report on water main breaks in the city of Boston from 1987 to 1997 showed their most common type of pipe, pit cast iron, lasted an average of 83 years before breaking. Even when construction-related breaks were disregarded, that average was still the same.

Ductile Iron Pipe and Steel Pipe

"Ductile iron is generally stable in most environments," said Grant Whittle, Vice President of Ultraliner, which installs pipe lining systems.

Ductile Iron Pipe and Steel Pipe

A report from U.S. Army Corps of Engineers "Conduits, Culverts and Pipe," states that ductile iron pipe can be used under levees and for water mains and other installations where fluids are carried under pressure. It is also suitable for pressure sewers and for gravity sewers where watertightness is essential. It can resist relatively high internal and external pressures and corrosion in most soils.

Ductile Iron Pipe and Steel Pipe

However, it is subject to corrosion caused by acids, highly septic sewage, and acid soils. Iron pipes also suffer from scaling, which causes cleaning problems.

Clay Pipe

If clay pipe is installed well and the soil is stable it seems to last 100 years or more. With its corrosion-proof properties, it was the material of choice in the 1950s for sanitary sewers.

Clay Pipe

When it is not installed properly, there can be stress concentrations on the pipe. Poorly installed clay pipe will fail within a few years of installation. Fifty years ago, when workers were putting in a lot of clay pipe, proper bedding wasn't widely understood and much of the clay pipe in the nation has been cracked since shortly after it was installed. The rigid nature of clay makes it very brittle, increasing the need for proper bedding.

Clay Pipe

Further complicating the assessment of the lifespan of clay pipe is the natural shifting of the soil. This is illustrated by an attempt to put in a new dig-in-place line going through a graveyard.

Clay Pipe

"Supposedly, everything was mapped out, and there were no caskets going through the area, but they started digging through and every time they'd go 10 or 20 feet, they'd have to call a Catholic priest out, because they would run into another grave that had shifted with the soil," Whittle said.

Clay Pipe

As soil drifts, it puts stresses on the pipe wall, and brittle pipes tend to crack and split under those stresses. Once a sewer pipe starts leaking, the surrounding soil enters the pipe with any inflow, creating voids and uneven loads on the pipe. This can cause collapse.

Clay Pipe

When contractors installed laterals in clay pipe decades ago they sometimes used a method called "hammer taps". This involved breaking a hole in the host pipe, pushing the lateral into the hole and filling the gaps with jute or some other sealing material. This not only caused cracks in the main, but the sealing material eventually washes away, allowing groundwater to enter the pipe.

Clay Pipe

Another outdated method that caused some structural problems was restraining a lateral with boards, bricks or rocks to hold them in place while backfilling.

Clay Pipe

"These supports form rigid inclusions that don't move as easily as the soft soil around it. As the pipe differentially settles, and the lateral doesn't want to settle because of the rigid inclusion below it, it creates a shear fracture at the connection between the lateral and the main," Whittle said.

Plastic Pipe

Plastic pipe consists of bell gasketed preformed pipe and pipeliners such as thermoplastics and thermoset processes. Plastic pipes possess the general attributes normally associated with plastics. Thermoplastics like polyvinyl chloride (PVC) and high density polyethylene (HDPE) can serve as stand-alone pipe and are often used as pull-to-form pipeliners.

Plastic Pipe

While they have a long lifetime, plastic pipe can experience molecular flow away from applied loads or stresses, leading to collapse. Rigid inclusions such as rocks can cause too much stress, and if the pipe is the jointed type, joints can still come apart if they weren't installed correctly.

Plastic Pipe

How long PVC pipe can last is a controversial issue. Some estimates put the life span of thermoplastic pipe at up to 500 years, while the standard design life is 50 years.

Plastic Pipe

Louisiana Tech University's Trenchless Technology Center has conducted studies on the life expectancy of thermoplastic and thermoset pipe lining systems. The centers tests were based on 10,000 hours of use (about 1 1/3 years). Called the Construction Productivity Advancement program, the liner samples were put under different pressures designed to give a series of failures within the 10,000 hours.

Plastic Pipe

"By drawing a line through those tests," said Dr. Ray Sterling, "the researchers could project the pressure that the pipes could withstand over a longer time. Results were too variable to project very far, though. I think the general results of the research were certainly that properly designed liner can be expected to last the 50-year design life, which is the normal design lifetime that's looked at in the industry."

Plastic Pipe

The standard testing method may not be the best for use with thermoplastic pipe, Whittle said, because it does not reflect properly supported PVC pipe. A typical soil situation will properly support thermoplastic pipe.

Plastic Pipe

"With the thermosets, you have a gradual degradation of the thermosetting material that causes a gradual falloff," Whittle said. "This shows that it will degrade and you will have a limited life span. The thermoplastic has indefinite design life because you can't cause it to degrade and you can't cause it to lose structural integrity over time when it's supported."

Plastic Pipe

With pipe lining systems some creep caused by stress concentrations during installation are inevitable, Whittle said.

Plastic Pipe

"You've got to design around the imperfections caused by that, but in most cases you can stabilize it," he said.

Conclusion

The American Society of Civil Engineers (ASCE) and Black & Veatch have begun gathering specific data from municipalities to learn how long certain types of pipe last in different areas of the United States. The objective of this project, entitled "Optimization of Collection System Maintenance Frequencies and System Performance," is to find the best approach for maintenance of collection systems. This effort will result in a decision-making model which can be used by cities and agencies in evaluating the cost of maintenance (as measured by maintenance frequency) and system performance. The project, funded by EPAs Office of Water under its 104b3 Cooperative Agreement Program, is in the final stages. The report will be available through ASCE shortly, possibly by the end of April.

Conclusion

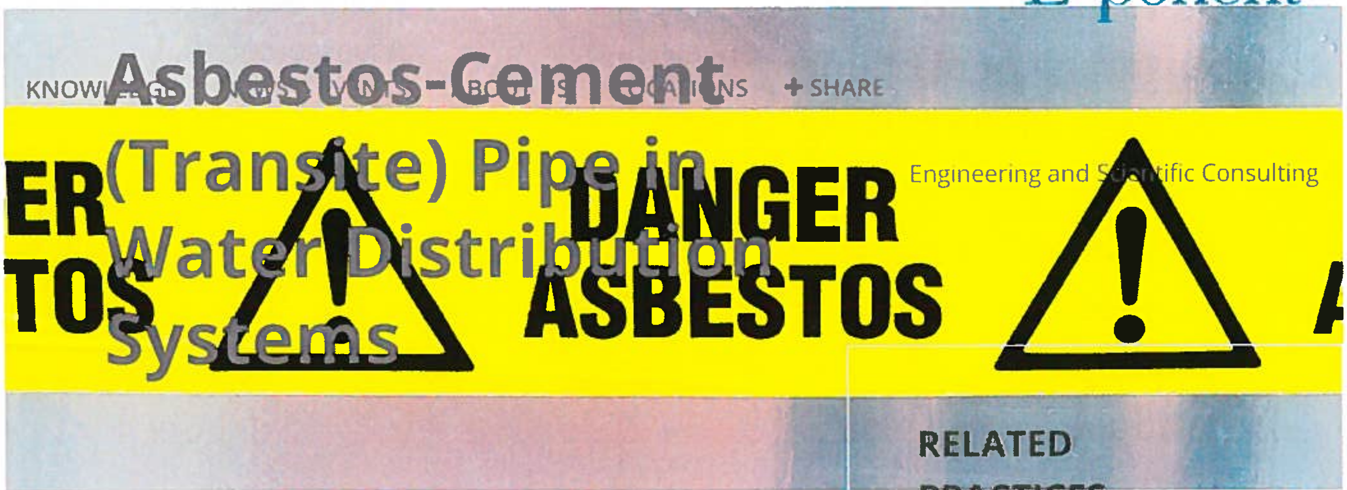
Another project, "Collection Systems: Methods for Evaluating and Improving Performance," by Ken Kerri of California State University and Rick Arbour, is already available. It can be ordered at http://www.owp.csus.edu/CollectionSys.html. The report contains detailed system and operations data from 13 high-performing collection system agencies relating to sewer maintenance, pump station and force main maintenance, emergency response, planning, control of infiltration/inflow and sanitary sewer overflows, safety, and regulatory compliance.

Conclusion

The U.S. water and wastewater infrastructure is on the brink of a restructuring process that will last for decades. EPA and other agencies already are working on the task of evaluating and recommending new procedures for water and sewer pipe design, maintenance and rehabilitation.

Conclusion

With careful planning and investment on the part of communities that will benefit from sound distribution and collection systems, the year 2020 will find the United States with a well-maintained and cost-effective pipe infrastructure.



Asbestos-Cement (Transite) Pipe in Water Distribution Systems

Asbestos-cement (AC) pipe was used extensively in the mid-1900s in potable water distribution systems, particularly in the western United States. The Chrysotile Institute estimates AC pipe lifespan at 70 years, but actual service life depends largely on pipe condition and working environment. Because thousands of miles of AC pipe installed in

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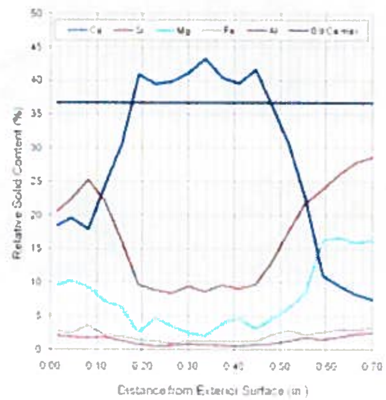
distribution systems in the U.S. is nearing the end of its useful service life, AC pipe condition assessment and strategic replacement planning will need to be done in the coming decade.



Over time, AC pipe undergoes gradual degradation in the form of corrosion (i.e., internal calcium leaching due to conveyed water and/or external leaching due to groundwater). Such leaching leads to reduction in effective cross-section, which results in pipe softening and loss of mechanical strength. Accordingly, as the water distribution system ages, the number of AC pipe failures increases with time. In light of these risks, an AC pipe condition assessment is essential to determine the remaining useful service life and develop a suitable, proactive replacement plan for the distribution system.

Exponent engineers and scientists assist water agencies in development of strategic and cost-effective AC pipe replacement plans, customized to the individual challenges of the distribution system.

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Long Term Performance of Asbestos Cement Pipe [Project #4093]

ORDER NUMBER: 4093

DATE AVAILABLE: January 2013

PRINCIPAL INVESTIGATORS:
Yafei Hu, Dunling Wang, and Rudaba Chowdhury

OBJECTIVE:
The overall objective of this research study was to explore the current conditions and state of the art in management of asbestos cement (AC) water main assets and develop a practical, comprehensive guidance manual to be used by the owners of these assets. Issues to be addressed included pipe deterioration and failure, condition assessment, remaining service life prediction, rehabilitation and replacement, and health and waste management protocols.

BACKGROUND:
AC pipe has been installed in water systems in North America starting in the 1930s and up until the early 1980s, mainly as an affordable, non-corroding alternative to metallic pipes in areas prone to corrosion. Health concerns associated with the mining, installation, removal, and disposal of asbestos products ended the selection and installation of new AC pipe, although there was no evidence of water-born fiber related illnesses. Estimates of the current level of AC pipe inventory still in operation (as of the mid-1990s) in North America were as high as 12 to 15% of all potable water mains.

AC pipes can deteriorate as a result of a variety of factors, including working environment and operational conditions, and eventually, when stresses exceed their strength, they fail. There is a substantial variability in the deterioration rate of AC pipes, and therefore also in their condition. Since total replacement is economically infeasible for many utilities, there is a great need to develop effective renewal strategies.

There has been some work done on this subject in Europe and Australia. However, the applicability of the work to AC pipes in North American water utilities has not been addressed. Furthermore, relatively little information and literature exists on life expectancy and management of North American AC pipes. This study is intended to close this gap.

APPROACH:

Comprehensive literature review and survey. A comprehensive literature review was conducted to summarize the current knowledge on deterioration mechanisms and factors affecting failure of AC pipes, condition assessment techniques, methods to estimate remaining service life, and management practices for AC water mains. This information was used as a basis for a survey of 20 utilities in the United States and Canada on their AC pipe inventory, breakage rates, working environments, and management practices.

The survey data were analyzed to correlate breakage rates with pipe characteristics (e.g., pipe size) and working environments (e.g., water quality, water temperature, burial depth, backfill soil types, and soil pore water pH and sulfate content) and to identify factors that affect the deterioration and eventual failure of AC pipes in North America.

Condition assessment, modeling, and remaining service life estimation. AC pipes samples were obtained from 10 participating utilities for inspection and condition assessment of sub-samples (specimens). The condition of AC pipe specimens was assessed by measuring the degradation depth (thickness) of the inner and outer pipe walls and testing residual pipe strength. Assessment techniques, including chemical (phenolphthalein staining tests) and mechanical (Shore D hardness, crush, and pressure) tests, were conducted on AC specimens and evaluated for their capability to measure degradation and assess the residual load-bearing capacity. In addition, scanning electron microscopic analyses were carried out on selected pipe specimens to further understand the nature and extent of deterioration through examination of changes in weight percentage of elements and microstructure.

Pipe degradation depths were correlated with pipe residual strengths, microstructure characteristics, pipe age, water quality, and soil properties to understand possible relationships and develop degradation rate models. These degradation rate models, together with knowledge about the current pipe condition, allow estimation of pipe residual strength over time. Acting loads applicable to AC water mains were identified from relevant standards (e.g., AWWA C401) and from the comprehensive survey. Time to failure can be estimated as the time at which acting loads exceed residual pipe strength.

Rehabilitation and replacement (R&R) methods and related health and waste management. The selection of methods for AC pipe R&R needs to consider the potential risk of exposure to asbestos fibers for workers and the general public, and to follow relevant regulations, such as the Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) and the Occupational Safety and Health Administration (OSHA) regulations. A set of R&R methods was evaluated for their risk to release asbestos fibers by referring to the asbestos NESHAP and OSHA requirements. From this review, suitable methods were identified for R&R of AC pipes.

Although the recommended R&R methods have the least risk to the workers and the public, some asbestos fibers may still be released. Appropriate measures are also required for the handling and disposal of AC pipe fragments. Current utility and contractor practices were studied, and recommendations for health and waste management practices during R&R activities were developed.

RESULTS/CONCLUSIONS:

AC condition in North America. Water quality, pipe diameter, and pipe age are identified as factors (with the highest coefficients of determination) that contribute to AC pipe failures. Internal degradation is more severe for conveyed water with low aggressiveness index, soft water, or water with low alkalinity. Soil movement contributes to failures of small diameter pipes in mid-western and western North America communities with expansive clay soil. Pipe age is a surrogate of many contributing factors, e.g., soils.

Breakage rates of AC pipes in the United States and Canada seem to be substantially lower than breakage rates observed in cast and ductile iron pipes (cast iron and ductile iron pipes account for over 60% of water mains in North America). All but one of the tested pipes are still adequate to bear the external loads and internal pressures that they experience. However, pipe breakage rates varied from utility to utility. For a given utility, they varied yearly, indicating likely differences in pipe properties, working environments, and other conditions.

Condition assessment, modeling, and remaining service life estimation. A set of assessment protocols was recommended based on the need for utilities to understand the condition of AC pipes at the utility (or system) level and at the pipe section level. The recommendations included analysis of historical break data, conveyed water quality, and soil pore water quality for a utility, and phenolphthalein staining and strength tests for pipe sections. The residual pipe strengths are clearly related to the depth of degradation obtained from the phenolphthalein staining tests and element analyses, and therefore can be estimated by testing the degradation depths.

A degradation depth model was developed, which is dependent on pipe age, water quality, and soil pore water pH. However, relatively low coefficients of determination in the various regression analyses warrant caution in the application of the results. The uncertainties are likely a result of the rather limited data set upon which they are based, as well as the fact that much of the collected information represented a snapshot in time (e.g., the current conveyed water quality data) rather than an extended history. It is therefore recognized that the proposed models represent only a first step towards accurate estimation of the deterioration depths and rates for AC pipes, and towards having the ability to predict long-term pipe condition.

The expected remaining service life predictions made using data collected on AC pipes from several utilities vary significantly from utility to utility and even within utilities, depending on the water quality and soil environments. AC pipes in some regions were subjected to aggressive water quality and soil environments and their expected remaining lives ranged from imminent failure to 50 years. In regions with less aggressive water quality and dry soil conditions, AC pipes might be expected to serve for another 100 to 150 years. However, active soil movement can cause premature failure of an AC pipe, substantially reducing its expected remaining service life.

Rehabilitation and replacement methods and related health and waste management. Repair methods using trenching and trenchless methods like pipe lining, sliplining, cured-in-place lining, and similar methods are the best R&R methods, because asbestos fiber release can be controlled. Pipe bursting, pipe reaming, and pipe eating methods break the pipes into pieces and leave some or all of the AC fragments in the ground, potentially creating a hazardous-waste site. These methods are severely restricted by NESHAP. They can only be used when the affected length is less than 80 m (260 linear feet). Local authorities may impose even stricter limits on the maximum length for using these R&R methods.

Recommendations are proposed to enable project managers to minimize the risk of exposure of workers and the public to asbestos fibers. They cover good practices on AC pipe projects: for staff training, site security; personal protection, excavation of AC pipes, on-site abandonment, removal from site and transportation of materials to specifically designed sites for appropriate disposal, and monitoring of the disposal sites.

APPLICATIONS/RECOMMENDATIONS:

Research report and guidance manual. A two-tier document was developed to communicate and apply the results of this research. The first tier is a succinct yet comprehensive guidance manual, intended to provide structured assistance to users. In addition to providing instructions on the various issues, the guidance manual will also provide pointers to corresponding issues in this technical report (second tier), for users who are interested in more in-depth technical background.

Recommendations for further study. One of the key components for estimating the remaining service life of AC water mains is degradation rate models. The model developed in this study is based on a small number of samples. It is recommended that a larger number of samples be tested to validate and refine the models, especially including samples from a wider range (and more detailed history) of water quality and soil conditions, and with regard to covering geographic areas not represented by the data from the participating utilities (e.g., utilities from the eastern United States).

It is also recommended that non-destructive methods, such as acoustic and surface penetration radar techniques, be investigated for their ability to assess the condition of AC pipes. Such non-destructive and non-intrusive technologies will be instrumental in enhancing the amount and quality of pipe condition surveys conducted by utilities, leading to more effective asset management.

There is evidence to suggest that microbiological activity and biofilm development in drinking water distribution systems can attack AC pipes. Some bacterial groups are capable of producing short chain organic acids, lowering local (cement matrix) pH values and facilitating transformation and dissolution of the alkaline components of the hydrated cement matrix. The factors that contribute to biofilm development, and to pipe attack, still need to be more fully understood and applied.

Administration

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Posted on: March 10, 2009 0 Like 0 0 0

Pipeline Construction & Maintenance

End of the Line

Replace asbestos-cement pipe without turning the jobsite into a hazardous-waste site.

By Kent Von Aspern, PE

End of the Line

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For nearly a century, asbestos-containing products have been an important part of American society as thousands of products — from roofing materials and insulation to tape wraps and pipe — were chosen for their strength, low unit weight, and resistance to heat and corrosion.

Hundreds of thousands of miles of the pipe remain in service. Since much of it's nearing the end of its design life, it's the proverbial elephant in the room that must be dealt with but seems easier to ignore.

Originally marketed as a strong, lightweight, non-corrosive alternative to cast iron and steel, asbestos-cement pipe offered superior flow properties due to its smooth interior walls, exceptional corrosion resistance from the asbestos fibers matrix, and simplified construction due to the low unit weight. By the mid-1940s, four major companies were manufacturing the pipe at more than a dozen U.S. plants.

From the 1940s through the late 1970s, the pipe became the predominant choice for water transmission and distribution systems, storm drains, and sanitary sewer force mains. Vitrified clay remained the more popular choice for gravity sewers, and reinforced concrete was typically used for sewer interceptors.

The pipe's performance, however, has varied. Failure rates are higher than other materials when surrounding soils are acidic or high in sulphates, magnesium salts, or alkaline hydroxides. Performance also suffers when the water supply contains ammonia or is classified as "soft water." In clay soils, the failure rate increases during the summer when the groundwater level reaches the pipe. Absent other factors, rates increase linearly with age.

In 1973 the National Emissions Standards for Hazardous Air Pollutants (NESHAP) was created by the EPA under the Clean Air Act in response to studies that found that asbestos was a leading contributor to asbestosis and certain forms of cancer. Through NESHAP, the EPA sought to protect the public by controlling exposure to asbestos found in more than 3,000 products.

Regulating so many diverse products proved to be daunting, so in 1979 the EPA announced its intent to ban all materials containing asbestos. A decade later, the Asbestos Ban and Phaseout Rule proposed eliminating all asbestos-containing materials in three stages between 1990 and 1997.

When a large manufacturer sued to block the ban, the 5th U.S. Circuit Court of Appeals ruled that EPA had failed to present a compelling case. It did, however, reinforce the agency's responsibility to regulate the material, and asbestos was banned from new products.

After 1973, asbestos fiber content in pipe was reduced from 15% to 20% down to less than 0.2%. By the 1980s its popularity had waned dramatically due to fears of liability and market conditions, especially the availability of PVC pipe. Manufacturers stopped producing the pipe in the United States, but it is still produced in other countries.

MASSIVE UNDERTAKING

In 2002, an American Water Works Association survey of 337 large utilities serving nearly 60 million customers found that 15.2% — more than 30,000 miles — of distribution systems were composed of asbestos-cement pipe. An informal survey using public information sources on the Internet reveals that much of it is installed in the West (see table).

Substantial portions have been in use for 40 to 60 years — its typical life expectancy. With an estimated 630,000 miles of the pipe in the United States and Canada, a tremendous amount will need attention in the near future.

But replacement won't be easy.

The key to regulation centers is on the word "friable," which the EPA defines as any material containing more than 1% asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. According to the agency, activities such as cutting, grinding, or crushing render the pipe friable.

Disposal is limited to 260 linear feet, or 35 cubic feet, of broken pipe. These days pipe removed during short spot repairs to correct breaks is commonly — and legally — crushed and mixed with backfill material. Pipe that's crushed and left in place and is more than 260 linear feet long, or has a total volume of 35 cubic feet, is considered a regulated asbestos-containing material — essentially making it hazardous waste.

Cutting, grinding, or crushing the pipe must be performed while water is sprayed directly on the work area to control dust. Broken pieces must be wrapped in water-tight bags and handled and disposed of as hazardous waste.

Unbroken segments aren't classified as friable material and may be disposed of at Class II facilities. Workers must receive special training, but special licenses aren't required.

Regulations control cutting into the pipe to make spot repairs or to install new connections, as well as to remove, dispose of, and rehabilitate pipes using bursting and reaming trenchless construction technologies.

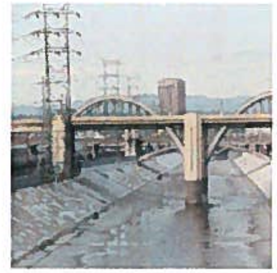
COST CONSIDERATIONS

The Water Research Foundation has commissioned a study of 17 public agencies throughout North America to determine the long-term performance of asbestos-cement pipe and when it should be replaced. The study is expected to be completed by March 2011.

Meanwhile, if your system contains asbestos-cement pipe, start thinking about how to fund replacement.

Unfortunately, two of the best alternatives — and the only ones that provide increased capacity — are severely restricted by NESHAP. In most cases the EPA has ruled that bursting and reaming render the pipe friable, so using those methods to replace more than 260 linear feet of pipe creates an active hazardous waste site.

In many areas, the agency has delegated enforcement of asbestos programs to local air quality control boards that have more stringent policies. San Francisco's Bay Area Air Quality Management District, for example, limits replacement length to 100 linear feet.



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With pipe bursting, broken pipe fragments are pushed into the surrounding soils, and a new, often larger, pipe is pulled into the opening. Bentonite is usually added to reduce friction on the pipe and help hold the tunnel open. Excavations are typically required at pulling and receiving pits and for reconnecting each service.

Reaming uses specially adapted horizontal directional drilling equipment. Although similar to pipe bursting, the host pipe is ground into small particles, many of which are removed with the surrounding soil to create space for the new pipe.

Sliplining, cured-in-place lining, fold-and-form lining, and similar techniques can be used, but beware: Lining is appropriate only when the hydraulic capacity of the existing pipeline can be reduced to accommodate the resulting smaller cross-sectional diameter. The smooth pipe interior presents challenges for methods — such as fold-and-form lining and sliplining without grouting the annular space — that don't involve mechanical bonding to the host pipe.

Every project is different. But generally, lining is more cost-effective than bursting and reaming; and both rehabilitation methods are less expensive than open-cut construction, assuming the replacement of an existing utility pipe in urban environments requiring traffic control and bypassing, at depths of 5 feet or more, and with a moderate number of service reconnections.

In addition, unlike bursting and reaming, lining doesn't render the material friable, leaving both public works directors and the public at ease.

— Kent Von Aspern is the business class leader for pipelines and pump stations in Northern California for HDR Inc.

Source: Compiled by Kent Von Aspern

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Kent Von Aspern, PE

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Asbestos-Cement Pipe Condition Assessment and Proactive Replacement Planning

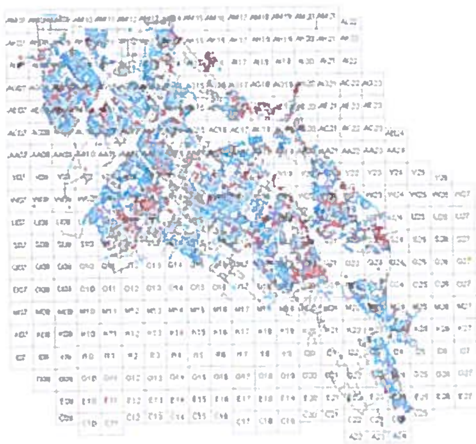
Background

Increasing pipe failure rate observed in a water distribution system prompted an investigation of pipe condition. Exponent worked with the Alameda County (CA) Water District to assess remaining life of some of their existing asbestos-cement water pipes. Gradual degradation of the pipe due to calcium leaching was identified and a service-life prediction model was developed to assist in creating an optimum pipe replacement schedule.

Our Work

Research was undertaken to investigate the stability of the asbestos-cement (AC) pipe infrastructure of the Alameda County Water District (ACWD) located in California's San Francisco Bay area. The study included the evaluation of current condition and prediction of remaining service life of the AC distribution pipe. Laboratory assessment of 47 pipe samples removed from the distribution system revealed that, while pipe strengths were in general satisfactory, progressing deterioration of AC pipe due to leaching of calcium from the cement matrix was identified. Extrapolation of the observed trends suggested that the age at which pipe strength would fall below the design strength is on average 70 to 80 years.

Analysis of leak records between 1987 and 2006 revealed that pipe age and nominal size are the most critical factors affecting leak rate, with an increasing rate of leaks observed for older pipes and a decreasing rate of leaks observed for larger diameter pipes. An observed non-uniform spatial distribution of leaks in the system suggested contribution from additional factors, such as climate, soil type, groundwater conditions, conveyed water chemistry and operating pressure. While these factors were also included in the analysis, insufficient data precluded incorporating them in a prediction model. A general, semi-empirical model for predicting future leak rates and cumulative number of leaks over time was developed based on pipe age and nominal pipe diameter.



To overcome the lack of well-defined correlations with factors that ultimately lead to non-uniform spatial distribution of leaks, the entire distribution system was divided into equal-sized areas (grid cells). A method was developed to correct the cumulative number of leaks within each grid cell to account for 40 years of unrecorded leak data. The general prediction model was individually calibrated for each cell to reflect the unique leak rate history observed for the specific cell, thus increasing the reliability of prediction of future number of leaks. The estimated remaining service life of the AC pipe in each cell was determined by comparison of predicted cumulative leaks to a threshold number of leaks. A sensitivity analysis of the remaining service life to the selected threshold number of leaks suggested that an acceptable threshold value is within the range from 6 to 10 leaks per mile over the life of the pipe. The developed methodology will be incorporated in strategic planning of future AC pipe replacement.

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Knowledge is power, but sharing knowlege brings peace!!

The history and problems of cast iron sewers pipes.

Posted on November 7, 2011 by Emmanuel

If your home is equipped with cast iron sewage pipes you will no doubt have comments in your inspection report regarding its presence and possibly issues. So what are these issues and why the comments about them?

[tab: A Brief History]

Cast iron pipes have been manufactured and used in the United States since the early 1800's. The first usage was for water distribution but eventually also expanded to waste water disposal (soil pipes also called sewage pipes). By the 1890's an actual cast iron soil pipe industry took shape and was recognized. Cast iron waste water piping was not the only product used over the years but it did provide a highly reliable and durable pipe that lasted much longer periods than other materials.

It wasn't until the late 1960's/early 1970's that plastic PVC sewer pipe was introduced. Once introduced the PVC pipe quickly became the choice for sewage pipe on new home construction. PVC provided much easier installations, cheaper materials, and easier production. Cast iron waste water piping was still being installed during the early PVC years and can be found in early 1970's homes. Cast iron waste piping is still used in many commercial, industrial and municipal applications, and even in some residential structures.

This is an example of older cast iron pipe in good shape

A good quality cast iron pipe, installed under ideal conditions, has a life expectancy of 75 – 100 years, and possibly even more. Cast iron does rust but when it does the rust actually forms a barrier layer over the remainder of the pipe which helps protect it from further rusting. Since most cast iron pipes were thick walled to begin with even with some rusting inside they can handle the lower pressures of waste water disposal quite well and last a long time. Cast iron also provides many other benefits in home waste systems that still makes it a good choice for homes. However it is more expensive to purchase and install. Also many plumbers of residential structures do not have the experience it takes to properly install and maintain it. As a result PVC has taken over for the majority of home installations today.

[tab: The Issues]

For all of its good points cast iron does have some problems related to it. One of the problems had to do with the varying quality of the pipe that was manufactured in earlier years. Standards for cast iron pipe have been around since the 1800's but like anything else they are voluntary standards. It goes without saying when you have many companies competing for business there will always be one or more that choose to make an inferior product just to beat their competitions' cost. Unfortunately the quality of manufacturing issue happened more times than desired which has led to less than acceptable or defective pipe brands.


An example of older cast iron in bad shape

In this example picture this might have been a low quality cast iron pipe. This pipe was only in the 40 year age range but already deteriorating badly. The two darker rust spots were actually where the pipe was almost rusted through and waste water was seeping out. It is unknown how much longer this pipe would last before completely rusting open and dumping waste on the ground. The gnawing question on this pipe is that if it has rusted this badly above ground then what is its condition beneath the ground?

Cast iron pipes have always been more labor intensive to install and maintain. They also require older methods that although they are taught in trade schools these methods are specific to cast iron. For plumbers that do not install much, if any, cast iron they just do not have the experience needed to properly perform the installation. When these inexperienced plumbers do attempt to handle/install the cast iron they add to the problems of cast iron pipes.

Cast iron pipe is highly resistant to the elements under proper conditions meaning they will not rust much or shift and break. The majority of our original soils are naturally non acidic in nature or pose the conditions needed to accelerate damage to cast iron. Unfortunately we have managed to change our soil's contents over time through dumping, heavy use of chemicals around the home (inside and out), as well as other actions. Then there are all of the chemicals we dump down our sinks and drains that work to deteriorate the cast iron from inside the pipe itself.

There are other causes of damage to cast iron that can reduce its life span. For example our significantly shifting soils causing joint breaks and other damage, when foundations experience movement it to can shift and break these pipes, tree root damage, digging and other manual actions, etc. All of this adds to accelerating the deterioration of even a high quality cast iron pipe. When you start adding together the defects and other damaging factors of cast iron pipe you can see that even a high quality cast iron can potentially not survive its expected lifespan.

[tab: The Inspection Report]

In your inspection report you will no doubt read disclaimers regarding the condition of cast iron pipes. Obviously when cast iron waste pipes are installed they are buried under the ground, in foundations, etc., mostly in concealed locations. There is no way during a normal home inspection for an Inspector to tell you what the condition of these pipes are in these concealed locations. The only way to obtain an idea of these pipes' condition is using sewer scopes to actually look inside and down the length of these pipes. However even a plumber can only view the interior of the pipe and can not see the exterior conditions without excavating them.

Cast iron pipes are not a problem piping system, and can be an exceptional system to have in your home. But if the signs of issues are there it is well worth taking the next step of performing sewer scoping. Listen to the recommendations of your Inspector and if you are uncomfortable then have sewer scoping performed anyhow. This is a large purchase and you will be living in your home for quite some time so isn't it worth being sure?

[tab: Links and References]

History of the sanitary sewage system

History of cast iron soil pipes

[Ductile Iron Pipe Research Association](#)

[Cast Iron Soil Pipe Institute](#)

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Questions

Question: Longevity We are working on a remodel of a 40 year old building and have been asked to make a recommendation on the condition of the cast iron soil pipe and fittings. What is the life expectancy of cast iron soil pipe and fittings?

Answers

Question: Longevity We are working on a remodel of a 40 year old building and have been asked to make a recommendation on the condition of the cast iron soil pipe and fittings. What is the life expectancy of cast iron soil pipe and fittings?
Answer:
The oldest installations of cast iron pipe are in underground lines, both water and gas. Many are over 100 years old, and some date back 200 - 400 years and are still in use. Many older buildings with cast iron installed inside are approaching the 100 year mark. We would suggest a good physical examination of any exposed piping and removal of a section to examine the interior for possible signs of corrosion. If the wall thickness of the pipe still falls within the specified dimensions, the pipe need not be replaced. It is important to note that the wall thickness on the older piping may not and need not be uniform. Centrifugal casting of pipe began roughly 35 years ago and results in a very uniform wall thickness. The pipe produced before centrifugal casting was statically cast - a process which produced pipe with some differences in wall thickness. This variable wall thickness should not be a concern as long as the thinnest wall thickness is equal to or greater than the specified minimum thickness. Contact the CISPI representative in your area to get advice on proper methods of measuring wall thickness and the minimum wall thickness required by the specific standard. For a thorough discussion of the corrosion resistance of cast iron soil pipe follow this link.

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What is the Life Expectancy of Cast Iron Sewer Pipe?

June 30, 2016 1 Comment Sewer & Drains By Don Paz

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Are you wondering what the life expectancy of cast iron sewer pipe is?

Cast iron sewer pipes are very common in homes built from 1900 to 1974. To this day, many commercial property are still constructed with cast iron pipes, although most manufactures of cast iron piping have turned to ductile iron pipe. Ductile iron pipe is stronger, more resilient, and more resistant to corrosion than its cast iron counterpart. As a result of what runs through cast iron sewer pipes, corrosive actions takes place within the pipe. When the pipe corrodes, scale, calcification, and rust forms inside of the pipe. This scale continues to accumulate slowly over time. When scale builds to a certain level, it will decrease the diameter of the pipe. Consequently, drain clogs and sewer backups occur more frequently.

When it comes to the life expectancy of cast iron sewer pipes, several factors can cause the life expectancy to vary. For example: Cast iron piping in a commercial location will most likely have more use than a single family home. The more use, the higher the chance of decreased life expectancy. A restaurant that it is open breakfast, lunch, and dinner will increase the chance of their cast iron drain pipes having shortened life spans, due to the high flow of water and amount of grease running through the pipes consistently.

Other factors that can shorten the life expectancy of cast iron sewer pipe:

–**Detergents**. Such as hand soaps and laundry detergent.

–**Chemical drain openers**. Especially sulfuric acid. These chemical drain openers may get the drain flowing, but they can also result in weakening your cast iron pipe.

–**Soil conditions**. Certain soils can be more acidic. Acidic soil can cause corrosive action to take place on the cast iron, therefore decreasing the lifespan of cast iron.

–**Grease**. Grease has long been a problem for cast iron drain pipes and is the primary reason for channeling. Channeling is when the bottom of the cast iron pipe has rotted away, resulting in a channel on the bottom of the pipe.

In most cases, cast iron sewer pipes should last 75-100 years in a residential application. In commercial applications, the lifespan of cast iron drain pipes is 30-50 years. Why the difference? Typically, commercial applications will have much higher usage. The increased use expeditiously shortens the life span of cast iron.

After being in the plumbing industry for many years and working with cast iron drain and sewer pipes, we have built extensive knowledge about cast iron piping. When you need assistance with your cast iron drain pipes, reach

lives up to their name! We could hear sound of water running in our house [illegible] was shut off and there were no visible water leaks. I called a plumber I had used to install a faucet previously and he diagnosed it as a slab leak. His suggested path was to start cutting holes in the drywall until he found the leaking pipe. He said he wasn't a fan of leak detection equipment as he found it a waste of money. He said that "based on his experience" he thought he could find it quickly, and he showed me which wall he intended to open first.

Something told me to get

a second opinion so I called Legendary Home Services and I [illegible] did. They were extremely professional on the phone and carefully explained every step of the process. Their answers were detailed, informative and left me with a feeling of confidence so I told them to put me on the schedule.

They arrived promptly on Monday morning and the two representatives were polite and thorough. They showed me their leak detection equipment and answered all my questions. They quickly found the leak, opened the wall and tested to ensure they

out to us, we will always have an answer. If you feel you need help determining if your cast iron drain pipes should be inspected, cleaned, or looked at, let us know, we are always here to help.

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Don Paz
Owner at Legendary Home Services, LLC

Don Paz is a licensed contractor with 15 years experience. His passion for helping people with their home service needs is reflected in his authorship endeavors with multiple industry publications. As the Director of Legendary Home Services, Don leads his team to always provide the best service imaginable, which takes care of the customer, keeps them and their home safe, and helps them to save money. Learn more or connect with Don at (@LegendaryServs or LinkedIn)

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cast iron life span sewer

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Module 3: Sewer Material

Lecture 3: Sewer Material

3.0 SEWER MATERIAL

3.1 Important Factors Considered for Selecting Material for Sewer

Following factors should be considered before selecting material for manufacturing sewer pipes:

a. Resistance to corrosion

Sewer carries wastewater that releases gases such as H_2S. This gas in contact with moisture can be converted in to sulfuric acid. The formation of acids can lead to the corrosion of sewer pipe. Hence, selection of corrosion resistance material is must for long life of pipe.

b. Resistance to abrasion

Sewage contain considerable amount of suspended solids, part of which are inorganic solids such as sand or grit. These particles moving at high velocity can cause wear and tear of sewer material. This abrasion can reduce thickness of pipe and reduces hydraulic efficiency of the sewer by making the interior surface rough.

c. Strength and durability

The sewer pipe should have sufficient strength to withstand all the forces that are likely to come on them. Sewers are subjected to considerable external loads of backfill material and traffic load, if any. They are not subjected to internal pressure of water. To withstand external load safely without failure, sufficient wall thickness of pipe or reinforcement is essential. In addition, the material selected should be durable and should have sufficient resistance against natural weathering action to provide longer life to the pipe.

d. Weight of the material

The material selected for sewer should have less specific weight, which will make pipe light in weight. The lightweight pipes are easy for handling and transport.

e. Imperviousness

To eliminate chances of sewage seepage from sewer to surrounding, the material selected for pipe should be impervious.

f. Economy and cost

Sewer should be less costly to make the sewerage scheme economical.

g. Hydraulically efficient

The sewer shall have smooth interior surface to have less frictional coefficient.

3.2 Materials for Sewers

3.2.1 Asbestos Cement Sewers

- These are manufactured from a mixture of asbestos fibers, silica and cement. Asbestos fibers are thoroughly mixed with cement to act as reinforcement.
- These pipes are available in size 10 to 100 cm internal diameter and length up to 4.0 m.
- These pipes can be easily assembled without skilled labour with the help of special coupling, called 'Ring Tie Coupling' or Simplex joint.
- The pipe and joints are resistant to corrosion and the joints are flexible to permit 12^{o} deflection for curved laying.
- These pipes are used for vertical transport of water. For example, transport of rainwater from roofs in multistoried buildings, for transport of sewage to grounds, and for transport of less foul sullage i.e., wastewater from kitchen and bathroom.

Advantages

- These pipes are light in weight and hence, easy to carry and transport.
- Easy to cut and assemble without skilled labour.
- Interior is smooth (Manning n = 0.011) hence, can make excellent hydraulically efficient sewer.

Disadvantages

- These pipes are structurally not very strong.
- These are susceptible to corrosion by sulphuric acid. When bacteria produces H_2S, in presence of water, H_2SO_4 can be formed.

3.2.2 Plain Cement Concrete or Reinforced Cement Concrete

Plain cement concrete (1: 1.5: 3) pipes are available up to 0.45 m diameter and reinforcement cement pipes are available up to 1.8 m diameter. These pipes can be cast in situ or precast pipes. Precast pipes are better in quality than the cast in situ pipes. The reinforcement in these pipes can be different such as single cage reinforced pipes, used for internal pressure less than 0.8 m; double cage reinforced pipes used for both internal and external pressure greater than 0.8 m; elliptical cage reinforced pipes used for larger diameter sewers subjected to external pressure; and hume pipes with steel shells coated with concrete from inside and outside. Nominal longitudinal reinforcement of 0.25% is provided in these pipes.

Advantages of concrete pipes

- Strong in tension as well as compression.
- Resistant to erosion and abrasion.
- They can be made of any desired strength.
- Easily moulded, and can be in situ or precast pipes.
- Economical for medium and large sizes.
- These pipes are available in wide range of size and the trench can be opened and backfilled rapidly during maintenance of sewers.

Disadvantages

- These pipes can get corroded and pitted by the action of H_2SO_4.
- The carrying capacity of the pipe reduces with time because of corrosion.
- The pipes are susceptible to erosion by sewage containing silt and grit.

The concrete sewers can be protected internally by vitrified clay linings. With protection lining they are used for almost all the branch and main sewers. Only high alumina cement concrete should be used when pipes are exposed to corrosive liquid like sewage.

3.2.3 Vitrified Clay or Stoneware Sewers

These pipes are used for house connections as well as lateral sewers. The size of the pipe available is 5 cm to 30 cm internal diameter with length 0.9 to 1.2 m. These pipes are rarely manufactured for diameter greater than 90 cm. These are jointed by bell and spigot flexible compression joints.

Advantages

- Resistant to corrosion, hence fit for carrying polluted water such as sewage.
- Interior surface is smooth and is hydraulically efficient.

- The pipes are highly impervious.
- Strong in compression.
- These pipes are durable and economical for small diameters.
- The pipe material does not absorb water more than 5% of their own weight, when immersed in water for 24 h.

Disadvantages

- Heavy, bulky and brittle and hence, difficult to transport.
- These pipes cannot be used as pressure pipes, because they are weak in tension.
- These require large number of joints as the individual pipe length is small.

3.2.4 Brick Sewers

This material is used for construction of large size combined sewer or particularly for storm water drains. The pipes are plastered from outside to avoid entry of tree roots and ground water through brick joints. These are lined from inside with stone ware or ceramic block to make them smooth and hydraulically efficient. Lining also make the pipe resistant to corrosion.

3.2.5 Cast Iron Sewers

These pipes are stronger and capable to withstand greater tensile, compressive, as well as bending stresses. However, these are costly. Cast iron pipes are used for outfall sewers, rising mains of pumping stations, and inverted siphons, where pipes are running under pressure. These are also suitable for sewers under heavy traffic load, such as sewers below railways and highways. They are used for carried over piers in case of low lying areas. They form 100% leak proof sewer line to avoid ground water contamination. They are less resistant to corrosion; hence, generally lined from inside with cement concrete, coal tar paint, epoxy, etc. These are joined together by bell and spigot joint. IS:1536-1989 and IS:1537-1976 provides the specifications for spun and vertically cast pipes, respectively.

3.2.6 Steel Pipes

These are used under the situations such as pressure main sewers, under water crossing, bridge crossing, necessary connections for pumping stations, laying pipes over self supporting spans, railway crossings, etc. They can withstand internal pressure, impact load and vibrations much better than CI pipes. They are more ductile and can withstand water hammer pressure better. These pipes cannot withstand high external load and these pipes may collapse when negative pressure is developed in pipes. They are susceptible to corrosion and are not generally used for partially flowing sewers. They are protected internally and externally against the action of corrosion.

3.2.7 Ductile Iron Pipes

Ductile iron pipes can also be used for conveying the sewers. They demonstrate higher capacity to withstand water hammer. The specifications for DI pipes is provided in IS:12288-1987. The predominant wall material is ductile iron, a spheroidized graphite cast iron. Internally these pipes are coated with cement mortar lining or any other polyethylene or poly wrap or plastic baggging/ sleeving lining to inhibit corrosion from the wastewater being conveyed, and various types of external coating are used to inhibit corrosion from the environment. Ductile iron has proven to be a better pipe material than cast iron but they are costly. Ductile iron is still believed to be stronger and more fracture resistant material; like most ferrous materials, it is susceptible to corrosion. A typical life expectancy of thicker walled pipe could be up to 75 years, however with the current thinner walled ductile pipe the life could be about 20 years in highly corrosive soils without a corrosion control program like cathodic protection.

3.2.8 Plastic sewers (PVC pipes)

Plastic is recent material used for sewer pipes. These are used for internal drainage works in house. These are available in sizes 75 to 315 mm external diameter and used in drainage works. They offer smooth internal surface. The additional advantages they offer are resistant to corrosion, light weight of pipe, economical in laying, jointing and maintenance, the pipe is tough and rigid, and ease in fabrication and transport of these pipes.

3.2.9 High Density Polythylene (HDPE) Pipes

Use of these pipes for sewers is recent development. They are not brittle like AC pipes and other pipes and hence hard fall during loading, unloading and handling do not cause any damage to the pipes. They can be joined by welding or can be jointed with detachable joints up to 630 mm diameter (IS:4984-1987). These are commonly used for conveyance of industrial wastewater. They offer all the advantages offered by PVC pipes.

3.2.10 Glass Fiber Reinforced Plastic Pipes

This martial is widely used where corrosion resistant pipes are required. GRP or FRP can be used as a lining material for conventional pipes to protect from internal or external corrosion. It is made from the composite matrix of glass fiber, polyester resin and fillers. These pipes have better strength, durability, high tensile strength, low density and high corrosion resistance. These are manufactured up to 2.4 m diameter and up to 18 m length (IS:12709-1989).

3.2.11 Lead Sewers

- They are smooth, soft and can take odd shapes.
- This pipe has an ability to resist sulphide corrosion.
- However, these pipes are very costly.
- These are used in house connection.

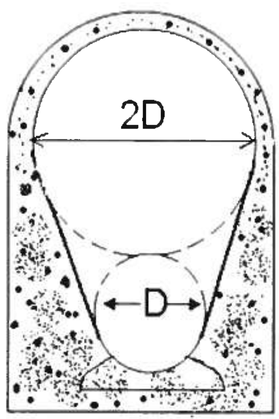
3.3 Shapes of Sewer Pipes

Sewers are generally circular pipes laid below ground level, slopping continuously towards the outfall. These are designed to flow under gravity. Shapes other than circular are also used.

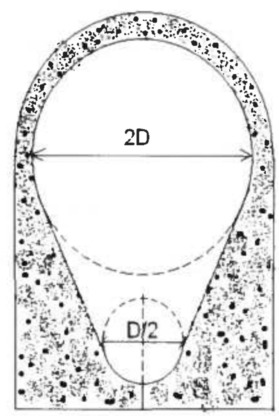
Other Shapes used for sewers are (Figure 3.1):

a. Standard Egg-shaped sewer
b. New egg-shaped sewer
c. Horse shoe shaped sewer
d. Parabolic shaped sewer
e. Semi-elliptical section
f. Rectangular shape section
g. U-shaped section
h. Semi-circular shaped sewer
i. Basket handled shape sewer

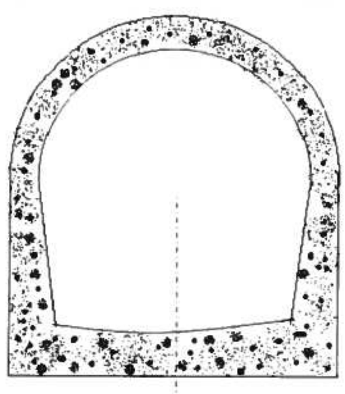
Standard egg-shaped sewers, also called as ovoid shaped sewer, and new or modified egg-shaped sewers are used in combined sewers. These sewers can generate self cleansing velocity during dry weather flow. Horse shoe shaped sewers and semi-circular sections are used for large sewers with heavy discharge such as trunk and outfall sewers. Rectangular section is used for conveying storm water. U-shaped section is used for larger sewers and especially in open cuts. Other sections of the sewers have become absolute due to difficulty in construction on site and non availability of these shapes readily in market.



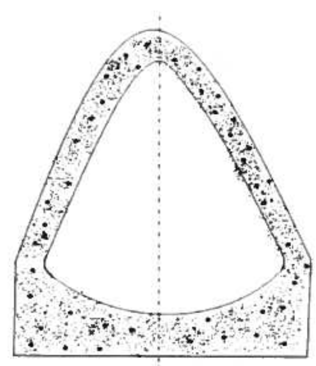
(a) Standard Egg Shaped Sewer



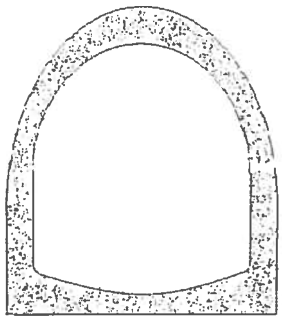
(b) New/ Modified Egg shaped Sewer



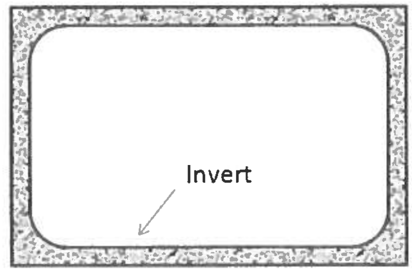
(c) Horse shoe sewer section



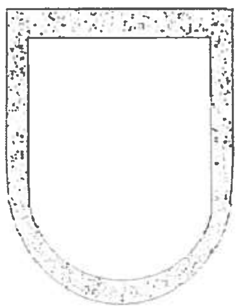
(d) Parabolic section



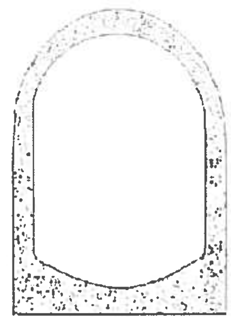
(e) Semi-elliptical section



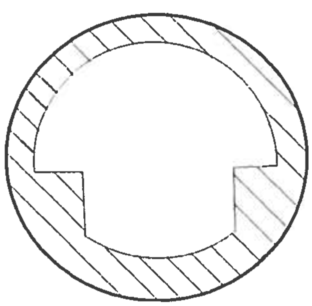
(f) Rectangular Sewer



(g) U-shaped section



(h) Semi-circular Section



(i) Basket-Handle Section

Figure 3.1: Different shapes used for construction of sewer other than circular

Questions

1. What should be properties of the material to be used for sewer construction?
2. Write a note on different materials used for sewer construction.
3. With schematic describe various shapes used for sewer section.

4. What are the advantages and drawback of the circular section sewers?

ONSITE WATER TREATMENT
The Journal for Decentralized Wastewater Treatment Solutions

News

Just how long will corrugated HDPE pipe last?

The answer will surprise you

By Michael Pluimer, M.S.M.E., Plastics Pipe Institute

As we move further into the 21st century, engineers are thinking more critically than ever about the long term service life of products that are being used to build and repair the nation's water, wastewater and storm sewer infrastructure.

Since it is the newest pipe product to be developed during the age of computers and automation, corrugated high-density polyethylene (HDPE) pipe has been studied and analyzed from both a structural and material standpoint arguably more than any competing material. Extensive testing and analysis on raw materials, finished product, and installation integrity have increased the confidence level of the product and resulted in the rapid increase in usage of corrugated HDPE pipe for stormwater, culverts, and other drainage applications.

Now an independent third party study has put a life expectancy on the corrugated high-density polyethylene (HDPE) pipe that manages storm water in municipalities all across North America.

And the number will surprise you.

Drexel University researchers, led by Dr. Grace Hsuan, have developed a new test protocol for corrugated HDPE pipe, utilizing the Rate Process Method, The results were published and presented at the recent international Plastics Pipes XIII conference, held in Washington DC.

According to Dr. Hsuan's data presented at the Plastics Pipes XIII conference, the pipe tested far surpassed the 100-year service requirement in the harsh environmental conditions of Florida. The results were dramatic enough to remove any doubt about the 100-year issue and re-set the baseline much higher for corrugated HDPE pipe.

Highlights of the data include:

- Service life of 572 years at 7.5 percent deflection (675 psi material stress in the pipe wall)
- Service life of 949 years at 6 percent deflection (600 psi material stress in the pipe wall)
- Service life of 2,893 years at 5 percent deflection (500 psi material stress in the pipe wall)

To predict the actual service life of the corrugated HDPE drainage pipe, a test protocol utilizing the Rate Process Method (RPM) was applied to the junction where the corrugation meets the pipe liner. The RPM is a method that is well established in the pressure pipe industry to predict the long-term performance of thermoplastic pipe by testing materials at higher temperatures and stresses to accelerate the tests, then using the resulting data to extrapolate to the anticipated service conditions.

Dr. Hsuan's paper states that the 100-year stress crack resistance (SCR) of corrugated HDPE pipes was evaluated using a 600 mm diameter pipe. The SCR tests were performed on the finished pipe at the liner and junction locations. The notched constant ligament stress (NCLS) test (ASTM 2163) was used for the pipe liner assessment and a similar test applied to the junction.

"As we look to rebuild our underground infrastructure, engineers are paying more attention to the service life of their construction materials and structures," said E. Lyn Heying, Project Manager from MECO Engineering Company, Inc. of Hannibal, Mo. "The goal is to avoid plaguing future generations with the same dire infrastructure situation that our generation is currently facing."

What determines pipe service life?

The service life of most drainage pipes is estimated to be between 20 and 100 years, depending on the material. But how are these numbers derived? What is the basis for service life determination? How can we be assured that the estimated service life is accurate? What defines service life? Indeed, these are some of the critical questions that must be addressed when assessing service life of drainage products.

The process for long-term service life prediction is three-fold:

The anticipated service conditions of the drainage pipe must be assessed, including such factors as environmental conditions, soil and traffic loads, and the resulting long-term stresses and strains evident in the pipe.

The criteria for determination of service life, including the proper identification of anticipated failure modes, must be assessed.

The capacity or ability of the material and the manufactured pipe product and system to withstand the identified service conditions must be evaluated.

The service life of many traditional pipe products (e.g. metal, concrete) is typically predicted by determining the amount of time it takes to deteriorate the inner wall to the point that the structure is no longer capable of withstanding its service loads.

For example, the primary failure mode of corrugated metal pipe is corrosion. So for corrugated metal pipe, the predicted service life is typically based on the amount of time, taking into account the expected service conditions (including flow rate and pH of the water and abrasiveness of the flow), for the waterway to deteriorate to a predetermined level where either the structure becomes too weak to carry the loads, or otherwise fails to serve its intended drainage purpose.

Likewise, reinforced concrete pipe service life is typically estimated based on the amount of time for the pipe wall to deteriorate down to the reinforcing steel. Once the metal reinforcement is exposed to air and water, corrosion begins, swelling the metal and breaking up the concrete encasement. Once again, environmental factors such as the effluent pH, flow rate, and abrasiveness play a large factor in the estimated service life. As a result, proper identification and prediction of these conditions becomes paramount.

It should be noted that neither of these service life predictors takes into account other critical pipeline considerations such as joint performance, allowed leakage rates, or non-structural cracking as part of their service life criteria, although they can have a dramatic affect during actual use.

The predicted design service life of corrugated HDPE pipe isn't quite as straightforward as the more traditional materials, primarily due to the fact plastics do not corrode (they're non-metallic) and the molecular structure of HDPE makes it inherently resistant to abrasion. The material just doesn't wear like traditional materials.

Establishing a protocol

Prior to Dr. Husan's most recent study, the Florida Department of Transportation had done the most extensive research on the subject of service life of corrugated HDPE pipe. In establishing its protocol for 100-year service life of corrugated HDPE pipe, they agreed that the limiting factor for service life would not be based on abrasion or wear of the inner wall, as it was for the competing materials.

Rather, they identified cracking via the slow crack growth mechanism as the primary mode of failure and concern for HDPE pipe. This decision was based in part due to research conducted on some older pipe that had exhibited circumferential cracking in the smooth waterway liner of the pipe wall.

While the Florida DOT acknowledged that the liner is not a structural component of the overall pipe structure (it exists for hydraulic purposes only), it was their desire to have "crack-free" pipe, and thus establish a protocol that will ensure the material will not crack over its intended service life.

Since the slow-crack growth mechanism for failure has been well researched and documented in the pressure pipe industry, and an ASTM test method was already in place to predict service life based on this failure mechanism, it was relatively easy to adapt to corrugated HDPE drainage pipes. In 2002, material changes were incorporated into AASHTO M294, the national specification for State Departments of Transportation for corrugated HDPE pipe, which ensured the material's long-term resistance to the slow crack growth failure mechanism.

Today, independent research like the Drexel University study and others are taking the service life issue to unprecedented levels. Some may view this amount of testing as excessive or too costly. But since corrugated HDPE pipe is relatively new in storm sewer applications, the testing provides additional confidence and security in the integrity of the product.

The HDPE pipe industry, led by the Plastics Pipe Institute (PPI), will continue to monitor, report on and deliver information and facts on relevant research that can help specifying engineers be comfortable. Our goal is to deliver a product that will still be in the ground performing its intended purpose for generations to come. According to these results, it looks like that won't be a problem.

About PPI

Michael Pluimer carries a Master's Degree in Mechanical Engineering from the University of Minnesota, and is the Technical and Engineering Manager for The Plastics Pipe Institute (PPI). The PPI is the major trade association representing all segments of the PE piping industry. Member companies share a common interest in broadening market opportunities that make effective use of plastic piping for water and gas distribution, sewer and wastewater, oil and gas production, industrial and mining uses, power and communications, duct and irrigation. More information is available at www.plasticpipe.org.

References

Hsuan, Y.G. and McGrath, T.J. (2005) "Protocol for Predicting Long-term Service of Corrugated High Density Polyethylene Pipes," prepared for Florida DOT,

Hsuan, Y.G., Plastics Pipes XIII Conference – Provide Reference

Palermo, Eugene, Plastics Pipes XIII Conference – Provide Reference

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix F. Remaining Life Estimates

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TETRA TECH

BHC CONSULTANTS

Existing Sewer System: COB Jan 2011
King County base data 2012
Data sources supplied may not reflect current or actual conditions. This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

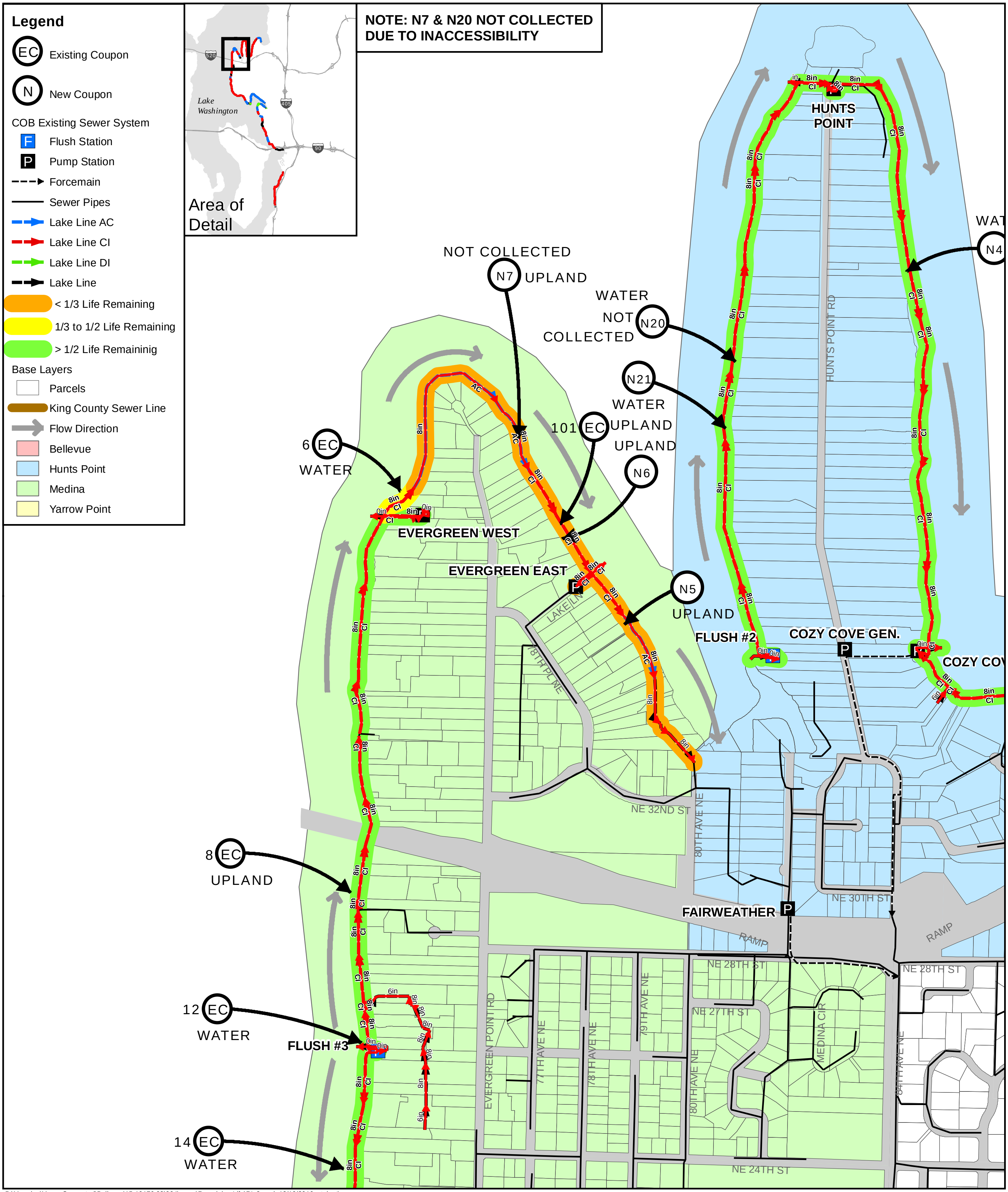
N W E S

0 400 800 Feet

CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES

Figure 1
December 2016



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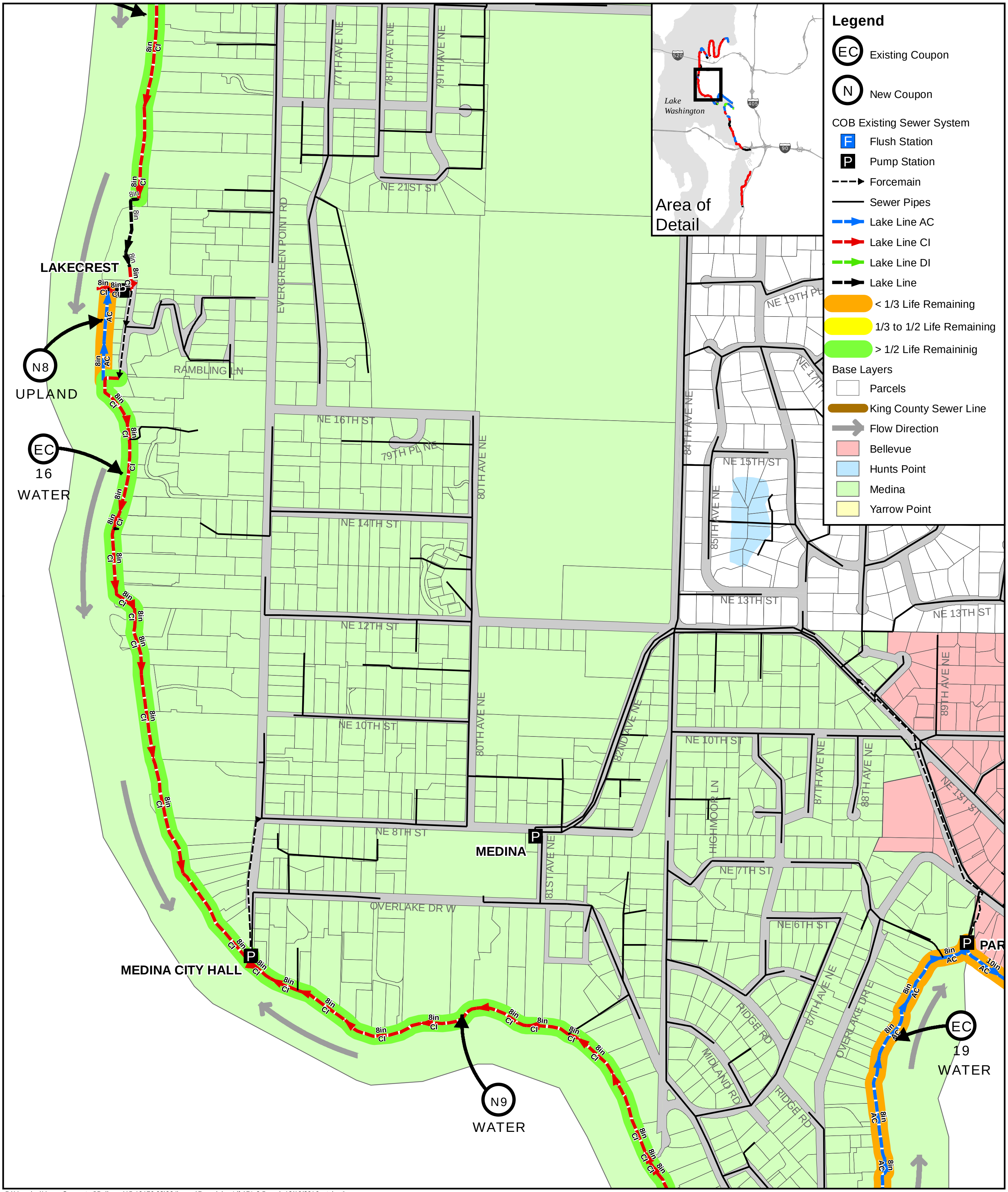
SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES

Figure 2
December 2016



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Existing Sewer System: COB Jan 2011
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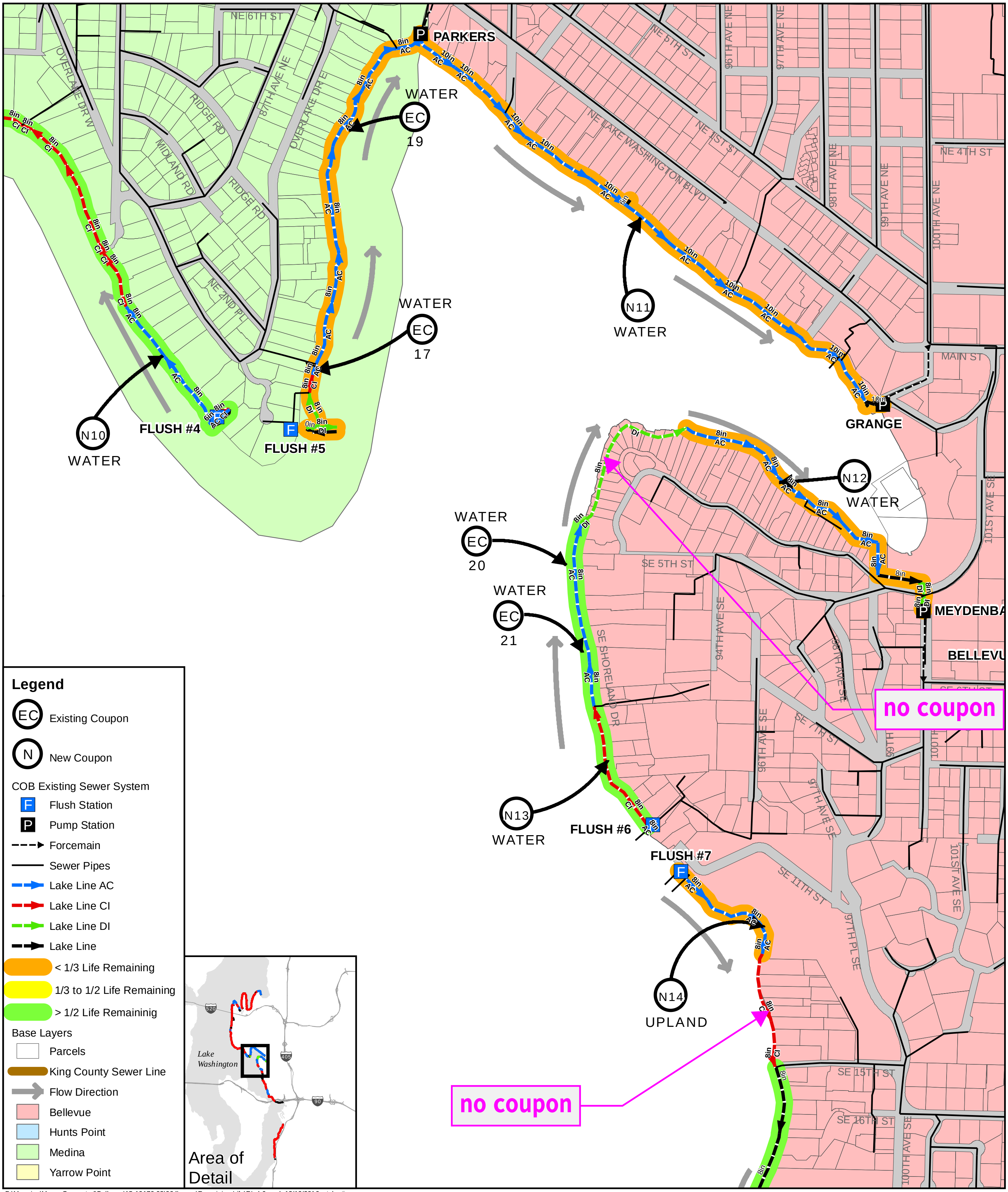
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES
Figure 3
December 2016



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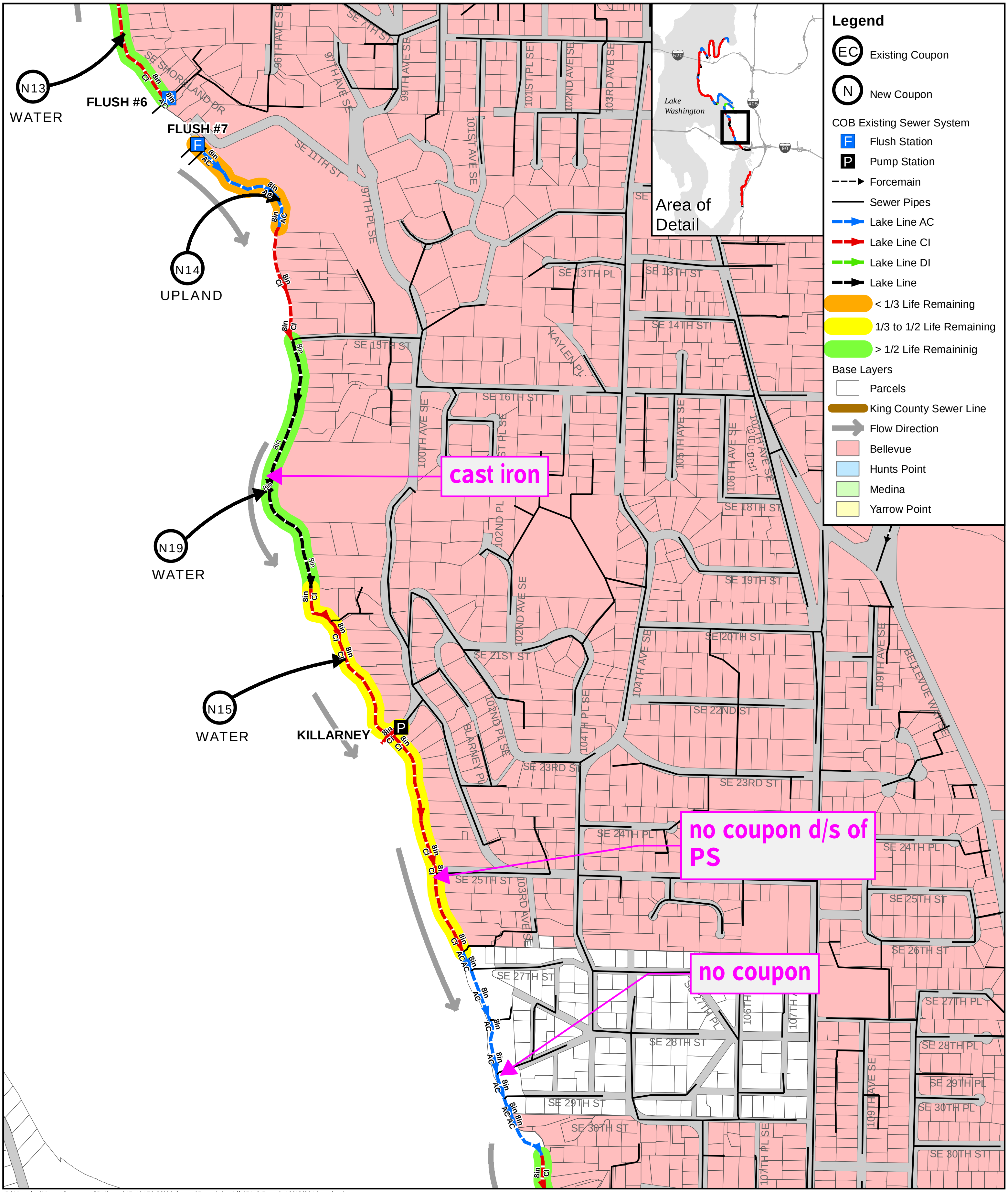
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES
Figure 4
December 2016



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TETRA TECH

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King County base data 2012
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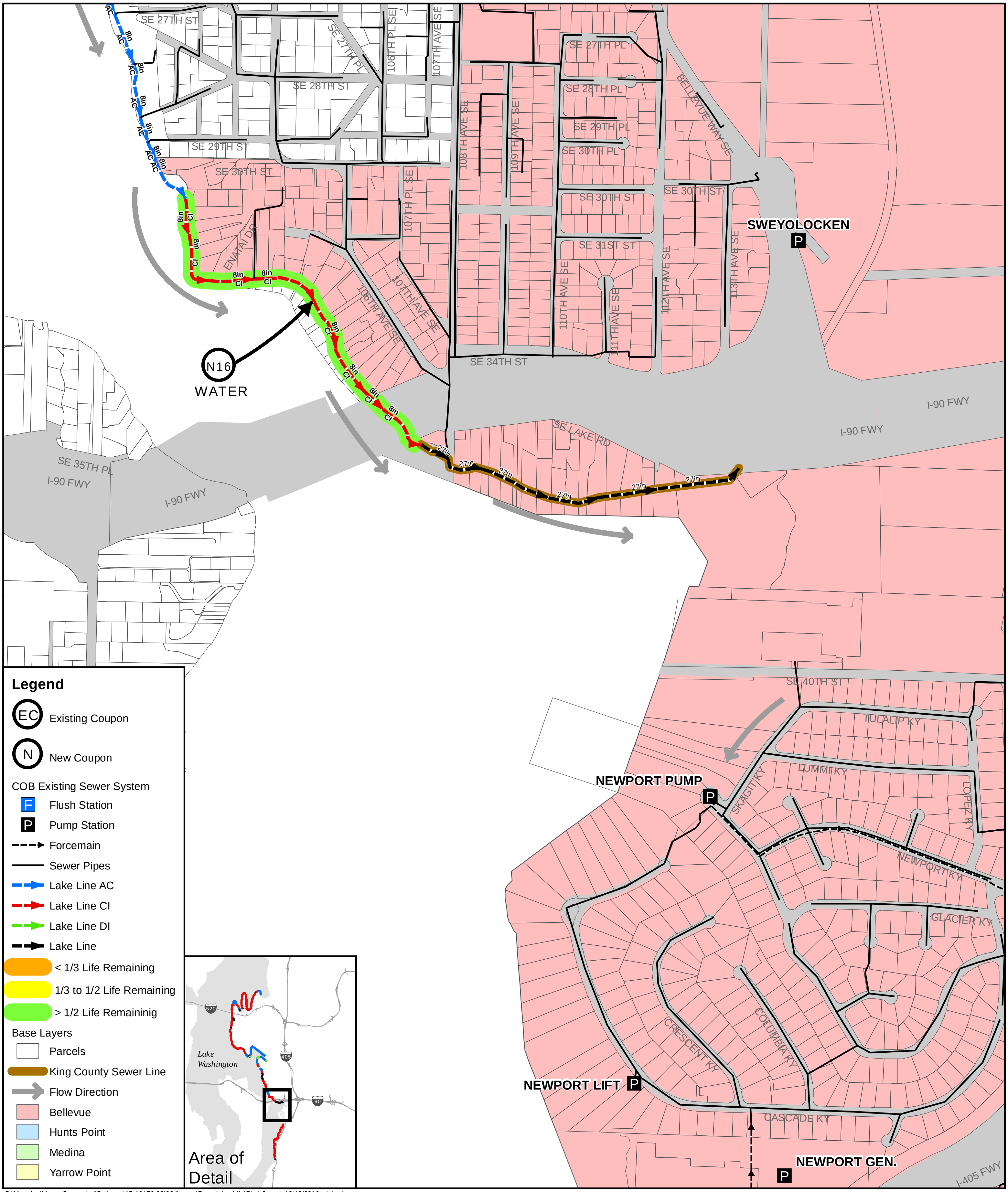
SEWER LAKE LINE CONDITION ASSESSMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES
Figure 5
December 2016



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TETRA TECH
BHC CONSULTANTS

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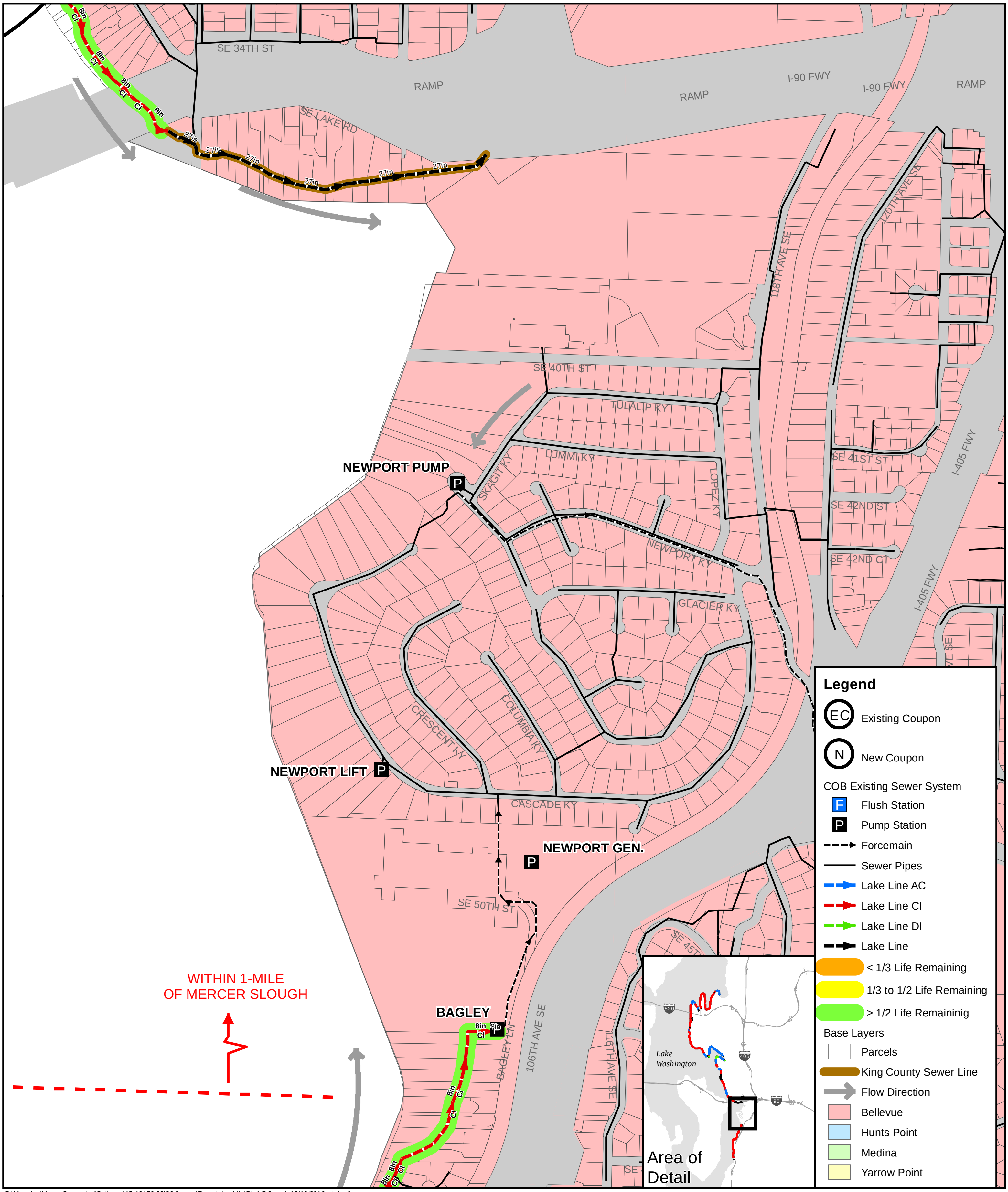
CITY OF BELLEVUE WASHINGTON

SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES
Figure 6
December 2016



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TETRA TECH

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King County base data 2012
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Feet
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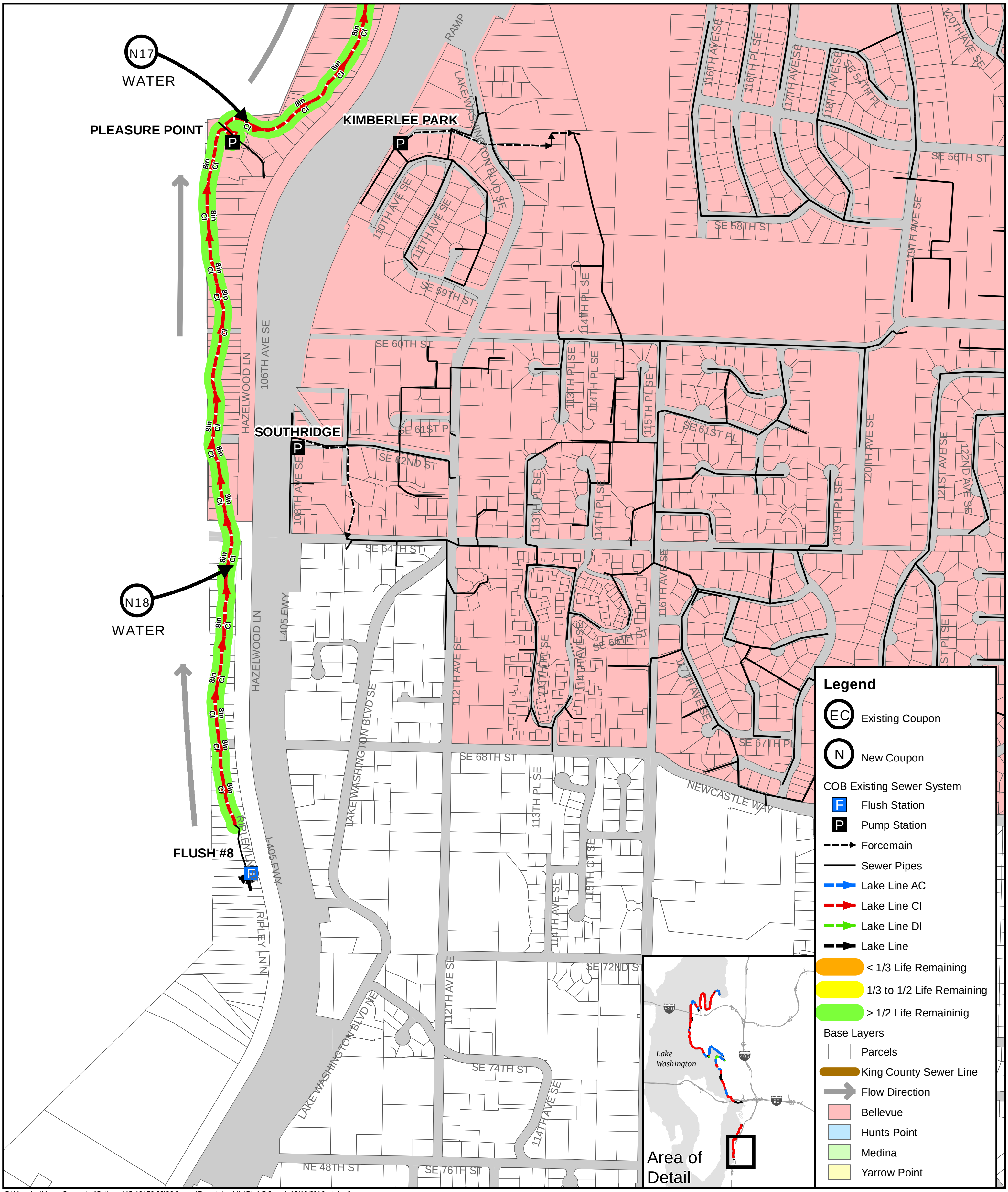
SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES

CITY OF BELLEVUE WASHINGTON

Figure 7
December 2016



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SEWER LAKE LINE CONDITION ASSESSEMENT
LAKE WASHINGTON PHASE 2
REMAINING LIFE ESTIMATES

Figure 8
December 2016

Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix G. Maximo Repair History

ASSETNUM	DESCRIPTION	INSTALLDATE	ADDRESS	COUPON	MATERIAL	LENGTH	DIAMETER	DOWNBASIN	WOYEAR	WORKTYPE	DESCRIPTION	FAILURE	PROBLEM
197120	LAKE LINE (From MH05-0144)		530 Overlake Dr E	EC19	AC	343	8	5	2004	CM	REPAIR LAKELINE BREAKS.		
197145	LAKE LINE (From MH05-0150)		450 Overlake Dr E	EC19	AC	410	8	5	2001	CM	Contractor was installing a rockery and put a couple of holes in the lake		
197145	LAKE LINE (From MH05-0150)		450 Overlake Dr E	EC19	AC	410	8	5	2002	CM	CUSTOMER AT THIS LOCATION REPORTS THAT A REPAIR WAS MADE TO A LEAK ON THE LINE IN MEYDENBAUER		
197145	LAKE LINE (From MH05-0150)		450 Overlake Dr E	EC19	AC	410	8	5	2002	CM	COVER LAKELINE CROWN BREAK WITH FULL CIRCLE REPAIR BAND.		
197145	LAKE LINE (From MH05-0150)		450 Overlake Dr E	EC19	AC	410	8	5	2002	CM	INSPECT INSTALLATION OF NEW 1" ROCK OVER LAKELINE AT THIS SITE & SOUTH.		
197238	LAKE LINE (From MH02-0219)		7747 Overlake Dr W	N9	CI	353	8	2	2010	CM	Sewer backup	MAINLINE	
197283	WASTEWATER MAIN : 4233 91ST AVE NE)	2/2/2011	4233 91st Ave NE	N2	DI	540	8	3	2003	CM	LOCATE LAKELINE & STUB. CALL OWNER FIRST TO ARRANGE GATE OPENING.		
197283	WASTEWATER MAIN : 4233 91ST AVE NE)	2/2/2011	4233 91st Ave NE	N2	DI	540	8	3	2007	CM	SEWAGE BUBBLING FROM BACK YARD APPROACHING LAKE WASHINGTON. VERY OBVIOUS.		
197481	LAKE LINE (From MH03-0260)		9000 NE 39th Pl	N3	CI	350	8	3	2011	CM	raw sewage appears to be coming up out of bulkhead	MAINLINE	BLOCKAGE
197483	LAKE LINE (From MH03-0132)		3644 Hunts Point Rd	N4	CI	695	8	3	2015	CM	Sewer overflow into lake	WW_MAINLINE	
197671	LAKE LINE (From MH08-0122)		COB	EC21	AC	900	8	8	2002	CM	REPAIR BROKEN LAKELINE		
197671	LAKE LINE (From MH08-0122)		COB	EC21	AC	900	8	8	2014	CM	Lakeline break at abandoned flush station	WW_LAKELINE	BREAK WITH OVERFLOW
197673	LAKE LINE (From MH08-0269)		700 Shoreland Dr SE	EC21	AC	294	8	8	2013	CM	Lakeline Locate Ticket #13247625	WW_MAINLINE	
197767	LAKE LINE (From MH07-0246)		COB	N11	AC	497	10	7	2004	CM	Dye Test between Parker Pump Station and Meydenbauer Beach Park. REPAIR LAKELINE.		
197769	LAKE LINE (From MH07-0213)		9545 Lake Washington Blvd NE	N11	Unknown	40	6	7	2013	CM	blockage in lakeline; sewer has come up into the yard	WW_MAINLINE	
197774	LAKE LINE (From MH07-0101)		COB	N11	AC	435	10	7	2012	CM	Lakeline blockage/jetting at 9425 lake wa blvd for 1 92nd Ave NE	WW_MAINLINE	
197774	LAKE LINE (From MH07-0101)		COB	N11	AC	435	10	7	2012	CM	Sewer backup into house	WW_MAINLINE	BLOCKAGE WITH OVERFLOW
197790	LAKE LINE (From MH07-0783)	1/1/1994	100 100th Ave SE	N11	PVC	61	10	7	2011	CM	lake line jetting due to blockage	WW_MAINLINE	
197804	LAKE LINE (From MH07-0275)		1 99th Ave NE	N11	AC	349	10	7	2011	CM	lake line	WW_MAINLINE	
197804	LAKE LINE (From MH07-0275)		1 99th Ave NE	N11	AC	349	10	7	2013	CM	Back up at Marina / Yacht Club	WW_LAKELINE	BLOCKAGE WITH OVERFLOW
197808	LAKE LINE (From MH07-0653)		100 100th Ave SE	N11	AC	358	10	7	2010	CM	Lakeline overflow	MAINLINE	
197808	LAKE LINE (From MH07-0653)		100 100th Ave SE	N11	AC	358	10	7	2011	CM	lake line jetting	WW_MAINLINE	
197930	LAKE LINE (From MH03-0206)	1/1/1959	4652 95th Ave NE	N11	AC	1003	8	2	2015	CM	Sewer overflow near Lake WA	WW_LAKELINE	BLOCKAGE WITH OVERFLOW
198728	LAKE LINE (From MH03-0112)	1/1/1960	3433 Hunts Point Rd	None	CI	850	8	3	2003	CM	REPLACE 15'+/- OF AC LAKELINE STUB WITH 6" DI PIPE & DI COTG. SEE MB. OWNER CHANGING BEACH.		
198825	LAKE LINE (From MH01-0106)	1/1/1960	3409 Evergreen Point Rd	None	CI	501	8	1	2008	EV	LOCATE SEWER #8346751		
198835	LAKE LINE (From MH01-0160)	1/1/1960	7530 NE 28th Pl	EC8	CI	446	8	1	2016	CM	Sewer is leaking/backing up at this time	WW_MAINLINE	
200904	LAKE LINE (From MH36-0191)		6417 Ripley Ln SE	N18	CI	395	8	36 - Newport	1996	EV	CALLER REPORTS NEIGHBORS CLEAN-OUT IS OVERFLOWING AND SEWAGE IS DRAINING INTO LAKE.PLS SEND CREW.		
200917	LAKE LINE (From MH36-0195)		6819 Ripley Ln SE	N18	CI	310	8	36 - Newport	2004	CM	Hydraulic Gradient Test - Handrod Stub and Video lateral. Inspect / clean check valve.		
200971	LAKE LINE (From MH09-0221)		7 Enatai Dr	N16	CI	338	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
200998	LAKE LINE (From MH09-0222)		12 Enatai Dr	N16	CI	292	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
201000	LAKE LINE (From MH09-0253)		3203 106th Ave SE	N16	CI	337	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
201000	LAKE LINE (From MH09-0253)		3203 106th Ave SE	N16	CI	337	8	9	2015	EV	LAKE LINE (From MH09-0253)	WW_MAINLINE	
201009	LAKE LINE (From MH09-0254)		3235 106th Ave SE	N16	CI	325	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
201009	LAKE LINE (From MH09-0254)		3235 106th Ave SE	N16	CI	325	8	9	2015	EV	LAKE LINE (From MH09-0254)	WW_MAINLINE	
201010	LAKE LINE (From MH09-0255)		3257 106th Ave SE	N16	CI	172	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
201010	LAKE LINE (From MH09-0255)		3257 106th Ave SE	N16	CI	172	8	9	2015	EV	LAKE LINE (From MH09-0255)	WW_MAINLINE	
211836	WASTEWATER MAIN : (UNVERIFIED LOCATION)		COB	N18	CI	330	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
211847	LAKE LINE (From MH36-0264)		7023 Ripley Ln SE	N18	Unknown	133	0	36 - Newport	2011	CM	Clean out overflowed last night, into Lake Washington.	WW_LAKELINE	BLOCKAGE WITH OVERFLOW
212410	LAKE LINE (From MH08-0329)		COB	N18	CI	891	8	8	2003	CM	CUSTOMER AT THIS LOCATION WOULD LIKE TO HAVE LAKELINE STUB VIDEO INSPECTED.		
213234	LAKE LINE (From MH09-0364)		COB	N18	CI	468	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	MAINLINE	
213234	LAKE LINE (From MH09-0364)		COB	N18	CI	468	8	9	2015	EV	LAKE LINE (From MH09-0364)	WW_MAINLINE	
213258	WASTEWATER MAIN : 10101 SE 30TH ST)	3/9/2011	10101 SE 30th St	N18	AC	125	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	WW_MAINLINE	
213259	LAKE LINE (From MH09-0362)		10010 SE 28th Pl	N18	AC	167	8	9	2011	CM	Beaux Arts to Enatai - Lakeline Cleaning	WW_MAINLINE	
213260	LAKE LINE (From MH09-0361)		10010 SE 28th Pl	N18	AC	325	8	9	2014	CM	jet lakeline via manhole in north Beaux Arts parking lot.	WW_MAINLINE	BLOCKAGE NO OVERFLOW
213260	LAKE LINE (From MH09-0361)		10010 SE 28th Pl	N18	AC	325	8	9	2015	EV	LAKE LINE (From MH09-0361)	WW_MAINLINE	
213260	LAKE LINE (From MH09-0361)		10010 SE 28th Pl	N18	AC	325	8	9	2016	CM	Sewer manhole/vault overflowing at this time	WW_MAINLINE	BLOCKAGE WITH OVERFLOW
213261	LAKE LINE (From MH09-0360)		9615 SE 16th St	N18	Unknown	387	8	9	2014	EV	Sewer Overflow @ Flush 7 Control MH	WW_MAINLINE	BLOCKAGE WITH OVERFLOW
213263	LAKE LINE (From MH09-0348)		10010 SE 28th Pl	None	AC	283	8	9	2013	CM	Possible lakeline break	WW_MAINLINE	BREAK WITH OVERFLOW
213498	LAKE LINE (From MH03-0313)		4615 92nd Ave NE	N2	CI	307	8	3	2011	CM	Lake line leaking	MAINLINE	BLOCKAGEOV

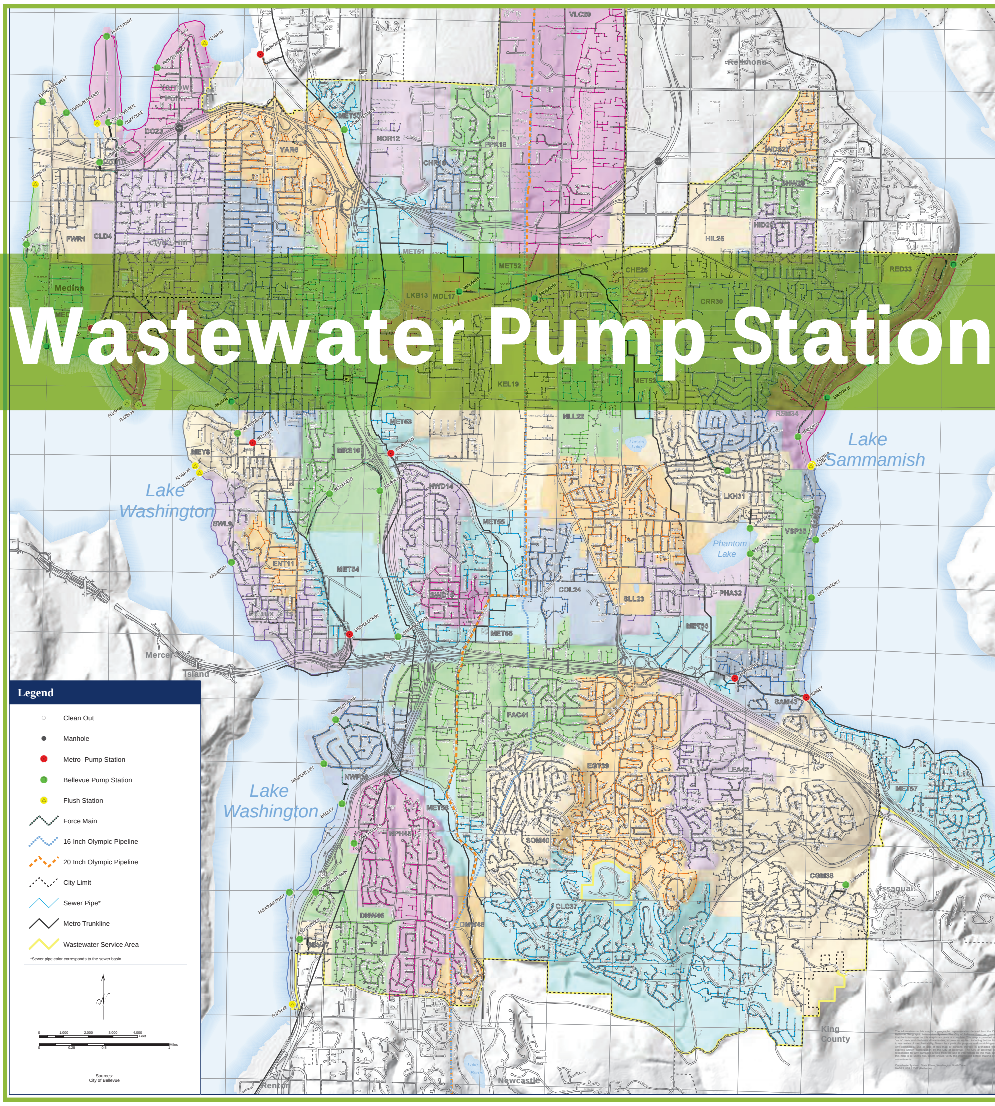
Sewer Lake Line Condition Assessment, Phase 2—Lake Washington

Appendix H. Prioritization Spreadsheet

Coupon	Length (ft)	Consequence of Failure: Length Score 20%	Location 20%	Number of Services 25%	Ease of Access 15%	Bypass Difficulty 10%	Public Health Beach/Marina 10%	Consequence Score	Probability of Failure: Location 10%	Exposed or Buried 5%	Age 10%	Material 20%	Remaining Life 40%	Failure Record 10%	Repair Record 5%	Probability Score	Risk Consequence X Probability	Priority Ranking
N12	1717	0	20	20	10	10	10	70	10	0	10	20	40	0	0	80	5600	1
N11	3139	5	20	20	10	10	0	65	10	0	10	20	40	0	5	85	5525	2
EC19	3322	5	20	15	10	10	0	60	10	0	10	20	40	0	5	85	5100	3
EC17	3322	5	20	5	10	10	0	50	10	0	10	20	40	0	0	80	4000	4
N15	1996	0	20	15	10	10	0	55	10	0	10	20	20	0	0	60	3300	5
N5	4174	15	0	20	0	5	0	40	0	0	10	20	40	0	0	70	2800	6
EC101	4317	15	0	5	10	5	0	35	10	0	10	20	40	0	0	80	2800	6
EC6	3803	10	20	5	10	10	0	55	10	0	0	0	20	0	0	30	1650	7
N6	3926	10	0	10	0	0	0	20	0	0	10	20	40	0	0	70	1400	8
N14	short	0	0	5	0	5	10	20	0	0	10	20	40	0	0	70	1400	8
N1	1747	0	0	10	0	5	0	15	0	0	10	20	40	0	0	70	1050	9
EC21	4241	15	20	10	10	10	0	65	10	0	0	0	0	0	5	15	975	10
N17	4905	20	20	25	10	10	0	85	10	0	0	0	0	0	0	10	850	11
N18	4699	20	20	25	10	10	0	85	10	0	0	0	0	0	0	10	850	11
N16	4144	15	20	25	10	10	0	80	10	0	0	0	0	0	0	10	800	12
N4	4317	15	20	20	10	10	0	75	10	0	0	0	0	0	0	10	750	13
N9	5145	20	20	15	10	10	0	75	10	0	0	0	0	0	0	10	750	13
N8	3139	5	0	5	0	0	0	10	0	0	10	20	40	0	0	70	700	14
N2	3877	10	20	20	10	10	0	70	10	0	0	0	0	0	0	10	700	14
N3	3926	10	20	20	10	10	0	70	10	0	0	0	0	0	0	10	700	14
N21	4464	15	20	15	10	10	0	70	10	0	0	0	0	0	0	10	700	14
EC16	4221	15	20	15	10	10	0	70	10	0	0	0	0	0	0	10	700	15
EC8	3803	10	20	15	10	10	0	65	10	0	0	0	0	0	0	10	650	15
EC20	4241	15	20	10	10	10	0	65	10	0	0	0	0	0	0	10	650	15
N19	3761	10	20	5	10	10	0	55	10	0	0	0	0	0	0	10	550	16
EC12	2185	5	20	5	10	10	0	50	10	0	0	0	0	0	0	10	500	17
EC14	2185	5	20	5	10	10	0	50	10	0	0	0	0	0	0	10	500	17
N13	878	0	20	5	10	10	0	45	10	0	0	0	0	0	0	10	450	18
N10	1162	0	20	5	10	10	0	45	10	0	0	0	0	0	0	10	450	18
N7																		
N20																		

Wastewater Pump Station Evaluation

Final Report



CITY OF BELLEVUE WASHINGTON

MSA
Murray, Smith & Associates, Inc.
Engineers | Planners

May 2015

WASTEWATER PUMP STATION EVALUATION, PHASE 2 REPORT

FOR

CITY OF BELLEVUE, WASHINGTON

MAY 2015

5-27-2015

MURRAY, SMITH & ASSOCIATES, INC.
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14-1529

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EXECUTIVE SUMMARY

Introduction

The City of Bellevue (City) owns and operates 46 wastewater pump and flush stations. Many of these pump stations were built in the late 1950s and upgraded in the late 1980s. Given the system's age, equipment may be reaching the end of its service life or may be obsolete. Murray, Smith & Associates, Inc. (MSA) was authorized by the City to conduct a needs-based (to meet service levels) condition assessment of 26 pump/lift stations, as well as a higher level, confirmation review of seven other stations that had previously been evaluated, to provide an overall system assessment that focuses on maintaining station reliability, serviceability, safety and overall efficiency. The remaining 13 stations owned and operated by the City were not field evaluated because they are currently undergoing or have recently completed an upgrade/replacement. However, the near-term and long-term capital projects for the 13 stations are included to provide a complete pump station financial plan. Following condition assessment, MSA was authorized to develop long-term capital planning needs projections for all wastewater pump and flush stations.

Project Overview

This project is the second phase of an overall evaluation process and includes 26 wastewater pump stations. The seven stations previously evaluated in the first phase and the remaining 13 stations have been wrapped into this study to provide a consistent basis for capital needs. Key elements of the project include:

- Pump station condition evaluations.
- Recommendations and planning level cost estimates for capital improvement projects.
- Long term resource needs planning based on a 75-year planning horizon.
- Report preparation.

Although the 13 remaining stations were not included as part of this condition assessment they were incorporated into the City's capital improvement projects and 75-year planning horizon to reflect the City's entire wastewater system.

Evaluation Approach

The evaluation of 26 of the City's wastewater pump stations includes the site, mechanical, structural, electrical and telemetry components of the pump station to evaluate these components individually as well as the station as a whole. The evaluations were based on site inspections and the operation of equipment, no component or material testing was conducted other than manipulating the normal operation of the equipment.

Components were evaluated in three categories:

- Condition – the physical condition of a component, used to estimate remaining useful life.
- Criticality – correlates the relationship of a component to the overall operation of the pump station and its consequence of failure.
- Serviceability – the ability to maintain, repair, or replace a component, considering accessibility, safety, and availability of parts.

Capital Improvement Projects

Capital improvement project recommendations for the 33 pump stations evaluated as part of this condition assessment were developed to correct observed deficiencies and ensure the reliability and serviceability of the stations. Planning level capital improvement project cost estimates have been developed for the recommendations. Project timelines were developed based on the condition, criticality and serviceability rating of components that drive project implementation. Projects were pushed back to the year 2017 since the 2015-2016 wastewater pump station rehabilitation budget has already been established. As part of the coordination with the City's current budget, Wilburton pump station upgrades were moved up to the year 2016. The City's total budget for Wilburton pump station is approximately $1.5 million. The project cost included in this report are reflective of needs based improvements only.

If applicable, capital improvement projects for the 13 remaining stations not included as part of this condition assessment were based on near term scheduled improvements within the City's established wastewater pump station rehabilitation budget. If projects for the 13 stations were not included in the established budget, capital improvement projects were based on the year of the station's last upgrade.

A summary of the capital improvement project costs by station is represented in Table ES-1.

Table ES-1
Summary of Prioritized Capital Improvement Project Costs for 46 Pump Stations

Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Yarrow Point	-	-	-	-	$379,000	-	-	-	-	-	-	-
Cozy Cove	-	-	-	$585,000	-	-	-	-	-	-	-	-
Evergreen East	-	-	-	-	$344,000	-	-	-	-	-	-	-
Grange	-	-	$234,000	-	-	-	-	-	-	-	-	-
Wilburton	-	$358,000		-	-	-	-	-	-	-	-	-
Station 18	-	-	$22,000	-	-	-	-	-	-	$120,000	-	-
Hunts Point	-	-	-	-	-	$373,000	-	-	-	-	-	-
Evergreen West	-	-	-	-	-	$352,000	-	-	-	-	-	-
Lake Crest	-	-	-	-	-	-	$360,000	-	-	-	-	-
Killarney	-	-	-	-	-	-	$181,000	-	-	-	$213,000	-
Meydenbauer	-	-	-	-	-	-	$343,000	-	-	-	-	-
Bagley	-	-	$154,000	-	-	-	-	-	-	-	$210,000	-
Pleasure Point	-	-	-	-	-	$150,000	-	-	-	-	$210,000	-
Kimberlee Park	-	-	-	-	-	-	-	-	$289,000	-	-	-
South Ridge	-	-	$123,000	-	-	-	-	-	-	-	-	-
Lakemont	-	-	-	-	-	-	-	-	$333,000	-	-	-
Station 4	-	-	$12,000	-	-	-	-	-	$172,000	-	-	-
Station 6	-	-	-	-	-	-	-	-	-	$148,000	-	-
Station 7	-	-	-	-	-	-	-	-	$137,000	-	-	-
Flush 10	-	-	-	-	-	-	-	-	-	$145,000	-	-
Station 19	-	-	-	-	-	-	-	-	-	$143,000	-	-
Station 17	-	-	-	-	-	-	-	-	-	$116,000	-	-
Station 16	-	-	-	-	-	-	-	-	$258,000	-	-	-
Station 12	-	-	$10,000	-	-	-	-	$861,000	-	-	-	-
Station 2	-	-	-	-	-	-	$220,000	-	-	-	-	-
Station 1	-	-	-	-	-	$191,000	-	-	-	-	-	-
Newport Lift	-	-	$244,000	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	$236,000	-	-	-	-	-	-	-	-
Palisades	-	-	-	-	-	-	-	-	-	$411,000	-	-
Parkers	-	-	-	-	-	-	-	$413,000	-	-	-	-
Medina	-	-	-	-	$292,000	-	-	-	-	-	-	-
Fairweather	-	-	-	$306,000	-	-	-	-	-	-	-	-
Cedar Terrace	-	-	-	-	-	-	-	-	-	$169,000	-	-
Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	$75,000	-	-	$630,000	-
Flush #2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
Flush #3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
Flush #4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #5	-	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #9	-	-	$80,000	-	-	-	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	$30,000	-	-	-	-	-	-	-	-	-
TOTAL	**$0**	**$7,180,000**	**$984,000**	**$1,157,000**	**$1,015,000**	**$1,066,000**	**$1,114,000**	**$1,724,000**	**$1,379,000**	**$1,552,000**	**$1,268,000**	**$1,230,000**

Notes:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

In addition to the capital improvement project recommendations presented in Table ES-1, it is recommended that the City conduct an evaluation of the force mains and downstream discharge piping at each station to determine their condition, criticality and serviceability.

Long Term Resource Planning

The long term resource planning element of this project outlines the 75-year financial planning cycle for the wastewater pump stations and provides the City with a program to track the remaining useful life of the pump station assets using the City's asset management software, Maximo.

At each pump station, five asset groups are used to track the larger, more costly, and/or critical components. While no changes are proposed to the Maximo tracking system, the five asset groups are generally defined below, with all smaller components considered ancillary to the larger ones.

Table ES-2
Asset Group Condition Rating Contributors

Asset Group	Asset Component
Pump Station	Wet well Dry pit Valve vault
Electrical System	Meter base Service disconnect Auto/Manual transfer switch Panelboard
Telemetry System	Modem Telemetry Cabinet RTU
Generator	Generator
Rotating Assembly	Pumps Motor Driver Motor

Parabolic depreciation curves were developed based on Step 4 of the Environmental Protection Agency (EPA) Fundamentals of Asset Management workshop. These EPA depreciation curves serve as templates for each asset group. This template predicts the decay of the asset group, helping to estimate the timing of component rehabilitation or replacement prior to reaching a minimum level of service and potential failure. By defining a minimum level of service, proactive rehabilitation or replacement can be planned which establishes the 75-year planning cycle. Figure ES-1 graphically depicts the relationship between the depreciation curves and the minimum level of service.

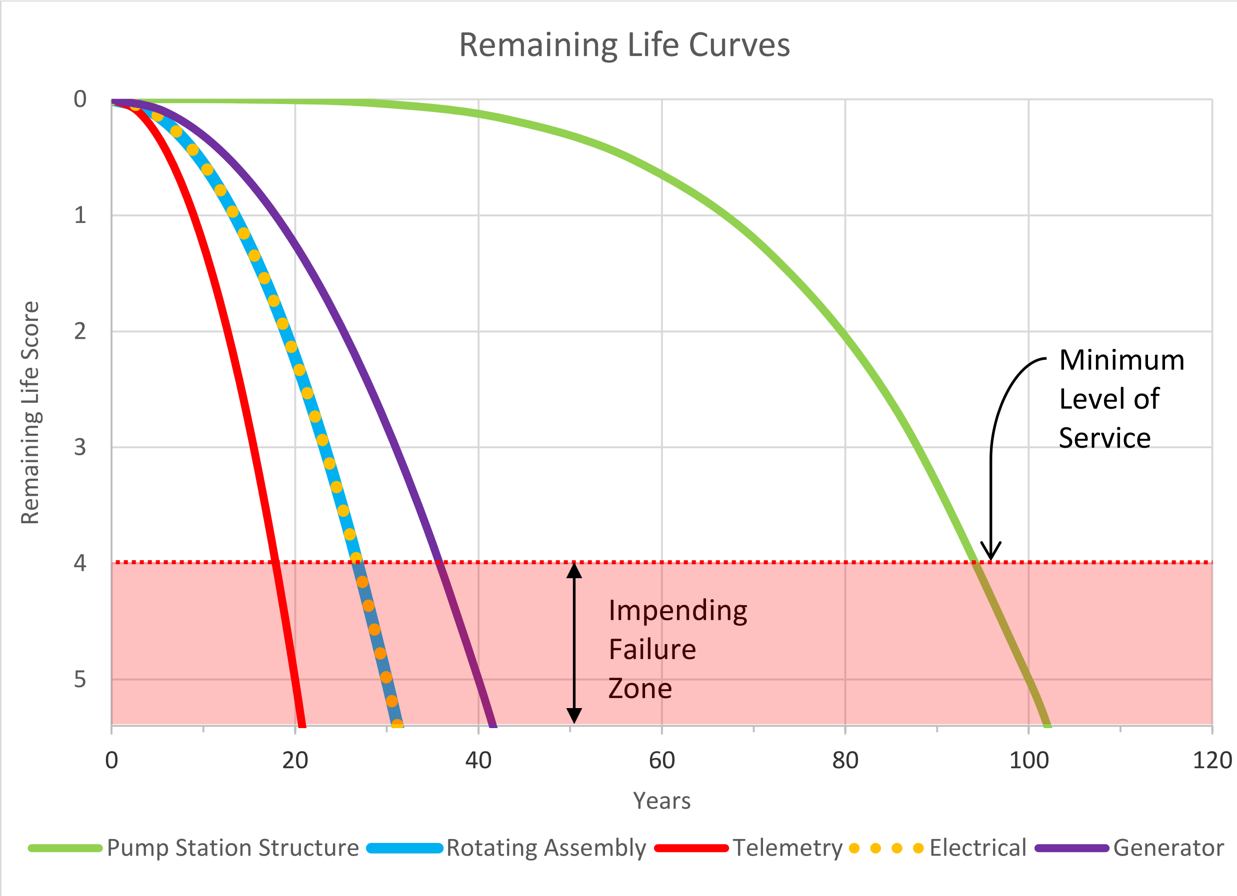


Figure ES-1: Remaining useful life depreciation curves for critical components

Tracked indicators for a given asset are used to assess remaining service life. These indicators are specific to a given asset and are scored accordingly. These indicators include:

- Condition – initial value from the evaluation process.
- Obsolescence – scale relating to availability of support and replacement parts.
- Call outs – unscheduled visits attributed to an asset group.
- Capacity – identifies the time before peak influent flow will exceed the capacity.

The remaining useful life of an asset is estimated by plotting the asset score on the parabolic depreciation curve as shown in the example in Figure ES-2. The difference in years between the current score and the minimum level of service represents the estimated time before a project is triggered for a given facility. As issues are addressed and projects are completed, the asset score must be updated. This assessment is completed for each asset group at the end of each respective pump station section.

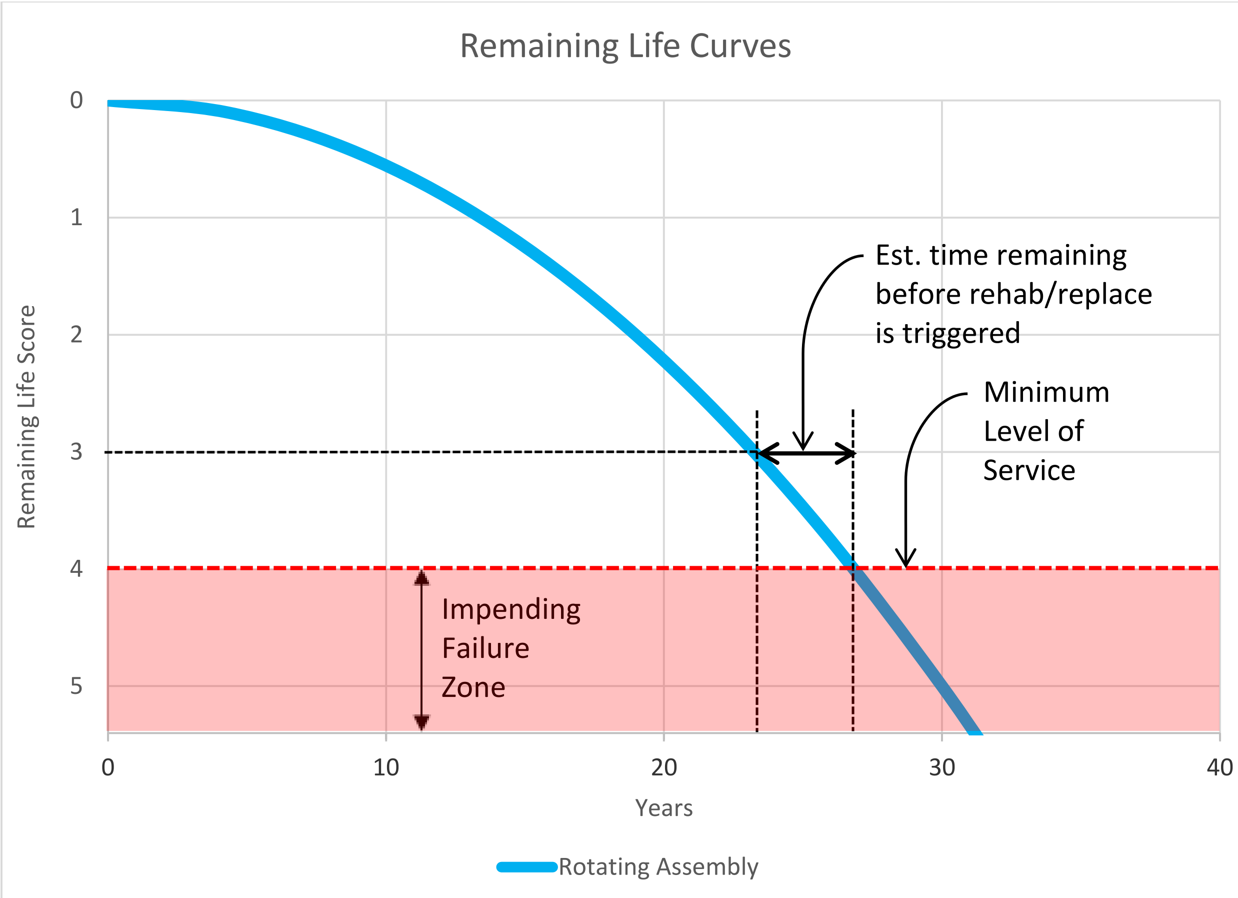


Figure ES-2: Remaining useful life estimation example

Based on the approach to long term resource planning using asset depreciation curves and the remaining useful life of an asset estimated based on condition, obsolescence, call outs, and station capacity, the likely costs due to rehabilitation and replacement projects at the pump stations over the course of 75 years was developed. Table ES-3 summarizes the pump station expenditures for the 46 pump stations evaluated over the next 75-year planning cycle.

Table ES-3
Summary of Prioritized Capital Improvement Project Costs for 46 Pump Stations

Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Yarrow Point	-	-	-	-	$379,000	-	-	-	-	-	-	-
Cozy Cove	-	-	-	$585,000	-	-	-	-	-	-	-	-
Evergreen East	-	-	-	-	$344,000	-	-	-	-	-	-	-
Grange	-	-	$234,000	-	-	-	-	-	-	-	-	-
Wilburton	-	$358,000		-	-	-	-	-	-	-	-	-
Station 18	-	-	$22,000	-	-	-	-	-	-	$120,000	-	-
Hunts Point	-	-	-	-	-	$373,000	-	-	-	-	-	-
Evergreen West	-	-	-	-	-	$352,000	-	-	-	-	-	-
Lake Crest	-	-	-	-	-	-	$360,000	-	-	-	-	-
Killarney	-	-	-	-	-	-	$181,000	-	-	-	$213,000	-
Meydenbauer	-	-	-	-	-	-	$343,000	-	-	-	-	-
Bagley	-	-	$154,000	-	-	-	-	-	-	-	$210,000	-
Pleasure Point	-	-	-	-	-	$150,000	-	-	-	-	$210,000	-
Kimberlee Park	-	-	-	-	-	-	-	-	$289,000	-	-	-
South Ridge	-	-	$123,000	-	-	-	-	-	-	-	-	-
Lakemont	-	-	-	-	-	-	-	-	$333,000	-	-	-
Station 4	-	-	$12,000	-	-	-	-	-	$172,000	-	-	-
Station 6	-	-	-	-	-	-	-	-	-	$148,000	-	-
Station 7	-	-	-	-	-	-	-	-	$137,000	-	-	-
Flush 10	-	-	-	-	-	-	-	-	-	$145,000	-	-
Station 19	-	-	-	-	-	-	-	-	-	$143,000	-	-
Station 17	-	-	-	-	-	-	-	-	-	$116,000	-	-
Station 16	-	-	-	-	-	-	-	-	$258,000	-	-	-
Station 12	-	-	$10,000	-	-	-	-	$861,000	-	-	-	-
Station 2	-	-	-	-	-	-	$220,000	-	-	-	-	-
Station 1	-	-	-	-	-	$191,000	-	-	-	-	-	-
Newport Lift	-	-	$244,000	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	$236,000	-	-	-	-	-	-	-	-
Palisades	-	-	-	-	-	-	-	-	-	$411,000	-	-
Parkers	-	-	-	-	-	-	-	$413,000	-	-	-	-
Medina	-	-	-	-	$292,000	-	-	-	-	-	-	-
Fairweather	-	-	-	$306,000	-	-	-	-	-	-	-	-
Cedar Terrace	-	-	-	-	-	-	-	-	-	$169,000	-	-
Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	$75,000	-	-	$630,000	-
Flush #2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
Flush #3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
Flush #4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #5	-	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #9	-	-	$80,000	-	-	-	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	$30,000	-	-	-	-	-	-	-	-	-
TOTAL	**$0**	**$7,180,000**	**$984,000**	**$1,157,000**	**$1,015,000**	**$1,066,000**	**$1,114,000**	**$1,724,000**	**$1,379,000**	**$1,552,000**	**$1,268,000**	**$1,230,000**

Notes:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table ES-3 Continued
Summary of Prioritized Capital Improvement Project Costs for 46 Pump Stations

Station Name	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Yarrow Point	$14,000	-	-	-	-	-	$179,000	-	-	-	-	-	-
Cozy Cove	$46,000	-	-	-	-	$198,000	-	-	-	$11,000	-	-	-
Evergreen East	-	$17,000	-	-	-	-	$178,000	-	-	-	$17,000	-	-
Grange	$43,000	-	-	-	$98,000	-	-	-	-	$8,000	-	-	-
Wilburton	-	-	-	$98,000	-	-	-	$14,000	-	-	-	-	-
Station 18	-	-	-	-	-	$98,000	-	-	-	-	-	$13,000	-
Hunts Point	-	-	$8,000	-	-	-	-	$95,000	-	-	-	$8,000	-
Evergreen West	-	-	$8,000	-	-	-	-	$185,000	-	-	-	$8,000	-
Lake Crest	-	-	-	$11,000	-	-	-	-	$95,000	-	-	-	$11,000
Killarney	-	-	-	$8,000	-	-	-	-	$85,000	-	-	-	$98,000
Meydenbauer	-	-	-	$11,000	-	-	-	-	$178,000	-	-	-	$11,000
Bagley	-	-	-	-	$95,000	-	-	$5,000	-	-	-	-	-
Pleasure Point	-	-	-	-	-	-	-	$103,000	-	-	-	-	-
Kimberlee Park	-	-	-	-	-	$14,000	-	-	-	-	$204,000	-	-
South Ridge	-	-	-	-	$155,000	-	-	-	$5,000	-	-	-	-
Lakemont	-	-	$101,000	-	-	-	-	-	-	-	$67,000	-	-
Station 4	-	-	-	-	-	$19,000	-	-	-	-	-	$90,000	-
Station 6	-	-	-	-	-	-	$5,000	-	-	-	-	$98,000	-
Station 7	-	-	-	-	-	$5,000	-	-	-	-	$78,000	-	-
Flush 10	-	$150,000	-	-	-	-	$5,000	-	-	-	-	-	-
Station 19	-	-	-	-	-	-	$8,000	-	-	-	-	$185,000	-
Station 17	-	$90,000	-	-	-	-	$8,000	-	-	-	-	$95,000	-
Station 16	-	-	-	-	-	$8,000	-	-	-	-	$201,000	-	-
Station 12	-	-	-	-	$8,000	-	-	-	-	-	$169,000	-	-
Station 2	-	-	-	$11,000	-	-	-	-	$200,000	-	-	-	$11,000
Station 1	-	-	$17,000	-	-	-	-	$180,000	-	-	-	$32,000	-
Newport Lift	-	-	-	-	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	-	-	-	-	-	-	$1,390,000	-	-	-
Palisades	-	-	-	-	-	-	-	-	-	-	-	-	-
Parkers	-	-	$1,390,000	-	-	-	-	-	-	-	-	-	-
Medina	-	-	-	-	-	-	-	-	-	-	-	-	$1,050,000
Fairweather	-	-	-	-	-	-	-	-	-	-	-	$1,390,000	-
Cedar Terrace	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Heights	-	-	-	$100,000	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	$832,000	-	-	-	-	-	-	-	-	$1,783,000
Midlakes	-	-	-	$367,000	-	-	-	-	-	-	-	-	$1,054,000
Emerald Ridge	-	-	-	$95,000	-	-	-	-	-	-	$219,000	-	-
Flush #1	-	-	-	-	-	-	-	$5,000	-	-	-	-	$75,000
Flush #2	-	-	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	$75,000	-	-	-	-	$5,000	-
Flush #4	$285,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #5	$122,500	-	-	$80,000	-	-	-	-	-	-	$170,000	-	-
Flush #6	$232,500	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #7	$225,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #8	-	$480,000	-	-	-	-	-	-	-	-	$5,000	-	-
Flush #9	-	$330,000	-	-	-	-	-	-	-	-	$75,000	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$968,000**	**$1,067,000**	**$1,524,000**	**$1,613,000**	**$356,000**	**$342,000**	**$458,000**	**$587,000**	**$568,000**	**$1,424,000**	**$1,205,000**	**$1,924,000**	**$4,093,000**

Notes:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table ES-3 Continued
Summary of Prioritized Capital Improvement Project Costs for 33 Pump Stations

Station Name	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Yarrow Point	-	-	-	-	$225,000	-	-	-	-	-	-	$104,000	-
Cozy Cove	-	-	-	$385,000	-	-	-	-	-	-	$101,000	-	-
Evergreen East	-	-	-	-	$255,000	-	-	-	-	-	-	$107,000	-
Grange	-	-	$305,000	-	-	-	-	-	-	$178,000	-	-	-
Wilburton	-	$310,000	-	-	-	-	-	-	$104,000	-	-	-	-
Station 18	-	-	-	-	$90,000	-	-	-	-	-	$180,000	-	-
Hunts Point	-	-	-	-	-	$265,000	-	-	-	-	-	-	$98,000
Evergreen West	-	-	-	-	-	$195,000	-	-	-	-	-	-	$98,000
Lake Crest	-	-	-	-	-	-	$270,000	-	-	-	-	-	-
Killarney	-	-	-	-	-	-	$225,000	-	-	-	-	-	-
Meydenbauer	-	-	-	-	-	-	$215,000	-	-	-	-	-	-
Bagley	$180,000	-	-	-	-	-	-	-	-	$110,000	-	-	-
Pleasure Point	$90,000	-	-	-	-	-	-	$195,000	-	-	-	-	-
Kimberlee Park	-	$14,000	-	-	-	-	-	-	-	-	$170,000	-	-
South Ridge	-	-	$159,000	-	-	-	-	-	-	$95,000	-	-	-
Lakemont	-	-	-	-	-	-	-	$475,000	-	-	-	-	-
Station 4	-	$11,000	-	-	-	-	-	-	-	-	$190,000	-	-
Station 6	-	-	$5,000	-	-	-	-	-	-	$259,000	-	-	-
Station 7	-	$5,000	-	-	-	-	-	-	$205,000	-	-	-	-
Flush 10	-	-	$160,000	-	-	-	-	-	-	-	-	$30,000	-
Station 19	-	-	$8,000	-	-	-	-	-	-	-	-	$180,000	-
Station 17	-	-	$8,000	-	-	-	$90,000	-	-	-	-	$90,000	-
Station 16	-	$8,000	-	-	-	-	-	-	$235,000	-	-	-	-
Station 12	$8,000	-	-	-	-	-	-	$573,000	-	-	-	-	-
Station 2	-	-	-	-	-	-	-	-	$100,000	-	-	-	-
Station 1	-	-	-	-	-	-	-	$207,000	-	-	-	-	$150,000
Newport Lift	$1,050,000	-	-	-	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	-	-	-	-	-	-	-	-	-	-
Palisades	-	$900,000	-	-	-	-	-	-	-	-	-	-	-
Parkers	-	$3,000	-	-	-	-	-	-	-	-	-	-	-
Medina	-	-	-	-	-	-	-	-	-	-	-	-	-
Fairweather	-	-	-	-	-	-	-	-	-	-	-	-	-
Cedar Terrace	-	-	$35,000	-	-	-	-	-	-	-	-	-	-
Lake Heights	-	$219,000	-	-	-	-	-	-	$95,000	-	-	-	-
Bellefield	-	-	-	-	-	-	-	-	$503,000	-	-	-	$503,000
Midlakes	-	-	-	-	-	-	-	-	$321,000	-	-	-	-
Emerald Ridge	-	-	-	-	-	-	$95,000	-	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-	-
Flush #2	$75,000	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-
Flush #3	-	-	$5,000	-	-	-	-	-	-	-	-	$210,000	-
Flush #4	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #5	-	-	-	-	-	-	$80,000	-	-	-	-	-	-
Flush #6	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #7	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #8	$75,000	-	-	-	-	-	$5,000	-	-	-	-	-	-
Flush #9	-	-	$5,000	-	-	-	$5,000	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$1,703,000**	**$1,470,000**	**$690,000**	**$390,000**	**$575,000**	**$475,000**	**$985,000**	**$1,450,000**	**$1,563,000**	**$642,000**	**$811,000**	**$896,000**	**$1,359,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table ES-3 Continued
Summary of Prioritized Capital Improvement Project Costs for 33 Pump Stations

Station Name	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Yarrow Point	-	-	-	-	-	$89,000	-	-	-	-	-	-	-
Cozy Cove	-	-	-	-	$119,000	-	-	-	-	-	$35,000	-	-
Evergreen East	-	-	-	-	-	$105,000	-	-	-	-	-	-	-
Grange	-	-	-	$16,000	-	-	-	-	-	-	$35,000	-	-
Wilburton	-	-	$22,000	-	-	-	-	-	-	-	-	-	-
Station 18	-	-	-	-	-	-	$8,000	-	-	-	-	$5,000	-
Hunts Point	-	-	-	-	-	-	$13,000	-	-	-	-	-	-
Evergreen West	-	-	-	-	-	-	$103,000	-	-	-	-	-	-
Lake Crest	$101,000	-	-	-	-	-	-	$16,000	-	-	-	-	-
Killarney	-	-	$103,000	-	-	-	-	-	-	$88,000	-	-	-
Meydenbauer	$101,000	-	-	-	-	-	-	$99,000	-	-	-	-	-
Bagley	-	$5,000	-	-	-	$185,000	-	-	-	-	-	-	-
Pleasure Point	-	-	-	$98,000	-	-	-	-	$95,000	-	-	-	$8,000
Kimberlee Park	-	-	$90,000	-	-	-	$14,000	-	-	-	-	$114,000	-
South Ridge	-	-	-	$70,000	-	-	-	-	-	-	-	-	-
Lakemont	-	-	-	$11,000	-	-	-	-	$11,000	-	-	-	$101,000
Station 4	-	-	-	$101,000	-	-	-	-	-	-	-	$19,000	-
Station 6	-	-	-	$95,000	-	-	-	-	-	-	$13,000	-	-
Station 7	-	-	$75,000	-	-	-	-	-	-	$13,000	-	-	-
Flush 10	-	-	-	-	-	-	-	$75,000	-	-	-	-	$5,000
Station 19	-	-	-	-	-	-	-	$8,000	-	-	-	-	$193,000
Station 17	-	-	-	-	-	-	-	$8,000	-	-	-	$185,000	-
Station 16	-	-	$98,000	-	-	-	-	-	-	$119,000	-	-	-
Station 12	-	-	$208,000	-	-	-	-	-	$14,000	-	-	$8,000	-
Station 2	$150,000	-	-	-	$11,000	-	-	-	-	$95,000	-	-	-
Station 1	-	-	-	$17,000	-	-	-	-	$90,000	-	-	-	$17,000
Newport Lift	-	-	-	-	$3,000	-	-	-	-	-	-	-	-
Newport Pump	-	$3,000	-	-	-	-	-	$120,000	-	-	-	-	-
Palisades	-	-	-	-	$3,000	-	-	-	-	-	-	-	-
Parkers	-	$100,000	-	-	$3,000	-	-	-	-	-	-	-	-
Medina	-	$6,000	-	-	-	-	-	-	-	-	$120,000	-	-
Fairweather	-	$3,000	-	-	-	-	-	-	$120,000	-	-	-	-
Cedar Terrace	-	-	-	-	-	-	$450,000	-	-	-	-	-	-
Lake Heights	-	-	$10,000	-	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	-	$116,000	-	-	-	-	-	-	$2,383,000	-
Midlakes	$69,000	-	-	-	$69,000	-	-	-	-	-	-	$1,283,000	-
Emerald Ridge	-	-	$5,000	-	-	-	-	-	-	$309,000	-	-	-
Flush #1	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000	-
Flush #2	-	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000
Flush #3	-	-	-	-	-	-	-	$5,000	-	-	-	-	$5,000
Flush #4	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #5	-	-	$5,000	-	-	-	-	-	-	$240,000	-	-	-
Flush #6	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #7	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #8	$170,000	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #9	$240,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$831,000**	**$117,000**	**$616,000**	**$408,000**	**$399,000**	**$754,000**	**$588,000**	**$331,000**	**$330,000**	**$869,000**	**$203,000**	**$4,007,000**	**$339,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table ES-3 Continued
Summary of Prioritized Capital Improvement Project Costs for 33 Pump Stations

Station Name	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078
Yarrow Point	-	-	-	$895,000	-	-	-	-	-	-	-	-	$14,000
Cozy Cove	-	-	$1,005,000	-	-	-	-	-	-	-	-	$91,000	-
Evergreen East	-	-	-	$925,000	-	-	-	-	-	-	-	-	$17,000
Grange	-	$1,010,000	-	-	-	-	-	-	-	-	$8,000	-	-
Wilburton	$820,000	-	-	-	-	-	-	-	-	$14,000	-	-	-
Station 18	-	-	$188,000	-	-	-	-	-	-	-	-	$700,000	-
Hunts Point	-	-	-	-	$895,000	-	-	-	-	-	-	-	-
Evergreen West	-	-	-	-	$790,000	-	-	-	-	-	-	-	-
Lake Crest	-	-	-	-	-	$860,000	-	-	-	-	-	-	-
Killarney	-	-	-	-	-	-	-	$820,000	-	-	-	-	-
Meydenbauer	-	-	-	-	-	$775,000	-	-	-	-	-	-	-
Bagley	-	$650,000	-	-	-	-	-	-	-	-	$95,000	-	-
Pleasure Point	-	-	-	-	-	-	-	-	$740,000	-	-	-	-
Kimberlee Park	-	-	$14,000	-	-	-	-	$850,000	-	-	-	-	-
South Ridge	-	$599,000	-	-	-	-	-	-	-	-	$5,000	-	-
Lakemont	-	-	-	-	-	-	-	$815,000	-	-	-	-	-
Station 4	-	-	-	-	-	-	-	-	$860,000	-	-	-	-
Station 6	-	-	-	-	-	-	-	-	$809,000	-	-	-	-
Station 7	-	-	-	-	-	-	-	$680,000	-	-	-	-	-
Flush 10	-	-	-	$85,000	-	-	-	-	-	-	-	-	$600,000
Station 19	-	-	-	-	-	-	-	-	-	-	-	-	$680,000
Station 17	-	-	-	$8,000	-	-	-	-	-	-	-	-	$815,000
Station 16	-	-	-	-	-	-	-	$805,000	-	-	-	-	-
Station 12	-	-	-	-	-	-	-	$1,373,000	-	-	-	-	-
Station 2	$11,000	-	-	-	-	$915,000	-	-	-	-	-	-	-
Station 1	-	-	-	-	$997,000	-	-	-	-	-	-	-	-
Newport Lift	$120,000	-	-	-	-	-	$3,000	-	-	-	-	-	-
Newport Pump	$3,000	-	-	-	-	-	-	-	-	-	-	-	-
Palisades	$100,000	-	-	-	-	-	$3,000	-	-	-	-	-	-
Parkers	-	-	-	-	-	-	$3,000	-	-	$100,000	-	-	-
Medina	$6,000	-	-	-	-	-	-	-	-	-	-	-	-
Fairweather	$3,000	-	-	-	-	-	-	-	-	-	-	-	-
Cedar Terrace	$15,000	-	-	-	-	-	-	-	-	-	-	-	-
Lake Heights	$309,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	-	-	-	-	-	-	$116,000	-	-	-	-	$116,000
Midlakes	-	-	-	-	-	-	-	$69,000	-	-	-	-	$69,000
Emerald Ridge	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #1	-	-	-	-	-	-	-	-	-	$560,000	-	-	-
Flush #2	-	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #3	-	-	-	$75,000	-	-	-	-	-	-	-	-	$520,000
Flush #4	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #5	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #6	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #7	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #8	-	$10,000	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #9	-	$5,000	-	-	-	$75,000	-	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$1,417,000**	**$2,274,000**	**$1,207,000**	**$1,988,000**	**$2,682,000**	**$2,635,000**	**$9,000**	**$5,528,000**	**$2,409,000**	**$679,000**	**$2,918,000**	**$791,000**	**$2,831,000**

Notes:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table ES-3 Continued
Summary of Prioritized Capital Improvement Project Costs for 33 Pump Stations

Station Name	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089
Yarrow Point	-	-	-	-	$179,000	-	-	-	-	-	-
Cozy Cove	-	-	-	$108,000	-	-	-	$101,000	-	-	-
Evergreen East	-	-	-	-	$195,000	-	-	-	-	-	-
Grange	-	-	$8,000	-	-	-	$178,000	-	-	-	-
Wilburton	-	$8,000	-	-	-	$104,000	-	-	-	-	-
Station 18	-	-	-	-	-	-	-	$98,000	-	-	-
Hunts Point	$8,000	-	-	-	-	$5,000	-	-	-	$98,000	-
Evergreen West	$8,000	-	-	-	-	-	-	$193,000	-	-	-
Lake Crest	-	$11,000	-	-	-	-	$5,000	-	-	-	-
Killarney	-	-	-	$8,000	-	-	-	-	$5,000	-	-
Meydenbauer	-	$11,000	-	-	-	-	$88,000	-	-	-	-
Bagley	-	-	$5,000	-	-	-	$95,000	-	-	-	-
Pleasure Point	-	-	-	-	$8,000	-	-	-	-	$95,000	-
Kimberlee Park	-	-	-	$14,000	-	-	-	-	$14,000	-	-
South Ridge	-	-	$160,000	-	-	-	-	-	-	-	-
Lakemont	-	-	-	$191,000	-	-	-	-	$11,000	-	-
Station 4	-	-	-	-	$11,000	-	-	-	-	$8,000	-
Station 6	-	-	-	-	$5,000	-	-	-	-	$8,000	-
Station 7	-	-	-	$5,000	-	-	-	-	$8,000	-	-
Flush 10	-	-	-	-	-	-	-	-	$5,000	-	-
Station 19	-	-	-	-	$90,000	-	-	-	$8,000	-	-
Station 17	-	-	-	-	-	-	-	-	$8,000	-	-
Station 16	-	-	-	$8,000	-	-	-	-	$11,000	-	-
Station 12	-	-	-	$8,000	-	-	-	-	$14,000	-	-
Station 2	-	$11,000	-	-	-	-	$5,000	-	-	-	-
Station 1	$17,000	-	-	-	-	$5,000	-	-	-	$252,000	-
Newport Lift	-	-	-	-	-	-	-	-	$3,000	-	-
Newport Pump	-	$3,000	-	-	-	-	-	-	$120,000	-	-
Palisades	-	-	-	-	-	-	-	-	-	-	$3,000
Parkers	-	-	-	-	-	-	-	-	-	-	$3,000
Medina	-	-	-	-	-	$6,000	-	-	-	-	$120,000
Fairweather	-	-	-	-	-	$3,000	-	-	-	-	$120,000
Cedar Terrace	-	-	-	-	-	$20,000	-	-	-	-	-
Lake Heights	-	$5,000	-	-	-	$95,000	-	-	-	-	-
Bellefield	-	-	-	$503,000	-	-	-	-	-	$387,000	-
Midlakes	-	-	-	$527,000	-	-	-	-	-	-	-
Emerald Ridge	-	$95,000	-	-	-	-	-	-	-	-	-
Flush #1	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #2	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	-	-	$75,000	-	-
Flush #4	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #5	-	$75,000	-	-	-	-	-	-	-	-	$380,000
Flush #6	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #7	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #8	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #9	-	$490,000	-	-	-	-	-	-	-	-	$5,000
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$33,000**	**$709,000**	**$173,000**	**$1,372,000**	**$488,000**	**$243,000**	**$396,000**	**$392,000**	**$282,000**	**$848,000**	**$631,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

SECTION 1 - INTRODUCTION

1.1 Authorization

On March 5, 2014, Murray, Smith & Associates, Inc. (MSA) was authorized by the City of Bellevue (City) to prepare this evaluation of 26 city-owned sewer pump/lift stations, as well as a higher level, confirmation review of seven others that had previously been evaluated. This scope was later expanded to capture the City's wastewater pump station capital planning, already in place, for the 13 remaining stations.

1.2 Background and Purpose

The City of Bellevue (City) owns and operates 46 wastewater pump and flush stations. Many of these pump stations were built in the early 1960s and upgraded in the late 1980s. Given the age of the facilities and a growing number of operation and maintenance issues, equipment may be reaching the end of its service life or may be obsolete. To address this concern, the City elected to conduct a needs-based (to meet service levels) condition assessment of the pump stations to provide an overall system assessment that focuses on maintaining station reliability, serviceability, safety and overall efficiency.

The City conducted an initial wastewater pump station evaluation project in 2013 when a consultant evaluated the condition of seven stations. That phase of the wastewater pump station evaluation program, Phase 1, was completed in early 2014, with the delivery of a final report which is referenced within this report, but not included.

This project is the second phase of an overall evaluation process and includes field evaluations of 26 wastewater pump stations. The first phase, which included the field evaluation of seven wastewater pump stations, has been incorporated into this study to provide a consistent basis for moving forward. Those 33 stations represent all stations that have not been recently rehabilitated or replaced. The remaining 13 stations owned and operated by the City were not field evaluated because they are currently undergoing or have recently completed an upgrade/replacement. However, the near-term and long-term capital projects for the 13 stations are included to provide a complete pump station financial plan. Station evaluations are focused on the wastewater pump stations, including the discharge piping and valves within each station, but force mains and downstream collection system considerations are not part of this contract. Detailed wet well evaluations are also not part of this contract.

This study supports the overall planning and budgeting of the City's 75-year planning horizon for the wastewater pump stations, planning for capital expenditures and balancing costs across fiscal years.

1.3 Overview

This report includes general discussions of the approach to evaluations, lifecycle cost estimating and prioritization as well as individual report sections for each of the wastewater pump station facilities that were evaluated. In this report, findings of the 26 pump stations inspected by MSA and Casne Engineering, MSA's electrical sub-consultant, are discussed. Individual report sections for each of the 26 pump station includes a discussion of the physical evaluation as well as short and long-term recommendations and their associated costs. Project recommendations have been proposed as the most cost-effective, need-based improvements that will bring the pump station in line with the City's service level requirements. In addition, the recommended projects and associated costs for the seven pump stations previously evaluated along with the 13 remaining stations not field-evaluated were reviewed for consistency with the 26 stations evaluated as part of this second phase. Projected future needs for all 46 wastewater pump and flush stations are all incorporated in a recommended capital improvement program.

1.4 Project Scope

MSA worked closely with the City to develop a scope of work that efficiently addresses key issues, engages staff, takes advantage of existing information and provides the necessary guidance and planning for the City's near-term and long-term management of their wastewater pump stations.

The scope of work for this phase of the wastewater pump station evaluation program includes the following abbreviated elements:

- ***Project Management -*** Provide overall leadership and team strategic guidance aligned with project objectives.

- ***Pump Station Condition Assessment -*** Evaluate each of the 26 pump stations on a component basis and as a whole facility. The condition assessment will be based on review of available existing data and observations made during site visits to each pump station. The condition assessment will include assessment of compliance with applicable codes and regulations. The Consultant will also evaluate obsolescence with respect to being able to obtain parts and equipment needed to maintain pump station systems and components.

- ***Recommendations and Planning Level Cost Estimates -*** For each of the 26 stations, summarize pump station and pump station component reliability and performance, and project future reliability and performance. Identify recommendations to address issues needed to prevent potential mechanical, electrical or structural failure, inability to cost-effectively operate and maintain pump station systems due to obsolescence or the inability of existing systems to meet operational requirements.

- ***Long Term Resource Needs Planning -*** For all 46 stations, estimate when major rehabilitation of pump station site, mechanical, structural and electrical/telemetry systems will be needed. Provide long-term planning level cost estimates for the anticipated rehabilitation needs. The remaining estimated useful life estimates will be based on the condition assessments, the performance of similar systems and the Consultant's expertise. Potential for breakdown/failure, obsolescence leading to the inability to operate and maintain, and inability to meet operational requirements will be considered in the long term needs assessment. Provide long-term planning level cost estimates through one pump station replacement cycle for each pump station.

- ***Report Preparation -*** Prepare a report that presents the findings of the project work. The report will include condition assessment findings and recommendations for pump station components assessed along with long term needs assessments for each pump station system (site, mechanical, structural and electrical/control). The report will incorporate the findings identified in the November 2013 City of Bellevue Wastewater Pump Station Evaluation Phase 1 report by HDR.

- ***Incorporation of Pump Stations Not Field-Evaluated -*** Incorporate the City's remaining 20 pump stations, the stations that were not field-evaluated under this second phase of the work, into the capital improvement program and 75-year financial planning outlook. These 20 stations include the seven stations that were previously evaluated by HDR and the 13 remaining stations that were recently rehabilitated or replaced. Include the costs and timing for the 20 pump stations not field-evaluated into the report.

- ***Station 12 Hydraulic Evaluation -*** Perform a hydraulic evaluation of Pump Station 12 to determine the source(s) of the hydraulic issues that are contributing to noise and irregular wear on the impeller and volute (appears to be cavitation). Prepare a technical memorandum that presents the findings of the hydraulic evaluation.

SECTION 2 – FIELD EVALUATION APPROACH FOR 26 STATIONS

2.1 Introduction

Murray, Smith & Associates, Inc.'s (MSA's) approach to evaluating the City's wastewater pump stations is based on our experience with evaluating pump station operation, pump station designs and long term capital improvement planning. The evaluation of 26 of the City's wastewater pump stations includes an evaluation of the site, mechanical, structural, electrical and telemetry components of the pump station to evaluate these components individually as well as the station as a whole. A list of the 26 wastewater pump stations field evaluated is provided below.

Yarrow Point	Evergreen West	Southridge	Station 19
Cozy Cove	Lake Crest	Lakemont	Station 17
Evergreen East	Killarney	Station 4	Station 16
Grange	Meydenbauer	Station 6	Station 12
Wilburton	Bagley	Station 7	Station 2
Station 18	Pleasure Point	Flush 10	Station 1
Hunts Point	Kimberlee Park		

2.2 Evaluation Methodology

Components were evaluated in three categories:

- Condition – the physical condition of a component, used to estimate remaining useful life.
- Criticality – correlates the relationship of a component to the overall operation of the pump station and its consequence of failure.
- Serviceability – the ability to maintain, repair, or replace a component, considering accessibility, safety, and availability of parts.

As the evaluations progressed, it became evident that some components could not be accurately evaluated within the scope of this work (largely visual inspection and minor operational testing). Therefore, the evaluation process was modified to avoid the perception of conveying a level of evaluation that could not be accomplished within the current scope. A discussion of the condition, criticality and serviceability rating is provided below.

2.2.1 Condition Rating

Each component was assigned a condition rating on a five-point scale, with a 1 indicating good condition and a 5 indicating poor condition. While estimations of remaining life are difficult to accurately predict, general timelines were assigned to each condition rating based on the information available. A detailed description of the condition rating can be found in Table 2-1.

Table 2-1
Condition Rating Description

Condition Rating	Description
1	Very good, well maintained, expected to remain reliable for more than 10 years.
2	Good, some degradation but performance and reliability is not significantly affected. Performance and reliability expected to remain satisfactory for 10 years +/-.
3	Fair, performance and reliability is still acceptable but some rehabilitation or replacement in the next 5-10 years is needed to maintain performance and/or reliability at acceptable levels.
4	Poor, performance and/or reliability has significantly decreased, maintenance rehabilitation or replacement needed to restore performance or reliability to acceptable levels. Failure (no longer functions) is likely in 5 years +/- if not rehabilitated or replaced.
5	Very poor, performance and/or reliability has significantly decreased and failure is probable within 3 years if rehabilitation or replacement is not performed.

2.2.2 Criticality Rating

Each component was also given a criticality rating based on its impact on the overall system operation. On a four-point scale, a rating of 1 indicates a component is not critical and its failure would not significantly affect the pump station operation, while a rating of 4 indicates a component is critical and the pump station could not operate if the component failed. Redundancy is considered in the assessment of a component that is critical but has an independent backup that would continue the successful operation of the station.

Estimating influent flows for comparison with the current pump station capacity was not within the scope of this work. Therefore, in order to determine the adequacy of the station's capacity and if the station has pumping redundancy, this report relied on observations by City staff. City staff report that several stations have experienced a condition of all pumps running, including:

Yarrow Point	Medina
Hunts Point	Parkers
Cozy Cove	Newport Lift
Fairweather	Newport Pump
Evergreen East	Bagley
Evergreen West	Pleasure Point

No mechanical issues were present during the noted instances where all pumps were running, therefore indicating a potential loss of pumping redundancy. Further evaluation to confirm that the influent flow exceeds the pumping capacity is needed at each of these pump stations to verify conditions.

A detailed description of the criticality rating can be found in Table 2-2.

Table 2-2
Criticality Rating Description

Criticality Rating	Description
1	Not critical, failure would not significantly affect pump station operation.
2	Somewhat critical, could marginally reduce pump station ability to handle station design flows.
3	Critical but redundant, pump station could not operate without a currently-installed redundant component.
4	Critical, pump station could not operate upon failure.

2.2.3 Serviceability Rating

Where applicable, components were assigned a serviceability rating to address accessibility, safety issues, and availability of parts. Availability of parts is generally associated with the obsolescence of a given piece of equipment. Once a piece of equipment is no longer manufactured, support diminishes over time, and parts become exceedingly difficult to obtain. On a four-point scale, a rating of 1 indicates a component is supported by the manufacturer, easily accessed, and no safety issue exists while a rating of 4 indicates that the component may not be able to be serviced, a safety issue exists, and/or accessibility is severely limited. A detailed description of the serviceability rating can be found in Table 2-3.

Table 2-3
Serviceability Rating Description

Serviceability Rating	Description
1	Very good, parts are readily available and component is easily accessed.
2	Fair, parts are available but can be difficult to get and/or item is somewhat difficult to access.
3	Poor, component is no longer supported by the manufacturer and parts must be customized and/or component is difficult to access.
4	Very poor, a safety issue exists.

2.3 Evaluation Form

MSA's standard wastewater pump station evaluation form was customized to address the City of Bellevue's needs and to capture the information relevant for comparison with the City's minimum level of service for wastewater pump stations. The form is comprehensive in the fact that it could be applied to any station regardless of the type and configuration. To collect and record information in the most complete and practical manner while at the pump station sites, the form was converted for use on an iPad utilizing OneNote software.

2.4 Pump Capacity Testing

As part of the evaluation process for the pump stations, the current pumping capacity was measured at each facility for comparison with the original design flow. Without flow meters on any of the stations, volumetric calculations were made based on the following available information:

- Pump on/off elevations (depth of volume pumped)
- Wet well dimensions (area of volume pumped)
- Time-to-fill (influent flow rate)
- Time-to-pump (pump rate, less influent rate)

Time-to-fill and time-to-pump durations were provided by the City from the system-wide supervisory control and data acquisition (SCADA) system. These durations were provided to the nearest second, a very reasonable level of accuracy, and the available data allowed for a couple of tests on each pump. Wet well dimensions were taken from as-built drawings, where available, and confirmed whenever possible (wet well entry was not included in this scope of work) to estimate the volume of liquid pumped. Given the information available, the accuracy of the flow calculations is estimated at +/- 20%.

In addition to the pump capacity estimations, pressure readings were provided by City staff for both pump-on and pump-off conditions. These pressure measurements, when used with the flow rate calculations identify potential issues in pump degradation and operation relative to the original design point. Assessments based on the available information are discussed in each of the pump station report sections.

2.5 Grandfathered Term

The term "grandfathered" is used to state that when stations were built, the code then did not include rules that are now required. The NEC 90.4 enforcement section states in part that, "The authority having jurisdiction for enforcement of the code has the responsibility for making interpretations of the rules, for deciding on the approval of equipment and materials and for granting the special permission contemplated in a number of the rules." The authority having jurisdiction does not routinely review work that is not upgraded unless the there is a major renovation at that station. Thus stations that have code requirement issues will not need to be addressed until a major renovation is done at that station.

2.6 Current Hazardous Area Classifications

Along with the condition, criticality and serviceability rating for applicable components, the evaluation of the station's structures include an assessment of compliance with applicable codes and regulations. Areas were classified based on the National Fire Protection Agency (NFPA) 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities to understand the fire and explosion hazard at the station.

This code includes three hazardous location types including: Class I, Class II and Class III. Class I location hazards include flammable gases or vapors. Class II location hazards include combustible dust and Class III location hazards include easily-ignitable fibers. Since the only potential hazard at the stations are flammable gases or vapors, most station's structures location types are Class I. If the structures were not Class I they were unclassified spaces meaning there is no potential fire or explosion hazard.

Within the Class I location type, there are two different hazardous location conditions labeled Division 1 and Division 2. Division 1 specifies "normal conditions" in which the hazard is present during normal operation. Division 2 specifies "abnormal conditions" in which the hazard is only present if components containing the flammable gas or vapor fail creating a fire or explosion hazard. A summary of the area classification is provided in Figure 2-1 and Figure 2-2 below, taken directly from the NFPA 820 Code, Table 4.2.

It was apparent at most stations that there are issues regarding NFPA 820 code requirements for the dry pit and wet well blower vault, and two corrective action alternatives were identified. Each of these two areas could either be re-classified by modifying ventilation systems or re-built according to its current classified area. A summary table of the structures NFPA 820 classification rating based on the existing conditions can be found in Table 2-4.

Table 2-4
Summary of Observed Structures NFPA 820 Classification Rating

Structure Type	Class 1, Division 1	Class 1, Division 2	Unclassified
Dry Pit	-	No ventilation or ventilated at less than 6 air changes per hour	Continuously ventilated at 6 air changes per hour
Wet Well	No ventilation or ventilated at less than 12 air changes per hour	Continuously ventilated at 12 air changes per hour	-
Wet Well Blower Vault	-	Entire area if enclosed with no ventilation or ventilated at less than 6 air changes per hour OR continuously ventilated at 6 air changes per hour or outdoors within 0.9 m (3 ft) of leakage sources	Areas beyond 0.9 m (3 ft) of leakage sources
Generator Vault	-	-	All conditions
Check Valve and Isolation Valve Vault	Not normally ventilated	Continuously ventilated at 12 air changes per hour	-

Figure 2-1
Excerpt of NFPA 820 Code Area Classifications (Rows 16-18)

Table 4.2 *Continued*

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	*NEC*-Area Electrical Classification (All Class I, Group D)	Material of Construction for Buildings or Structures	Fire Protection Measures
16	a	WASTEWATER PUMPING STATION WET WELLS Liquid side of a pumping station serving a sanitary sewer or combined system	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1	NC, LC, or LFS	CGD
	b			B		Division 2		
17	a	BELOWGRADE OR PARTIALLY BELOWGRADE WASTEWATER PUMPING STATION DRY WELL Pump room physically separated from wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	Buildup of vapors from flammable or combustible liquids	C	Entire space or room	Unclassified	NC, LC, or LFS	FE
	b			D		Division 2, or unclassified, if space provided with pressurization in accordance with NFPA 496		
18		ABOVEGRADE WASTEWATER PUMPING STATION Pump room physically separated with no personnel access to wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	NA	NR	NA	Unclassified	NC, LC, or LFS	FE

(continues)

Figure 2-2
Excerpt of NFPA 820 Code Area Classifications (Rows 19-21)

Table 4.2 *Continued*

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	*NEC*-Area Electrical Classification (All Class I, Group D)	Material of Construction for Buildings or Structures	Fire Protection Measures
19	a	ABOVEGRADE WASTEWATER PUMPING STATION Pump room not physically separated from wet well; pumping of wastewater from a sanitary or combined sewer system through closed pumps and pipes	Possible ignition of flammable gases and floating flammable liquids	A	Entire space or room	Division 1	NC	FE
	b			B		Division 2	NC, LC, or LFS	
20	a	ODOR-CONTROL SYSTEM AREAS Areas physically separated from wet well and housing systems handling wet well gases	Leakage and ignition of flammable gases	D	Entire area if enclosed	Division 2	NC, LC, or LFS	CGD and FDS
	b			C, or outdoors	Areas within 0.9 m (3 ft) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor-control vessels	Division 2		
	c				Areas beyond 0.9 m (3 ft)	Unclassified		
21	a	MAINTENANCE HOLES Access to sewer for personnel entry	Possible ignition of flammable gases and floating flammable liquids	NNV	Inside	Division 1	In accordance with 8.3.1	NR
	b			B		Division 2		

2.7 Water Service Backflow Prevention

As required by building and health codes, backflow preventers are installed on the water service for each station to reduce the potential for contamination of the domestic water system. Washington Administrative Code 246-290-490 addresses the installation requirements of an approved backflow preventer, which generally includes a reduced pressure backflow device that is installed to avoid potential for submergence and has clear access to facilitate testing and replacement.

Backflow preventers were present at each of the stations evaluated that were served by a potable water source. Three facilities, Station 1, Station 2, and Flush 10, rely on non-potable lake water intakes for washdown water. The backflow preventer installations at the remaining facilities generally included one of the following installation conditions:

1. Aboveground installation in a protected housing with a drain to daylight.
2. Installation in an aboveground valve box that can be removed to facilitate access and also drains to daylight.
3. Installation in a belowground valve box that does not have a method for drainage.
4. Installation in a belowground vault or dry well that has a sump pump to reduce the potential for flooding.

The first two installation conditions appear to comply with code requirements. The third installation condition readily introduces the potential for flooding and does not comply with code requirements. It is anticipated that the fourth installation condition complies with City standards as an exception, since it relies on a sump pump and does not drain to daylight. However, this fourth installation condition should be reviewed as needed with the City's cross connection control program.

2.8 Fall Protection

Safety regulations require fall protection in varying degrees, depending on the type of situation and whether it is permanent or temporary. Both Washington Administrative Code 296-800-26005 and Occupational Safety and Health Administration code 1910.23 require that protection at temporary openings, similar to those at a pump station site where hatches are periodically opened to facilitate maintenance, can be accomplished by installing protective railing, either permanent or temporary, or have an individual constantly attend the opening and identify the hazard. Manhole covers and hatches are treated similarly in that they must be closed when not in use or have a person constantly attending the opening.

Most of the pump stations have hatches and manhole openings that do not have grating to cover the openings or handrail. The City should review fall protection policies and confirm current protocols are adequate to address fall protection at the pump station sites. As part of pump station upgrades to address deficiencies, fall protection improvements should be implemented as necessary to conform to City policies and applicable code requirements.

SECTION 3 - CAPITAL IMPROVEMENT PROJECTS

3.1 Introduction

The capital improvement project recommendations for the 46 pump stations are based on the observed deficiencies when available and sound engineering judgment. A total of 26 stations were field evaluated as part of this scope of work. The seven stations that were previously evaluated by another consultant and the 13 stations not field evaluated were reviewed and incorporated into the capital improvement projects based on information available. Section 31 of this report presents a summary of the seven previously evaluated stations and any modifications to the original recommendations. Section 32 of this report presents a summary of the cost planning for the 13 stations that were not field evaluated. Recommended improvement projects were not distributed within the 2015 and 2016 years, as those years have already been budgeted by the City. The prioritization of the near-term projects for all 46 pump stations is included in this section.

The projects identified for each facility include rehabilitation and replacement costs for all structural, mechanical, and electrical components necessary to maintain pump station operation at a minimum level of service as defined in Section 4. The projects and associated costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Force mains were not evaluated as part of this effort.

3.2 Capital Improvement Projects for all 46 Stations

The following capital improvement project costs and timelines are representative of the 26 pump stations evaluated, the seven pump stations previously evaluated by another consultant and the 13 pump stations not field evaluated as part of any study. The time frames for the 33 pump stations that were evaluated are based on the condition, criticality and serviceability rating of components that trigger project implementation. The condition assessment rating of a component, as determined during the field evaluations, establishes the remaining useful life and defines a time frame of a capital improvement project, see Table 3-1. High criticality and/or serviceability ratings then serve as factors to accelerate the identified project by one condition-rating time frame. Time frames overlap due to the uncertainty of equipment degradation over time.

Table 3-1
Summary of Capital Improvement Project Costs/Timeline for 33 Pump Stations

Condition Rating	5	4	3	2	1
Action time frame	<3 years	5+/- years	5-10 years	10+/- years	>10 years
Calendar window	2015-2018	2018-2022	2020-2025	2023-2026	Long term planning

The time frames for the 13 pump stations not field evaluated are based on the wastewater pump station budget in the City's capital improvement projects. If any of the 13 pump stations did not have projects within this budget, the timeline was based on the year of the station's last upgrade.

3.2.1 Basis of Capital Improvement Project Costing

Project costs for the 33 pump stations that were field evaluated are based on 2014 planning level cost estimates (ENR CCI value of 10,162 for August 2014, Seattle, WA) with an expected accuracy range of -30% to 50% in accordance with American Association of Cost Engineering (AACE) estimate class 4. Project costs include construction costs plus sales tax at 9.5%, Engineering, Legal and Administration (ELA) costs at 35% and a contingency of 30% in accordance with AACE.

Project costs for the 13 remaining pump stations not field evaluated are based on bid tabs provided by the City for a given station. If the station had not been recently upgraded and did not have a recent bid tab, project costs were based on bid tabs from stations with similar capacity and overall structure.

A summary of the capital improvement project costs by station in a designated time frame is represented in Table 3-2.

Table 3-2
Summary of Capital Improvement Project Costs/Timeline for 46 Pump Stations

	Station Name	2015-2018	2018-2022	2020-2025	2023-2026
Field Evaluated Stations	Yarrow Point	$379,000	-	-	-
	Cozy Cove	$585,000	-	-	-
	Evergreen East	$344,000	-	-	-
	Grange	-	$234,000	-	-
	Wilburton	-	-	$358,000	-
	Station 18	$22,000	-	$120,000	-
	Hunts Point	$373,000	-	-	-
	Evergreen West	$352,000	-	-	-
	Lake Crest	-	$360,000	-	-
	Killarney	-	$181,000	-	$213,000
	Meydenbauer	-	$343,000	-	-
	Bagley	$154,000	-	-	$210,000
	Pleasure Point	$150,000	-	-	$210,000
	Kimberlee Park	-	-	-	$289,000
	South Ridge	-	-	$123,000	-
	Lakemont	-	$333,000	-	-
	Station 4	$12,000	-	$172,000	-
	Station 6	-	-	$148,000	-
	Station 7	-	-	$137,000	-
	Flush 10	-	-	$145,000	-
	Station 19	-	-	$143,000	-
	Station 17	-	-	$116,000	-
	Station 16	-	$258,000	-	-
	Station 12	$10,000	-	$861,000	-
	Station 2	-	$220,000	-	-
	Station 1	-	$191,000	-	-
Field Confirmed Stations	Newport Lift	$244,000	-	-	-
	Newport Pump	$236,000	-	-	-
	Palisades	-	-	$411,000	-
	Parkers	$413,000	-	-	-
	Medina	$292,000	-	-	-
	Fairweather	$306,000	-	-	-
	Cedar Terrace	-	-	$169,000	-
Remaining 13 Stations Not Field Evaluated	Lake Heights	$659,000	-	-	$5,000
	Bellefield	$3,874,000	-	$116,000	-
	Midlakes	$2,289,000	-	$69,000	-
	Emerald Ridge		-	$5,000	$5,000
	Flush #1		$5,000	$75,000	$630,000
	Flush #2		$5,000	$75,000	$1,230,000
	Flush #3	$75,000	-	-	$300,000
	Flush #4		$5,000	$75,000	$285,000
	Flush #5		$5,000	-	$122,500
	Flush #6		$5,000	$75,000	$232,500
	Flush #7		$5,000	$75,000	$225,000
	Flush #8		$5,000	$75,000	$480,000
	Flush #9	$80,000	-	-	$330,000
	Crane/Rail Study and Load Testing	$30,000	-	-	-
	TOTAL	**$10,879,000**	**$2,155,000**	**$3,543,000**	**$4,767,000**

3.3 Prioritization of Capital Improvement Projects for all 46 Stations

The recommended timing of the capital improvement projects for each of the 46 pump stations were based on field assessments that considered condition, criticality, and serviceability when available, or on City-provided information for stations not field evaluated. More than one project was identified within each given timeframe, necessitating a prioritization of those recommended projects. Based on discussions with the City, projects and sewer pump stations with conflicting needs in the same years were further prioritized based on the following criteria:

1. Loss of pump station redundancy (all pumps run during peak flows).
2. Overflow location:
    a. Public impact.
    b. Property damage.
    c. Environmental impact.
3. Number of upstream pump stations (failure would effectively take out upstream stations as well).
4. Pumping design capacity (tie-breaker when all other considerations are equal).
5. Type of station (flush stations were given the lowest priority).

The projects were initially prioritized and distributed within each planned time frame and then the timing was further adjusted to alleviate financial costs within a given year. Capital improvement projects for the 33 pump stations were not distributed within the 2015 and 2016 years, as those years have already been budgeted by the City. As part of the coordination with the City's current budget, Wilburton pump station upgrades were moved up to the year 2016. The City's total budget for Wilburton pump station is approximately $1.5 million. The project cost included in this report are reflective of needs based improvements only.

The prioritization of the 13 remaining stations that were not field evaluated were based on discussions with the City regarding the criteria shown above. Since most of the 13 stations are flush stations they were given the lowest priority.

A summary of the prioritized capital improvement project costs by station in a designated year is represented in Table 3-3.

3.4 Additional Capital Improvement Projects

Force mains are a highly critical component to the operation of a wastewater pump station and their consequence of failure can be significant. Most force mains have no redundancy, and while station components have been upgraded over the years, force mains are typically the original equipment, installed when the station was originally constructed.

Force mains are subject to the harsh environmental conditions of wastewater and depending on the type of pipe material, configuration, service area and operating conditions of the station, their condition can be highly variable. Force main replacement or rehabilitation can be a significant cost, and may rival the capital costs associated with the pump station upgrades.

Given the age of the pump stations, it is recommended that the City conduct an evaluation of the force mains and downstream discharge at each pump station to determine their condition, criticality and serviceability. This evaluation should consider the short term capital needs and long term resource planning needs, so the information can be incorporated into the information presented within this report.

Table 3-3
Summary of Prioritized Capital Improvement Project Costs for 46 Pump Stations

	Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Field Evaluated Stations	Yarrow Point	-	-	-	-	$379,000	-	-	-	-	-	-	-
	Cozy Cove	-	-	-	$585,000	-	-	-	-	-	-	-	-
	Evergreen East	-	-	-	-	$344,000	-	-	-	-	-	-	-
	Grange	-	-	$234,000	-	-	-	-	-	-	-	-	-
	Wilburton	-	$358,000		-	-	-	-	-	-	-	-	-
	Station 18	-	-	$22,000	-	-	-	-	-	-	$120,000	-	-
	Hunts Point	-	-	-	-	-	$373,000	-	-	-	-	-	-
	Evergreen West	-	-	-	-	-	$352,000	-	-	-	-	-	-
	Lake Crest	-	-	-	-	-	-	$360,000	-	-	-	-	-
	Killarney	-	-	-	-	-	-	$181,000	-	-	-	$213,000	-
	Meydenbauer	-	-	-	-	-	-	$343,000	-	-	-	-	-
	Bagley	-	-	$154,000	-	-	-	-	-	-	-	$210,000	-
	Pleasure Point	-	-	-	-	-	$150,000	-	-	-	-	$210,000	-
	Kimberlee Park	-	-	-	-	-	-	-	-	$289,000	-	-	-
	South Ridge	-	-	$123,000	-	-	-	-	-	-	-	-	-
	Lakemont	-	-	-	-	-	-	-	-	$333,000	-	-	-
	Station 4	-	-	$12,000	-	-	-	-	-	$172,000	-	-	-
	Station 6	-	-	-	-	-	-	-	-	-	$148,000	-	-
	Station 7	-	-	-	-	-	-	-	-	$137,000	-	-	-
	Flush 10	-	-	-	-	-	-	-	-	-	$145,000	-	-
	Station 19	-	-	-	-	-	-	-	-	-	$143,000	-	-
	Station 17	-	-	-	-	-	-	-	-	-	$116,000	-	-
	Station 16	-	-	-	-	-	-	-	-	$258,000	-	-	-
	Station 12	-	-	$10,000	-	-	-	-	$861,000	-	-	-	-
	Station 2	-	-	-	-	-	-	$220,000	-	-	-	-	-
	Station 1	-	-	-	-	-	$191,000	-	-	-	-	-	-
Field Confirmed Stations	Newport Lift	-	-	$244,000	-	-	-	-	-	-	-	-	-
	Newport Pump	-	-	-	$236,000	-	-	-	-	-	-	-	-
	Palisades	-	-	-	-	-	-	-	-	-	$411,000	-	-
	Parkers	-	-	-	-	-	-	-	$413,000	-	-	-	-
	Medina	-	-	-	-	$292,000	-	-	-	-	-	-	-
	Fairweather	-	-	-	$306,000	-	-	-	-	-	-	-	-
	Cedar Terrace	-	-	-	-	-	-	-	-	-	$169,000	-	-
Remaining 13 Stations Not Field Evaluated	Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
	Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
	Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
	Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
	Flush #1	-	-	-	$5,000	-	-	-	$75,000	-	-	$630,000	-
	Flush #2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
	Flush #3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
	Flush #4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
	Flush #5	-	-	-	-	-	-	$5,000	-	-	-	-	-
	Flush #6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
	Flush #7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
	Flush #8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
	Flush #9	-	-	$80,000	-	-	-	-	-	-	-	-	-
	Crane/Rail Study and Load Testing	-	-	$30,000	-	-	-	-	-	-	-	-	-
	TOTAL	**$0**	**$7,180,000**	**$984,000**	**$1,157,000**	**$1,015,000**	**$1,066,000**	**$1,114,000**	**$1,724,000**	**$1,379,000**	**$1,552,000**	**$1,268,000**	**$1,230,000**

SECTION 4 - LONG TERM RESOURCE PLANNING

4.1 Introduction

The purpose of this discussion is to outline the 75-year financial planning cycle for the wastewater pump stations and provide the City with a program to track the remaining useful life of the assets using the City's asset management software, Maximo. Suggested management strategies focus on asset groups that are highly critical to the function of the station.

The recommended management strategies set the baseline for determining the 75-year outlook planning cycle for each individual pump station. This helps determine the likely costs due to rehabilitation and replacement projects at the station over the course of 75 years. Using asset depreciation curves, the remaining useful life of an asset is estimated based on condition, obsolescence, alarm conditions (call outs), and station capacity.

All estimations of remaining useful life are based on the assumption that system maintenance is and will continue to be performed to an industry standard level of care.

4.2 Asset Groups

The City currently uses seven asset group categories in its Maximo database for wastewater pump stations. These are tracked by City staff with failure codes to document the problem, cause, and remedy of arising issues. The seven asset groups, with examples of sub-components tracked by the City are as follows:

- Pump Station – valves, dehumidifier, sump pump
- Electrical System – HVAC, lighting, generator failure, load center, outlet, transfer switch, service entrance, motor driver
- Telemetry System – communication failure, control system, device failure, SCADA
- Generator (if applicable) – battery, cooling system, electrical, equipment failure, fuel, hardware, motor, time clock
- Rotating Assembly – bearing, valve, coupling, impeller, mechanical seal, motor
- Security System – hatch/door, intrusion alarm, motion detector, video
- General Maintenance – contract, sweep

Two of the asset groups, Security System and General Maintenance, do not include components that directly affect the pumping operation of the system. Therefore, no tracking is recommended to predict the remaining useful life of these asset groups and they are not discussed further.

In order to align with the City's current asset groups and provide a practical level of asset management for evaluation and planning, the remaining five asset groups will only be used to track the larger, more costly, and/or critical components. While no changes are proposed to the Maximo tracking system, the remaining five asset groups are generally defined below, with all smaller components considered ancillary to the larger ones:

- Pump Station – structure (wet well, dry pit) and site
- Electrical System – major electrical (transfer switch, service entrance) and minor electrical (HVAC, lighting)
- Telemetry System – control panel, communication system
- Generator (if applicable) – generator
- Rotating Assembly – pumps, motors, starters, power cables (tracked as a single asset)

4.3 Life Cycle Rehabilitation and Replacement Models

Parabolic depreciation curves were developed based on guidelines from Environmental Protection Agency (EPA) asset management training manuals and customized to match up with the five-point scale used for the pump station evaluation process. These curves do not indicate the depreciation of an asset's value, but rather they predict the remaining life of an asset and allow for proactive rehabilitation/replacement planning. The curves are developed from the following equation:

$$\text{Remaining Life Score} = \left(\frac{\text{Life - to - Date}}{\text{Est. Useful Life}}\right)^n \times \text{Maximum Score}$$

The generalized curves were created based on the underlying understanding that physical assets do not generally depreciate linearly with time. An estimated useful life span was assigned based on our engineering experience and common industry standards with similar asset types. The "n" value for the coefficient was determined based on Step 4 of the EPA Fundamentals of Asset Management workshop and varied depending on the physical asset type. Mechanical, electrical and telemetry assets were assigned an "n" value of 2 since these assets condition depreciates at a generally constant rate. This "n" value of 2 gives the depreciation curve a more symmetrical curved shape. The structural assets were assigned an "n" value of 3 for the generalized curves since the structures condition does not significantly depreciate during its earlier years of life and depreciates significantly and rapidly during the final years of its design life. This "n" value of 3 gives the depreciation curve a generally flat shape until the few years before its end of design life where the curve takes the shape of a steep slope.

These curves serve as templates for each asset group and generally represent composites of the asset components included in a given group. This methodology predicts the decay of the asset group, helping to estimate the timing of component rehabilitation or replacement projects that then establishes the 75-year planning cycle. A summary of the remaining useful life and depreciation curves can be found in Table 4-1.

Table 4-1
Asset Group Life Expectancies

Asset Remaining Life Score	Remaining Useful Life (years)				
	Pump Station Structure	Electrical System	Telemetry System	Generator (if applicable)	Rotating Assembly
0	100	30	20	40	30
1	30-35	15-20	10-15	20-25	15-20
2	20-25	10-15	5-10	10-15	10-15
3	10-15	5-10	0-5	5-10	5-10
4	5-10	0-5	0-5	0-5	0-5
5	0-5	0-5	0-5	0-5	0-5

Based on this approach, rehabilitation or replacement of an asset should occur before the asset remaining life reaches a 5, indicating it is near failure. By defining a minimum level of service at the remaining life score of 4, proactive rehabilitation or replacement can be planned. Figure 4-1 graphically depicts the relationship between the depreciation curves and the minimum level of service.

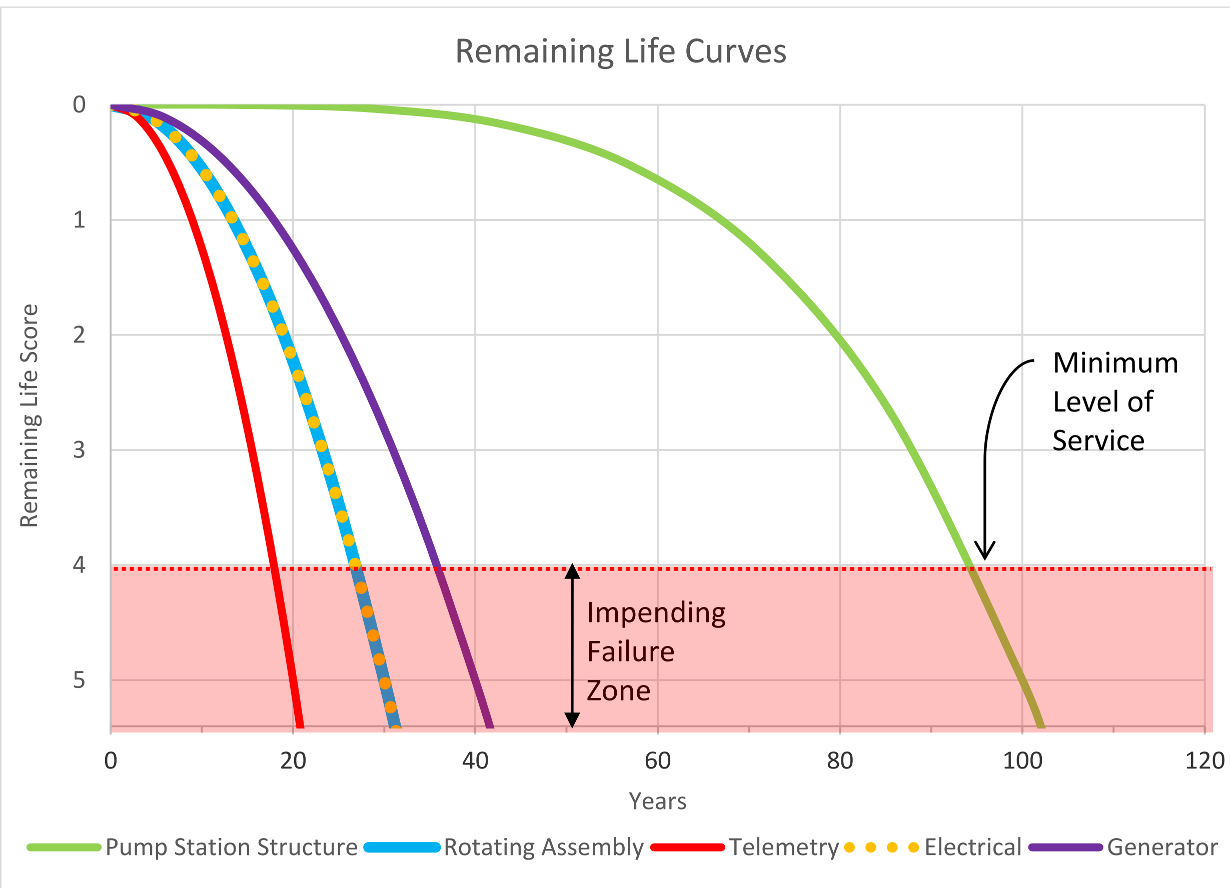


Figure 4-1: Remaining useful life depreciation curves for critical components

For long-term capital expense planning purposes, rehabilitation cycles are tied to the overall asset replacement cycle. This does not recommend an immediate rehabilitation, but estimates funds for typical rehabilitation expenses and frequencies. Table 4-2 summarizes the frequency of the cycles.

Table 4-2
Asset Group Rehabilitation and Replacement Cycles

Asset Group	Rehabilitation Cycles	Replacement Cycle
Pump Station Structure	3 per replacement cycle	90-95 years
Electrical System	n/a	25-30 years
Telemetry System	n/a	15-20 years
Generator	1 per replacement cycle	35-40 years
Rotating Assembly	2 per replacement cycle	25-30 years

Development of costs for rehabilitation and replacement projects encompasses all components of an asset group, not only the larger components. In Table 4-3, the more significant cost items are identified under their tracked asset group.

Table 4-3
Asset Group Major Life Cycle Cost Components

Asset Group	Rehabilitation Cost Component	Replacement Cost Component
Pump Station Structure	Structure repair/recoating	Structure(s) Site piping Bypass pumping Dewatering Site landscaping/restoration Ancillary components
Electrical System	N/A	Main service and disconnect Transfer switch HVAC/lighting Ancillary components
Telemetry System	N/A	Panel/RTU/Modem Instruments Ancillary components
Generator	Motor rebuild	Generator Ancillary components
Rotating Assembly	Pump wet end rebuild Motor rewind	Pumps Motors Starters Cables Station Pipe/Valves Ancillary components

Tables 4-4 and 4-5 summarize the rehabilitation and replacement costs used to develop the long-term 75-year life cycle planning costs for each of the facilities. These costs include construction plus 35% for engineering, legal and administrative costs, 9.5% for sales tax, and 30% markup for contingencies. Costs in the table include and are considered an AACE class 4 estimate with an expected accuracy range of -30% to +50%.

Rehabilitation and replacement planning level cost ranges were developed based on available information and assumptions from the pump station field visits. The estimated complexity/size was based on the 26 field evaluated pump stations and do not include other pump stations the City owns and operates. Utilizing this range, each pump station was assigned a cost relative to other facilities that allowed for consideration of larger equipment and more complicated sites. These costs include a range of common project elements, but are based on the assumption that each pump station is replaced in its current configuration. Additional costs, such as acquiring property and easements are not included.

Table 4-4
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	$10,000 $5,000	$15,000 $10,000	$20,000 $15,000	$25,000 $20,000	$30,000 $25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 4-5
Asset Group Life Cycle Replacement Project Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

4.4 Project Triggers and Justifiers

Predicting failures before they occur requires monitoring of equipment performance indicators. Tracked indicators for a given asset can be compartmentalized into two general categories, project triggers and project justifiers. Justifiers include traits such as age, run hours, starts, and extraneous costs, none of which may necessarily indicate that asset failure is approaching. Use of generalized justifiers is based on theoretical values of wear and age indicators that may not apply to a specific asset, thereby resulting in over or under prediction of the remaining useful life of the asset.

A more reliable approach is to use project triggers, which are identified as measurements specific to a given asset. Four categories will be used to track project triggers on a scale of zero to five points:

- Condition – initial value from the evaluation process
- Obsolescence – scale relating to availability of support and replacement parts
- Call outs – unscheduled visits attributed to an asset group
- Capacity – identifies the time before peak influent flow will exceed the capacity

In some instances, assets are not visible and or the condition cannot be determined based on visual inspection alone. Where applicable, the condition of an asset is estimated using perceived age when no other information is available.

4.4.1 Condition Rating

The condition rating of an asset group is taken from a compilation of individual asset components that were evaluated during field investigations. The greatest (worst condition) value is used from the individual components to represent the asset group as a whole. Asset group condition ratings are drawn from the components defined in Table 4-6.

Table 4-6
Asset Group Condition Rating Contributors

Asset Group	Asset Component
Pump Station Structure	Wet well Dry pit Valve vault
Electrical System	Meter base Service disconnect Auto/Manual transfer switch Panelboard
Telemetry System	Modem Telemetry Cabinet RTU
Generator	Generator
Rotating Assembly	Pumps Motor Driver Motor

The overall asset group condition rating correlates to an estimated remaining useful life, shown in Table 4-7. The condition rating allows for the tracking of a deteriorating condition that might not yet be contributing to callouts.

Table 4-7
Condition Rating Scale

Value	Description
0	New
1	Very good – 10+ years remain
2	Good – 10+/- years remain
3	Fair – 5-10 years remain
4	Poor – 5+/- years remain
5	Very poor – 3+/- years remain

4.4.2 Obsolescence Rating

Once a piece of equipment is no longer supported, parts and service become challenging to obtain. As the time to obtain parts or service increases, an asset group, and the pump station as a whole, could be out of service for a significant amount of time. Therefore, the obsolescence rating scale in Table 4-8 assesses a value based on how readily available parts and service are.

Table 4-8
Obsolescence Rating Scale

Value	Description
0	New - parts available on shelf
1	Parts available on shelf
2	Parts available within 24 hours
3	Parts available within 48 hours
4	Parts no longer manufactured
5	Parts no longer available

4.4.3 Call Outs Rating

Tracking the number of call outs for a given asset group over the past year provides an indication of problems that operation and maintenance staff are spending extra time addressing. As call outs increase, more attention will be drawn to the respective asset. Table 4-9 provides the trigger value based on call outs received the previous year. Infrequent callouts associated with ragging issues were not used to avoid minimizing equipment failure callouts.

Table 4-9
Call Outs Rating Scale

Value	Description
0	0 call outs
1	n/a
2	1 call out
3	n/a
4	2 call outs
5	3 call outs

4.4.4 Time to Capacity Exceedance Rating

Tracking the estimated time until a pump station capacity is exceeded is important to avoid rehabilitation or replacement of components that do not provide the necessary additional capacity. Tracking this data will require review of hydraulic model outputs and pump station drawdown testing. As the design influent flow was not readily available for this work effort, the only trigger in this category was based on the loss of pumping redundancy as observed by staff. This condition is a possible indicator that station capacity has been exceeded. The time to capacity exceedance is converted to a trigger value in Table 4-10.

Table 4-10
Time to Capacity Exceedance Rating Scale

Value	Description
0	Never*
1	20+ years
2	15-20 years
3	10-15 years
4	5-10 years
5	Less than 5 years

*Existing capacity meets/exceeds build-out flows

4.4.5 Overall Asset Rating

The overall asset score is based on the largest (worst) value of the triggers. This approach avoids minimizing a serious issue, as may happen by averaging the values. Table 4-11 provides an example of how an overall asset score is applied.

Table 4-11
Project Trigger Asset Template

Trigger	Rating
Condition	3
Obsolescence	2
Call Outs	3
Consumed Capacity	0
Overall Asset	**3**

The remaining useful life of an asset is estimated by plotting the asset score on the parabolic depreciation curve as shown in Figure 4-2. The difference in years between the current score and a score of 4 represents the estimated time before a project is triggered for a given facility. As issues are addressed and projects are completed, the asset score must be updated. This assessment is completed for each asset group at the end of each respective pump station section within this report.

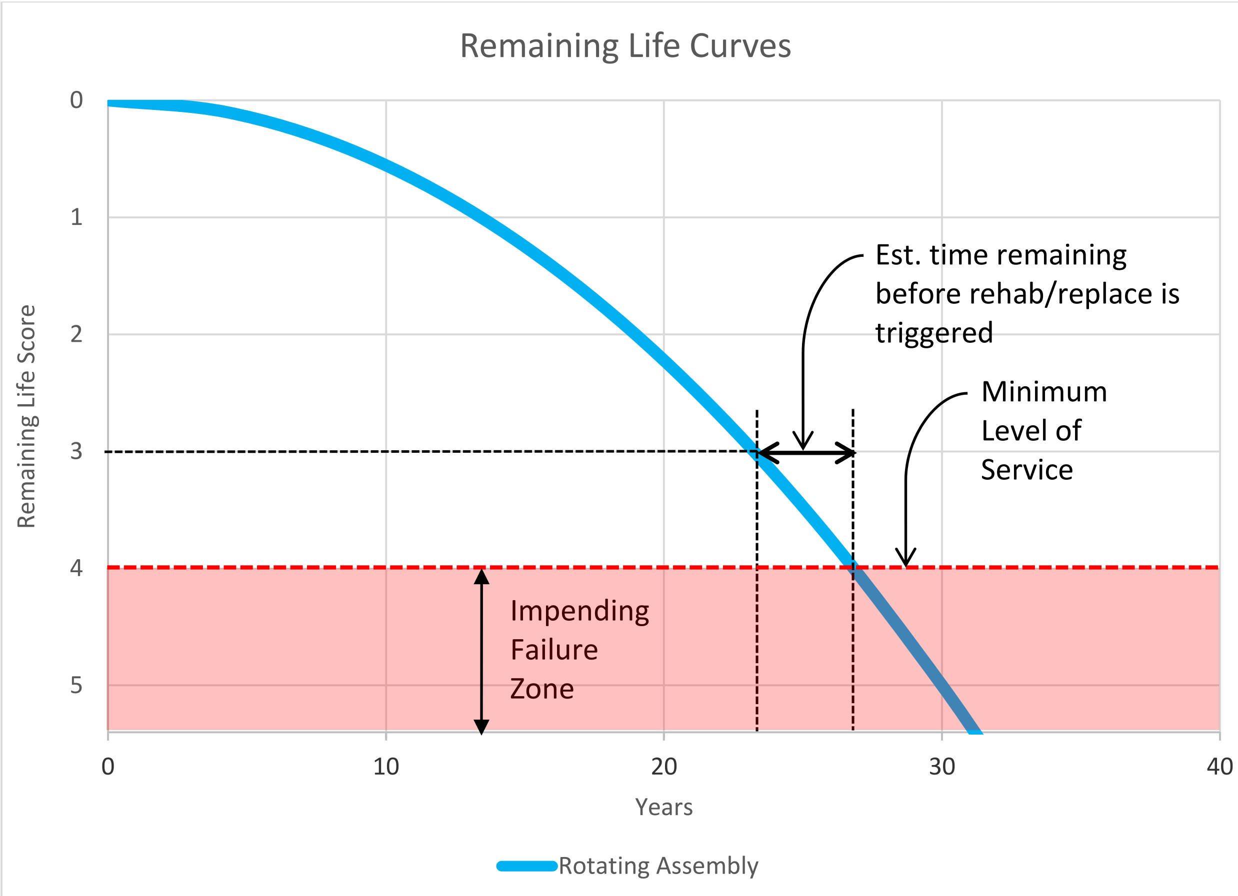


Figure 4-2: Remaining useful life estimation

The remaining useful life, based on the asset score, was used in the long term planning to identify the timing of rehabilitation and replacement projects. Given the uncertainty associated with the exact timing of the long term forecast, it is understood that the plan needs to be flexible. For this reason, the rating tool can be used by the City to update the long term planning forecast, preferably on an annual basis, as conditions change over time. For example, if the condition or call outs in the example shown in Table 4-11 increase and the rating jumps up to a 4 sooner than the current plan, City staff can accelerate the timing of the rehabilitation/replacement projects. Likewise, if the condition and call outs do not change over time, projects may be pushed out to accommodate more pressing projects.

4.5 75-Year Planning Cycle

The recommended management strategies presented in this section sets the baseline for determining the 75-year planning cycle for each of the 26 pump stations evaluated along with the seven stations previously evaluated and the 13 stations not field evaluated. The likely costs due to rehabilitation and replacement projects at the station over the course of 75 years was developed using asset depreciation curves with the remaining useful life of an asset estimated based on condition, obsolescence, call outs, and station capacity.

The 75-year planning cycle is represented in the table below and all costs, timing and grouping of projects are based on sound engineering judgment.

Table 4-12
75-year Planning Cycle

Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Yarrow Point	-	-	-	-	$379,000	-	-	-	-	-	-	-
Cozy Cove	-	-	-	$585,000	-	-	-	-	-	-	-	-
Evergreen East	-	-	-	-	$344,000	-	-	-	-	-	-	-
Grange	-	-	$234,000	-	-	-	-	-	-	-	-	-
Wilburton	-	$358,000		-	-	-	-	-	-	-	-	-
Station 18	-	-	$22,000	-	-	-	-	-	-	$120,000	-	-
Hunts Point	-	-	-	-	-	$373,000	-	-	-	-	-	-
Evergreen West	-	-	-	-	-	$352,000	-	-	-	-	-	-
Lake Crest	-	-	-	-	-	-	$360,000	-	-	-	-	-
Killarney	-	-	-	-	-	-	$181,000	-	-	-	$213,000	-
Meydenbauer	-	-	-	-	-	-	$343,000	-	-	-	-	-
Bagley	-	-	$154,000	-	-	-	-	-	-	-	$210,000	-
Pleasure Point	-	-	-	-	-	$150,000	-	-	-	-	$210,000	-
Kimberlee Park	-	-	-	-	-	-	-	-	$289,000	-	-	-
South Ridge	-	-	$123,000	-	-	-	-	-	-	-	-	-
Lakemont	-	-	-	-	-	-	-	-	$333,000	-	-	-
Station 4	-	-	$12,000	-	-	-	-	-	$172,000	-	-	-
Station 6	-	-	-	-	-	-	-	-	-	$148,000	-	-
Station 7	-	-	-	-	-	-	-	-	$137,000	-	-	-
Flush 10	-	-	-	-	-	-	-	-	-	$145,000	-	-
Station 19	-	-	-	-	-	-	-	-	-	$143,000	-	-
Station 17	-	-	-	-	-	-	-	-	-	$116,000	-	-
Station 16	-	-	-	-	-	-	-	-	$258,000	-	-	-
Station 12	-	-	$10,000	-	-	-	-	$861,000	-	-	-	-
Station 2	-	-	-	-	-	-	$220,000	-	-	-	-	-
Station 1	-	-	-	-	-	$191,000	-	-	-	-	-	-
Newport Lift	-	-	$244,000	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	$236,000	-	-	-	-	-	-	-	-
Palisades	-	-	-	-	-	-	-	-	-	$411,000	-	-
Parkers	-	-	-	-	-	-	-	$413,000	-	-	-	-
Medina	-	-	-	-	$292,000	-	-	-	-	-	-	-
Fairweather	-	-	-	$306,000	-	-	-	-	-	-	-	-
Cedar Terrace	-	-	-	-	-	-	-	-	-	$169,000	-	-
Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	$75,000	-	-	$630,000	-
Flush #2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
Flush #3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
Flush #4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #5	-	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #9	-	-	$80,000	-	-	-	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	$30,000	-	-	-	-	-	-	-	-	-
TOTAL	**$0**	**$7,180,000**	**$984,000**	**$1,157,000**	**$1,015,000**	**$1,066,000**	**$1,114,000**	**$1,724,000**	**$1,379,000**	**$1,552,000**	**$1,268,000**	**$1,230,000**

Note:

1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

Table 4-12 Continued
75-year Planning Cycle

Station Name	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Yarrow Point	$14,000	-	-	-	-	-	$179,000	-	-	-	-	-	-
Cozy Cove	$46,000	-	-	-	-	$198,000	-	-	-	$11,000	-	-	-
Evergreen East	-	$17,000	-	-	-	-	$178,000	-	-	-	$17,000	-	-
Grange	$43,000	-	-	-	$98,000	-	-	-	-	$8,000	-	-	-
Wilburton	-	-	-	$98,000	-	-	-	$14,000	-	-	-	-	-
Station 18	-	-	-	-	-	$98,000	-	-	-	-	-	$13,000	-
Hunts Point	-	-	$8,000	-	-	-	-	$95,000	-	-	-	$8,000	-
Evergreen West	-	-	$8,000	-	-	-	-	$185,000	-	-	-	$8,000	-
Lake Crest	-	-	-	$11,000	-	-	-	-	$95,000	-	-	-	$11,000
Killarney	-	-	-	$8,000	-	-	-	-	$85,000	-	-	-	$98,000
Meydenbauer	-	-	-	$11,000	-	-	-	-	$178,000	-	-	-	$11,000
Bagley	-	-	-	-	$95,000	-	-	$5,000	-	-	-	-	-
Pleasure Point	-	-	-	-	-	-	-	$103,000	-	-	-	-	-
Kimberlee Park	-	-	-	-	-	$14,000	-	-	-	-	$204,000	-	-
South Ridge	-	-	-	-	$155,000	-	-	-	$5,000	-	-	-	-
Lakemont	-	-	$101,000	-	-	-	-	-	-	-	$67,000	-	-
Station 4	-	-	-	-	-	$19,000	-	-	-	-	-	$90,000	-
Station 6	-	-	-	-	-	-	$5,000	-	-	-	-	$98,000	-
Station 7	-	-	-	-	-	$5,000	-	-	-	-	$78,000	-	-
Flush 10	-	$150,000	-	-	-	-	$5,000	-	-	-	-	-	-
Station 19	-	-	-	-	-	-	$8,000	-	-	-	-	$185,000	-
Station 17	-	$90,000	-	-	-	-	$8,000	-	-	-	-	$95,000	-
Station 16	-	-	-	-	-	$8,000	-	-	-	-	$201,000	-	-
Station 12	-	-	-	-	$8,000	-	-	-	-	-	$169,000	-	-
Station 2	-	-	-	$11,000	-	-	-	-	$200,000	-	-	-	$11,000
Station 1	-	-	$17,000	-	-	-	-	$180,000	-	-	-	$32,000	-
Newport Lift	-	-	-	-	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	-	-	-	-	-	-	$1,390,000	-	-	-
Palisades	-	-	-	-	-	-	-	-	-	-	-	-	-
Parkers	-	-	$1,390,000	-	-	-	-	-	-	-	-	-	-
Medina	-	-	-	-	-	-	-	-	-	-	-	-	$1,050,000
Fairweather	-	-	-	-	-	-	-	-	-	-	-	$1,390,000	-
Cedar Terrace	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Heights	-	-	-	$100,000	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	$832,000	-	-	-	-	-	-	-	-	$1,783,000
Midlakes	-	-	-	$367,000	-	-	-	-	-	-	-	-	$1,054,000
Emerald Ridge	-	-	-	$95,000	-	-	-	-	-	-	$219,000	-	-
Flush #1	-	-	-	-	-	-	-	$5,000	-	-	-	-	$75,000
Flush #2	-	-	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	$75,000	-	-	-	-	$5,000	-
Flush #4	$285,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #5	$122,500	-	-	$80,000	-	-	-	-	-	-	$170,000	-	-
Flush #6	$232,500	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #7	$225,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #8	-	$480,000	-	-	-	-	-	-	-	-	$5,000	-	-
Flush #9	-	$330,000	-	-	-	-	-	-	-	-	$75,000	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$968,000**	**$1,067,000**	**$1,524,000**	**$1,613,000**	**$356,000**	**$342,000**	**$458,000**	**$587,000**	**$568,000**	**$1,424,000**	**$1,205,000**	**$1,924,000**	**$4,093,000**

Note:
1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

Table 4-12 Continued
75-year Planning Cycle

Station Name	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Yarrow Point	-	-	-	-	$225,000	-	-	-	-	-	-	$104,000	-
Cozy Cove	-	-	-	$385,000	-	-	-	-	-	-	$101,000	-	-
Evergreen East	-	-	-	-	$255,000	-	-	-	-	-	-	$107,000	-
Grange	-	-	$305,000	-	-	-	-	-	-	$178,000	-	-	-
Wilburton	-	$310,000	-	-	-	-	-	-	$104,000	-	-	-	-
Station 18	-	-	-	-	$90,000	-	-	-	-	-	$180,000	-	-
Hunts Point	-	-	-	-	-	$265,000	-	-	-	-	-	-	$98,000
Evergreen West	-	-	-	-	-	$195,000	-	-	-	-	-	-	$98,000
Lake Crest	-	-	-	-	-	-	$270,000	-	-	-	-	-	-
Killarney	-	-	-	-	-	-	$225,000	-	-	-	-	-	-
Meydenbauer	-	-	-	-	-	-	$215,000	-	-	-	-	-	-
Bagley	$180,000	-	-	-	-	-	-	-	-	$110,000	-	-	-
Pleasure Point	$90,000	-	-	-	-	-	-	$195,000	-	-	-	-	-
Kimberlee Park	-	$14,000	-	-	-	-	-	-	-	-	$170,000	-	-
South Ridge	-	-	$159,000	-	-	-	-	-	-	$95,000	-	-	-
Lakemont	-	-	-	-	-	-	-	$475,000	-	-	-	-	-
Station 4	-	$11,000	-	-	-	-	-	-	-	-	$190,000	-	-
Station 6	-	-	$5,000	-	-	-	-	-	-	$259,000	-	-	-
Station 7	-	$5,000	-	-	-	-	-	-	$205,000	-	-	-	-
Flush 10	-	-	$160,000	-	-	-	-	-	-	-	-	$30,000	-
Station 19	-	-	$8,000	-	-	-	-	-	-	-	-	$180,000	-
Station 17	-	-	$8,000	-	-	-	$90,000	-	-	-	-	$90,000	-
Station 16	-	$8,000	-	-	-	-	-	-	$235,000	-	-	-	-
Station 12	$8,000	-	-	-	-	-	-	$573,000	-	-	-	-	-
Station 2	-	-	-	-	-	-	-	-	$100,000	-	-	-	-
Station 1	-	-	-	-	-	-	-	$207,000	-	-	-	-	$150,000
Newport Lift	$1,050,000	-	-	-	-	-	-	-	-	-	-	-	-
Newport Pump	-	-	-	-	-	-	-	-	-	-	-	-	-
Palisades	-	$900,000	-	-	-	-	-	-	-	-	-	-	-
Parkers	-	$3,000	-	-	-	-	-	-	-	-	-	-	-
Medina	-	-	-	-	-	-	-	-	-	-	-	-	-
Fairweather	-	-	-	-	-	-	-	-	-	-	-	-	-
Cedar Terrace	-	-	$35,000	-	-	-	-	-	-	-	-	-	-
Lake Heights	-	$219,000	-	-	-	-	-	-	$95,000	-	-	-	-
Bellefield	-	-	-	-	-	-	-	-	$503,000	-	-	-	$503,000
Midlakes	-	-	-	-	-	-	-	-	$321,000	-	-	-	-
Emerald Ridge	-	-	-	-	-	-	$95,000	-	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-	-
Flush #2	$75,000	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-
Flush #3	-	-	$5,000	-	-	-	-	-	-	-	-	$210,000	-
Flush #4	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #5	-	-	-	-	-	-	$80,000	-	-	-	-	-	-
Flush #6	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #7	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #8	$75,000	-	-	-	-	-	$5,000	-	-	-	-	-	-
Flush #9	-	-	$5,000	-	-	-	$5,000	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$1,703,000**	**$1,470,000**	**$690,000**	**$390,000**	**$575,000**	**$475,000**	**$985,000**	**$1,450,000**	**$1,563,000**	**$642,000**	**$811,000**	**$896,000**	**$1,359,000**

Note:

1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

Table 4-12 Continued
75-year Planning Cycle

Station Name	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Yarrow Point	-	-	-	-	-	$89,000	-	-	-	-	-	-	-
Cozy Cove	-	-	-	-	$119,000	-	-	-	-	-	$35,000	-	-
Evergreen East	-	-	-	-	-	$105,000	-	-	-	-	-	-	-
Grange	-	-	-	$16,000	-	-	-	-	-	-	$35,000	-	-
Wilburton	-	-	$22,000	-	-	-	-	-	-	-	-	-	-
Station 18	-	-	-	-	-	-	$8,000	-	-	-	-	$5,000	-
Hunts Point	-	-	-	-	-	-	$13,000	-	-	-	-	-	-
Evergreen West	-	-	-	-	-	-	$103,000	-	-	-	-	-	-
Lake Crest	$101,000	-	-	-	-	-	-	$16,000	-	-	-	-	-
Killarney	-	-	$103,000	-	-	-	-	-	-	$88,000	-	-	-
Meydenbauer	$101,000	-	-	-	-	-	-	$99,000	-	-	-	-	-
Bagley	-	$5,000	-	-	-	$185,000	-	-	-	-	-	-	-
Pleasure Point	-	-	-	$98,000	-	-	-	-	$95,000	-	-	-	$8,000
Kimberlee Park	-	-	$90,000	-	-	-	$14,000	-	-	-	-	$114,000	-
South Ridge	-	-	-	$70,000	-	-	-	-	-	-	-	-	-
Lakemont	-	-	-	$11,000	-	-	-	-	$11,000	-	-	-	$101,000
Station 4	-	-	-	$101,000	-	-	-	-	-	-	-	$19,000	-
Station 6	-	-	-	$95,000	-	-	-	-	-	-	$13,000	-	-
Station 7	-	-	$75,000	-	-	-	-	-	-	$13,000	-	-	-
Flush 10	-	-	-	-	-	-	-	$75,000	-	-	-	-	$5,000
Station 19	-	-	-	-	-	-	-	$8,000	-	-	-	-	$193,000
Station 17	-	-	-	-	-	-	-	$8,000	-	-	-	$185,000	-
Station 16	-	-	$98,000	-	-	-	-	-	-	$119,000	-	-	-
Station 12	-	-	$208,000	-	-	-	-	-	$14,000	-	-	$8,000	-
Station 2	$150,000	-	-	-	$11,000	-	-	-	-	$95,000	-	-	-
Station 1	-	-	-	$17,000	-	-	-	-	$90,000	-	-	-	$17,000
Newport Lift	-	-	-	-	$3,000	-	-	-	-	-	-	-	-
Newport Pump	-	$3,000	-	-	-	-	-	$120,000	-	-	-	-	-
Palisades	-	-	-	-	$3,000	-	-	-	-	-	-	-	-
Parkers	-	$100,000	-	-	$3,000	-	-	-	-	-	-	-	-
Medina	-	$6,000	-	-	-	-	-	-	-	-	$120,000	-	-
Fairweather	-	$3,000	-	-	-	-	-	-	$120,000	-	-	-	-
Cedar Terrace	-	-	-	-	-	-	$450,000	-	-	-	-	-	-
Lake Heights	-	-	$10,000	-	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	-	$116,000	-	-	-	-	-	-	$2,383,000	-
Midlakes	$69,000	-	-	-	$69,000	-	-	-	-	-	-	$1,283,000	-
Emerald Ridge	-	-	$5,000	-	-	-	-	-	-	$309,000	-	-	-
Flush #1	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000	-
Flush #2	-	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000
Flush #3	-	-	-	-	-	-	-	$5,000	-	-	-	-	$5,000
Flush #4	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #5	-	-	$5,000	-	-	-	-	-	-	$240,000	-	-	-
Flush #6	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #7	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #8	$170,000	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #9	$240,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$831,000**	**$117,000**	**$616,000**	**$408,000**	**$399,000**	**$754,000**	**$588,000**	**$331,000**	**$330,000**	**$869,000**	**$203,000**	**$4,007,000**	**$339,000**

Note:

1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

Table 4-12 Continued
75-year Planning Cycle

Station Name	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078
Yarrow Point	-	-	-	$895,000	-	-	-	-	-	-	-	-	$14,000
Cozy Cove	-	-	$1,005,000	-	-	-	-	-	-	-	-	$91,000	-
Evergreen East	-	-	-	$925,000	-	-	-	-	-	-	-	-	$17,000
Grange	-	$1,010,000	-	-	-	-	-	-	-	-	$8,000	-	-
Wilburton	$820,000	-	-	-	-	-	-	-	-	$14,000	-	-	-
Station 18	-	-	$188,000	-	-	-	-	-	-	-	-	$700,000	-
Hunts Point	-	-	-	-	$895,000	-	-	-	-	-	-	-	-
Evergreen West	-	-	-	-	$790,000	-	-	-	-	-	-	-	-
Lake Crest	-	-	-	-	-	$860,000	-	-	-	-	-	-	-
Killarney	-	-	-	-	-	-	-	$820,000	-	-	-	-	-
Meydenbauer	-	-	-	-	-	$775,000	-	-	-	-	-	-	-
Bagley	-	$650,000	-	-	-	-	-	-	-	-	$95,000	-	-
Pleasure Point	-	-	-	-	-	-	-	-	$740,000	-	-	-	-
Kimberlee Park	-	-	$14,000	-	-	-	-	$850,000	-	-	-	-	-
South Ridge	-	$599,000	-	-	-	-	-	-	-	-	$5,000	-	-
Lakemont	-	-	-	-	-	-	-	$815,000	-	-	-	-	-
Station 4	-	-	-	-	-	-	-	-	$860,000	-	-	-	-
Station 6	-	-	-	-	-	-	-	-	$809,000	-	-	-	-
Station 7	-	-	-	-	-	-	-	$680,000	-	-	-	-	-
Flush 10	-	-	-	$85,000	-	-	-	-	-	-	-	-	$600,000
Station 19	-	-	-	-	-	-	-	-	-	-	-	-	$680,000
Station 17	-	-	-	$8,000	-	-	-	-	-	-	-	-	$815,000
Station 16	-	-	-	-	-	-	-	$805,000	-	-	-	-	-
Station 12	-	-	-	-	-	-	-	$1,373,000	-	-	-	-	-
Station 2	$11,000	-	-	-	-	$915,000	-	-	-	-	-	-	-
Station 1	-	-	-	-	$997,000	-	-	-	-	-	-	-	-
Newport Lift	$120,000	-	-	-	-	-	$3,000	-	-	-	-	-	-
Newport Pump	$3,000	-	-	-	-	-	-	-	-	-	-	-	-
Palisades	$100,000	-	-	-	-	-	$3,000	-	-	-	-	-	-
Parkers	-	-	-	-	-	-	$3,000	-	-	$100,000	-	-	-
Medina	$6,000	-	-	-	-	-	-	-	-	-	-	-	-
Fairweather	$3,000	-	-	-	-	-	-	-	-	-	-	-	-
Cedar Terrace	$15,000	-	-	-	-	-	-	-	-	-	-	-	-
Lake Heights	$309,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	-	-	-	-	-	-	$116,000	-	-	-	-	$116,000
Midlakes	-	-	-	-	-	-	-	$69,000	-	-	-	-	$69,000
Emerald Ridge	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #1	-	-	-	-	-	-	-	-	-	$560,000	-	-	-
Flush #2	-	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #3	-	-	-	$75,000	-	-	-	-	-	-	-	-	$520,000
Flush #4	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #5	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #6	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #7	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #8	-	$10,000	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #9	-	$5,000	-	-	-	$75,000	-	-	-	-	-	-	-
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$1,417,000**	**$2,274,000**	**$1,207,000**	**$1,988,000**	**$2,682,000**	**$2,635,000**	**$9,000**	**$5,528,000**	**$2,409,000**	**$679,000**	**$2,918,000**	**$791,000**	**$2,831,000**

Note:

1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

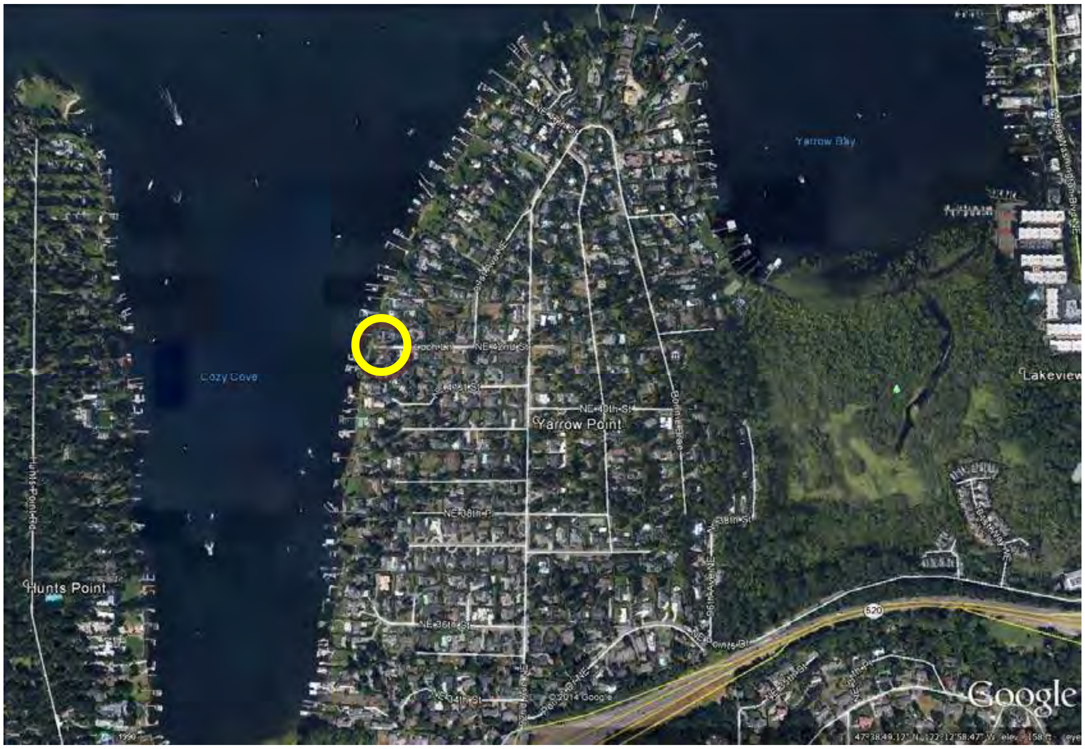
Table 4-12 Continued
75-year Planning Cycle

Station Name	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089
Yarrow Point	-	-	-	-	$179,000	-	-	-	-	-	-
Cozy Cove	-	-	-	$108,000	-	-	-	$101,000	-	-	-
Evergreen East	-	-	-	-	$195,000	-	-	-	-	-	-
Grange	-	-	$8,000	-	-	-	$178,000	-	-	-	-
Wilburton	-	$8,000	-	-	-	$104,000	-	-	-	-	-
Station 18	-	-	-	-	-	-	-	$98,000	-	-	-
Hunts Point	$8,000	-	-	-	-	$5,000	-	-	-	$98,000	-
Evergreen West	$8,000	-	-	-	-	-	-	$193,000	-	-	-
Lake Crest	-	$11,000	-	-	-	-	$5,000	-	-	-	-
Killarney	-	-	-	$8,000	-	-	-	-	$5,000	-	-
Meydenbauer	-	$11,000	-	-	-	-	$88,000	-	-	-	-
Bagley	-	-	$5,000	-	-	-	$95,000	-	-	-	-
Pleasure Point	-	-	-	-	$8,000	-	-	-	-	$95,000	-
Kimberlee Park	-	-	-	$14,000	-	-	-	-	$14,000	-	-
South Ridge	-	-	$160,000	-	-	-	-	-	-	-	-
Lakemont	-	-	-	$191,000	-	-	-	-	$11,000	-	-
Station 4	-	-	-	-	$11,000	-	-	-	-	$8,000	-
Station 6	-	-	-	-	$5,000	-	-	-	-	$8,000	-
Station 7	-	-	-	$5,000	-	-	-	-	$8,000	-	-
Flush 10	-	-	-	-	-	-	-	-	$5,000	-	-
Station 19	-	-	-	-	$90,000	-	-	-	$8,000	-	-
Station 17	-	-	-	-	-	-	-	-	$8,000	-	-
Station 16	-	-	-	$8,000	-	-	-	-	$11,000	-	-
Station 12	-	-	-	$8,000	-	-	-	-	$14,000	-	-
Station 2	-	$11,000	-	-	-	-	$5,000	-	-	-	-
Station 1	$17,000	-	-	-	-	$5,000	-	-	-	$252,000	-
Newport Lift	-	-	-	-	-	-	-	-	$3,000	-	-
Newport Pump	-	$3,000	-	-	-	-	-	-	$120,000	-	-
Palisades	-	-	-	-	-	-	-	-	-	-	$3,000
Parkers	-	-	-	-	-	-	-	-	-	-	$3,000
Medina	-	-	-	-	-	$6,000	-	-	-	-	$120,000
Fairweather	-	-	-	-	-	$3,000	-	-	-	-	$120,000
Cedar Terrace	-	-	-	-	-	$20,000	-	-	-	-	-
Lake Heights	-	$5,000	-	-	-	$95,000	-	-	-	-	-
Bellefield	-	-	-	$503,000	-	-	-	-	-	$387,000	-
Midlakes	-	-	-	$527,000	-	-	-	-	-	-	-
Emerald Ridge	-	$95,000	-	-	-	-	-	-	-	-	-
Flush #1	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #2	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	-	-	$75,000	-	-
Flush #4	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #5	-	$75,000	-	-	-	-	-	-	-	-	$380,000
Flush #6	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #7	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #8	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #9	-	$490,000	-	-	-	-	-	-	-	-	$5,000
Crane/Rail Study and Load Testing	-	-	-	-	-	-	-	-	-	-	-
TOTAL	**$33,000**	**$709,000**	**$173,000**	**$1,372,000**	**$488,000**	**$243,000**	**$396,000**	**$392,000**	**$282,000**	**$848,000**	**$631,000**

Note:

1. Refer to pump station sections for description of required work. Timing of projects have been prioritized based on Section 3 discussions.

SECTION 5
YARROW POINT



5.1 Yarrow Point Pump Station General Description

Date of Visit	April 16th, 2014
City of Bellevue Asset No.	187612
Address	9000 NE 42nd St
Station Configuration	Wet well/Dry pit
Original Construction	1960
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	208/3 Phase
Standby Power	Generator receptacle
Field-Measured Station Firm Capacity	380-460 gpm

5.1.1 Summary of Findings

Yarrow Point pump station is located in a public access path to the lake. It is adjacent to two homes at the end of NE 42nd street. This pump station receives flow from Flush Station 1 and discharges to the lake line. Significant deficiencies identified at this site include the corroding conduit connected to the City owned meter base and the Paco pumps used at this station that are obsolete and aging. There is also delamination of the interior coating in the wet well that should be addressed. Lastly this station has a reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the stations level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Table 5-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 5-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
YP-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$379,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Wet well interior coating failing	Recoat interior of wet well		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	City owned meter base conduit corroding	Replace galvanized conduit		
	Fused disconnect aging	Replace fused disconnect		
	Telephone network interface termination box not accessible	Replace and lower box so accessible		
	Panelboard is aging	Replace panelboard		
	Primary level indicator is aging	Replace primary level indicator		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

5.2 Site

5.2.1 Site Description

Vehicle access to site	Via NE 42nd St. Removable bollards at pavement end, 50' from site, allow vehicle access to site if needed
Landscaping	Grass
Site lighting	None
Fencing/security	Dry pit/equipment access hatches locked. Locked manhole access to wet well
Public accessibility to site	Full access to site – public access point to lake

General observations/notes from field visit:

- Located at the end of 42nd street, removable bollards preventing public vehicle access to edge of lake
- Two spaces for vehicle parking in front, full vehicle access to site when bollards removed

General site view toward vehicle access

General site view toward lake

5.3 Station Facilities

5.3.1 Wet Well – Structure and Accessories

5.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid, Olympic Foundry Co. 30” diameter and ladder down to platform grating
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8”, above operating level*
Lighting	Yes, dim lighting
Ventilation	Supply fan
Ventilation continuous	No, dry pit hatch switch (manual)

*Based on Record Drawings, unable to confirm in field.

5.3.1.2 Wet Well Findings

Condition	1	2	**3**	4	5
Criticality	1	2	3	**4**	
Serviceability	1	**2**	3	4	

Condition Rating 3 – Ground surface inspection identified interior coating is delaminating.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Wet well interior shows signs of corrosion and partial coating failure

Wet well lid locks to secure access

5.3.2 Dry Pit – Structure and Accessories

5.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete, coated
Access description	Lift assist hatch and spiral staircase
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8’-6”
Lighting	Yes, adequate for visibility/maintenance
Ventilation	Supply fan
Ventilation continuous	No, dry pit hatch switch (automatic)

5.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

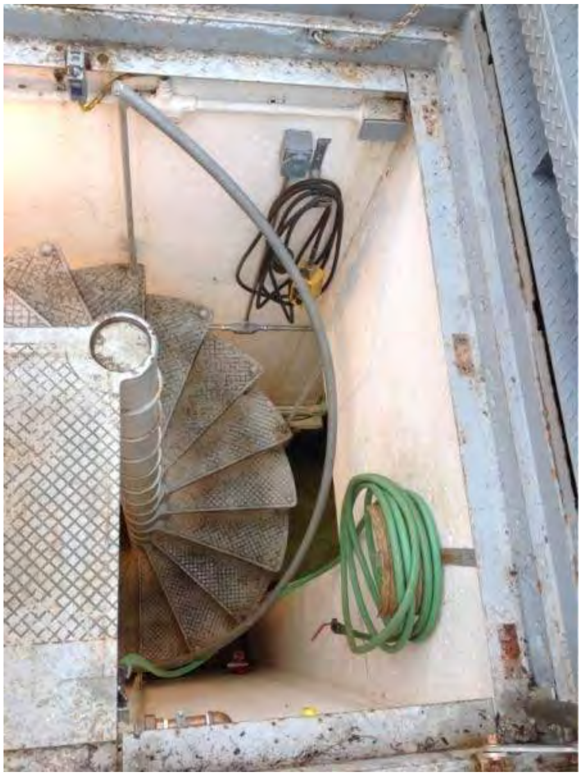
Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

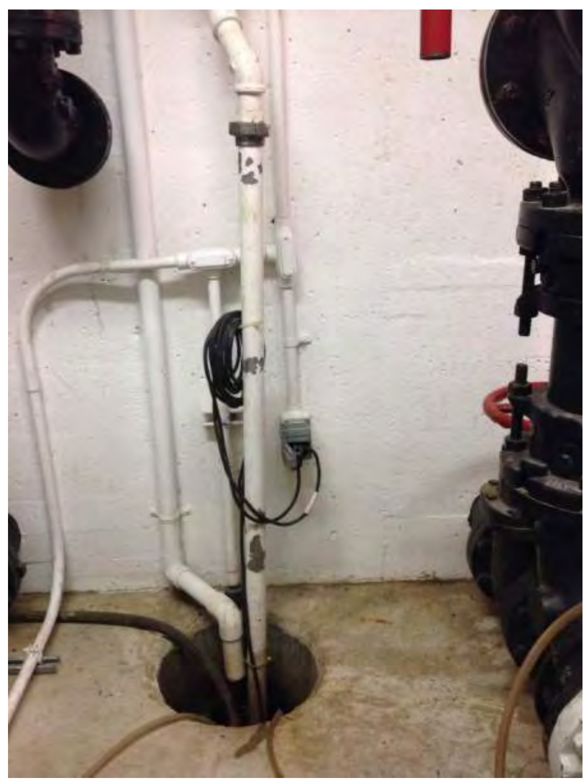
- No vent out of structure – passive through open hatch
- Heavy hatch on equipment access – not routinely opened
- No exhaust fan – required in addition to supply fan to unclassify space per NFPA 820 code



Spiral staircase appears to be in good condition

Pump and piping configuration

Equipment access hatch



Sump pump in dry pit

5.3.3 Wet Well Blower Vault – Structure and Accessories

5.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6'-4"x6'-4"x4' deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

5.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Wet well blower vault houses supply ventilation fan for wet well
- Duct isolation valve opens and fan starts when switch is activated in the dry pit Equipment does not appear to be rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.

Interior of wet well blower vault appears to be in good condition

Wet well blower vault hatch opening

5.4 Mechanical

5.4.1 Pumps

Pump System Performance

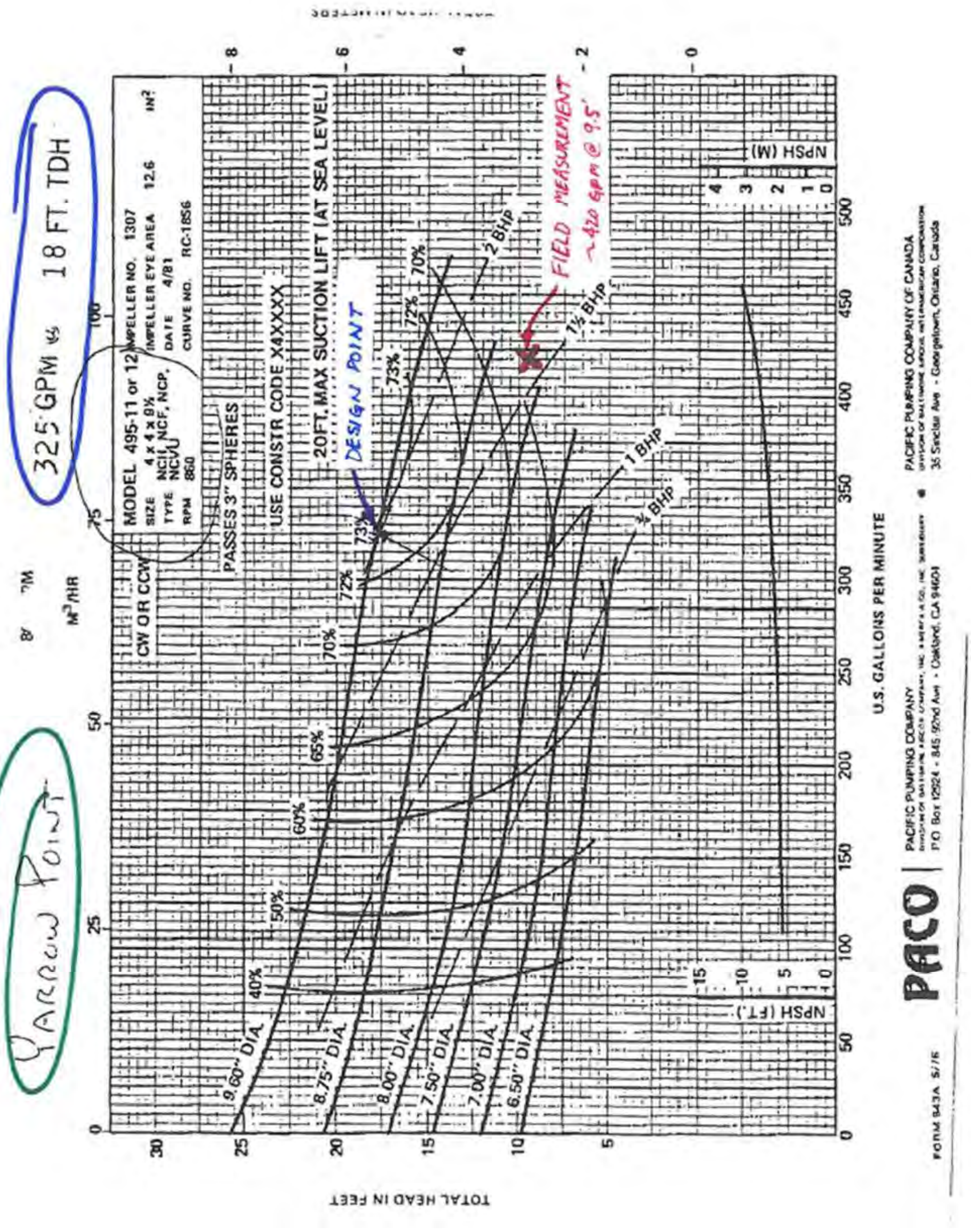
The field tested performance of the pumps at the Yarrow Point Pump Station measured considerably higher flow (~420 gpm vs. 325 gpm) and lower head (9.5 ft vs. 18 ft) than the design point. Assuming the accuracies of the measurements are reasonable and based on the pumping system head comparison in the following figure, it is possible that the design system head condition was overestimated relative to the current situation. Regardless, this pump appears to be operating near the end of the pump curve where cavitation could be a potential concern and should be replaced.

The following table documents the pump run hours and starts by month over the past year.

Table 5-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	63.17	1,902	62.29	1,901
May-13	54.81	1,826	46.14	1,545
Jun-13	52.93	1,808	31.52	1,109
Jul-13	40.82	1,392	40.12	1,387
Aug-13	37.77	1,315	37.05	1,315
Sep-13	43.92	1,420	42.8	1,420
Oct-13	39.07	1,341	37.91	1,338
Nov-13	42.16	1,390	40.66	1,387
Dec-13	43.66	1,462	42.21	1,453
Jan-14	53.02	1,660	51.52	1,664
Feb-14	67.54	1,847	65.62	1,833
Mar-14	102.73	2,169	101.34	2,168
Total	**641.6**	**19,532**	**599.18**	**18,520**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.8	2.2	1.6	2.1

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.


YARROW POINT
325 GPM @ 18 FT. TDH
MODEL 495-11 or 12
IMPELLER NO. 1307
SIZE 4 x 4 x 9¾
IMPELLER EYE AREA 12.6 IN²
TYPE NCII, NCF, NCP, NCVU
DATE 4/81
RPM 860
CURVE NO. RC-1856
CW OR CCW
PASSES 3" SPHERES
USE CONSTR CODE X4XXXX
20FT. MAX SUCTION LIFT (AT SEA LEVEL)
DESIGN POINT
FIELD MEASUREMENT
~420 GPM @ 9.5'
9.60" DIA.
8.75" DIA.
8.00" DIA.
7.50" DIA.
7.00" DIA.
6.50" DIA.
2 BHP
1½ BHP
1 BHP
¾ BHP
NPSH (FT.)
NPSH (M)
U.S. GALLONS PER MINUTE
TOTAL HEAD IN FEET
M³/HR
PACO
PACIFIC PUMPING COMPANY
P.O. Box 12924 • 845 92nd Ave • Oakland, CA 94604
PACIFIC PUMPING COMPANY OF CANADA
35 Sinclair Ave • Georgetown, Ontario, Canada
FORM 943A 5/76

5.4.1.1 Pump 1 – City of Bellevue Asset No. 193844

Pump style	Vertical, non-clog
Make	Paco pumps
Model	52-49511-X46D60-01
Serial No.	WG88A0171401B
Horsepower	3
Voltage/phase	208/3
Date of installation	1989
Design conditions	323 gpm @ 18 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Pump 1 Drawdown Test

Static head (feet)	7
Calculated pumping capacity	380 gpm -430 gpm
Total Dynamic head (feet)	9.5
Number of tests performed	2

General observations/notes from drawdown test:

- Pump operating below the pump curve and at a lower head condition, most likely the result of wet end wear and differing head conditions from the original design. With limited remaining life, the pump should be considered for replacement.

Duplex configuration (Pump 1 in foreground)

Pump and motor #1

Pump 1 showing signs of aging on exterior

5.4.1.2 Pump 2 – City of Bellevue Asset No. 193835

Pump style	Vertical, non-clog
Make	Paco pumps
Model	52-49511-X46D60-01
Serial No.	WG88A0171401A
Horsepower	3
Voltage/phase	208/3
Date of installation	1989
Design conditions	323 gpm @ 18 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer’s representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Quiet under operation
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pumping redundancy

Pump 2 Drawdown Test

Static head (feet)	7
Calculated pumping capacity	400 gpm -460 gpm
Total Dynamic head (feet)	9.5
Number of tests performed	2

General observations/notes from drawdown test:

- Pump operating below the pump curve and at a lower head condition, most likely the result of wet end wear and differing head conditions from the original design. With limited remaining life, the pump should be considered for replacement.

Duplex configuration (Pump 2 in background)

Pump and motor #2

Pump 2 showing signs of aging on exterior

5.4.2. Exposed Piping and Valves

5.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve type(s)	Gate valve w/ hand wheel

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Paint on suction/discharge piping and valves are in good condition

5.4.2.2 Discharge Piping/Valve(s)

Size	4” through check valve and plug valve increase to 6”, wye into 8”
Material	DI
Valve type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Paint on suction/discharge piping and valves are in good condition

Gate valve isolation for suction piping

Ball check valve vertical installation on discharge piping

Plug valve on discharge piping

5.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

General observations/notes from field visit:

- No bypass pumping but, 4” drain off header inside dry pit

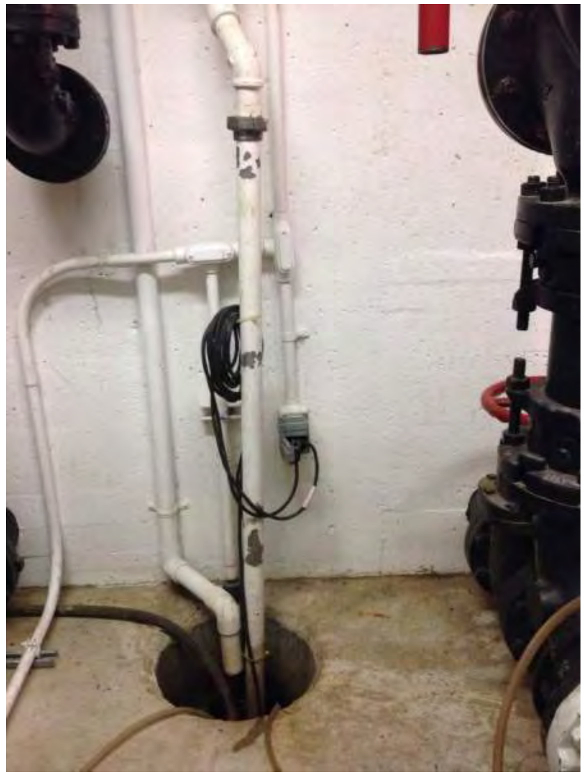
5.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in dry pit in two locations
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	Water meter box/insulation box and bags

General observations/notes from field visit:

- Backflow assembly adjacent to dry well below grade, no drain to daylight – does not meet code for installation

Backflow preventer assembly, below grade



4” drain off header to wet well, near sump

Backflow preventer assembly adjacent to dry pit

5.4.5 Ventilation

5.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Located in adjacent wet well blower vault
Fan type	Centrifugal
Airflow rate	560 CFM @ 0.5" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- 2 speed fan, not continuous

5.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	Ceiling of dry pit
Fan type	Centrifugal
Airflow rate	820 CFM @ 1" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located on the ceiling of the dry pit

General observations/notes from field visit:

- 2 speed fan, not continuous

Supply fan located near ceiling of dry pit

Wet well supply fan located in wet well blower vault

5.5 Electrical

5.5.1 Electrical Service

5.5.1.1 Electrical Service Description

Voltage	315 KVA
Phases	3
Utility transformer	Overhead
Service meter location	Adjacent to dry well on utility pole

5.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Galvanized rigid conduit for the meter base is corroded at grade

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 2 – Standard parts; accessible but requires coordination with utility

5.5.2 Backup Power

5.5.2.1 Backup Power Description

Type	Generator receptacle
Location	Near telephone pole
Transfer switch type	Manual
Transfer switch location	Adjacent to service meter

5.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Generator receptacle and manual transfer switch appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator receptacle and manual transfer switch are installed outdoors

General observations/notes from field visit:

- 4-wire 4-pole in excellent condition

Utility service and generator receptacle

GRC conduit corroded at grade

5.5.3 Site – Panelboard

5.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/208/3 phase
Manufacturer	Unknown
Model	Unknown

5.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Panel appears to be in good condition, but aging

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

5.5.4 Site - Starters

5.5.4.1 Starters Description

Starters	120/208, (2) FVNR Starters

5.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Both GE and Cutler Hammer starters are in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Starters located in dry pit, appears to be in good condition

5.5.5 Site – Telemetry Control Panel

5.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376845
Location	In dry pit, integral with power panel
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger
Secondary Level Indication	High level float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/Series 5000 Option F
Telephone Network Interface	Overhead, at top of Qwest pole

5.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- Control panel located in dry pit, power panel was not opened upon site visit
- Rust along all seams of telephone network interface termination box, wires poorly configured, not accessible

Telemetry control panel with operator interface, appears to be in good condition

Rusted telephone network interface termination box, located overhead at top Qwest pole

5.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 5-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classification	Does not meet code requirements, possible fire and explosion hazard	• De-classify • Re-build to classified area
Wet well interior coating failing	May decrease integrity of wet well structure	• Recoat interior of wet well
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps and motors
City owned meter base conduit corroding	Loss of power at the site	• Replace galvanized conduit
Fused disconnect is aging	Loss of power at the site	• Replace fused disconnect
Telephone network interface termination box not accessible	Structural integrity of box compromised, difficult to access	• Replace and relocate
Panelboard is aging	Loss of power at the site	• Replace panelboard
Primary level indicator is aging	Reliance on secondary system, loss of level control redundancy	• Replace primary level indicator
Backflow assembly enclosure requires drain to daylight.	Does not meet code, potential for cross-connection	• Install drain • Install device above grade in an enclosure

5.6.1 Project Recommendations

Due to the location of the Yarrow Point pump station and its impact to the general public, it is recommended that a single project be completed to address all deficiencies identified and avoid returning for a second project soon after. Due to the reported loss of pump redundancy at this station, an investigation should be done to determine the reason behind the loss of redundancy. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy. The pumps are also operating near the end of the curve where cavitation is a potential concern, in addition the pumps are obsolete. Given these factors all deficiencies identified should be replaced upon confirmation of the investigation results. The reported loss of pump redundancy reduces the station's level of service below industry standards and regulatory requirements thus the timing of the project should be done as soon as possible within the 2015-2018 time frame.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and project recommendations is presented in Table 5-4 and represents the most cost effective alternative based on engineering judgment.

Table 5-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
YP-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$379,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Wet well interior coating failing	Recoat interior of wet well		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	City owned meter base conduit corroding	Replace galvanized conduit		
	Fused disconnect aging	Replace fused disconnect		
	Telephone network interface termination box not accessible	Replace and lower box so accessible		
	Panelboard is aging	Replace panelboard		
	Primary level indicator is aging	Replace primary level indicator		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

5.6.2 Project Justification

The timing of the recommended project is driven by the investigation of the reported loss of pump redundancy which reduces the station's level of service below industry standards and regulatory requirements.

The Paco pumps used at this station are no longer manufactured, making the pumps obsolete. Also, based on the drawdown tests, their capacity appears to have deteriorated. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

Continued deterioration of the meter base will eventually jeopardize power service to the site and create an unsafe situation with exposed wiring and the potential for stray current. Failure of the power service will require the station to operate off of the standby generator until the service is temporarily repaired and new meter based installed.

5.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 5-4 have been implemented in the timeline identified.

5.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 5-5 and 5-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 5-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 5-5
Current Estimated Remaining Useful Life

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	3	1	0	-	3	10-15
Electrical System	3	1	0	-	3	5-10
Telemetry System	2	1	0	-	2	5-10
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 5-6 includes project estimated remaining useful life when the recommended projects provided in Table 5-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 5-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	0	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	15-20

5.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 5-1 graphically represents the rehabilitation and replacement cost projections for the Yarrow Point Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 5-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 5-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 5-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	\$30,000 \$15,000 \$10,000	\$40,000 \$20,000 \$15,000	\$50,000 \$25,000 \$20,000	\$60,000 \$30,000 \$25,000	\$70,000 \$35,000 \$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	\$5,000 \$5,000	\$8,000 \$8,000	\$11,000 \$11,000	\$14,000 \$14,000	\$17,000 \$17,000

Table 5-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

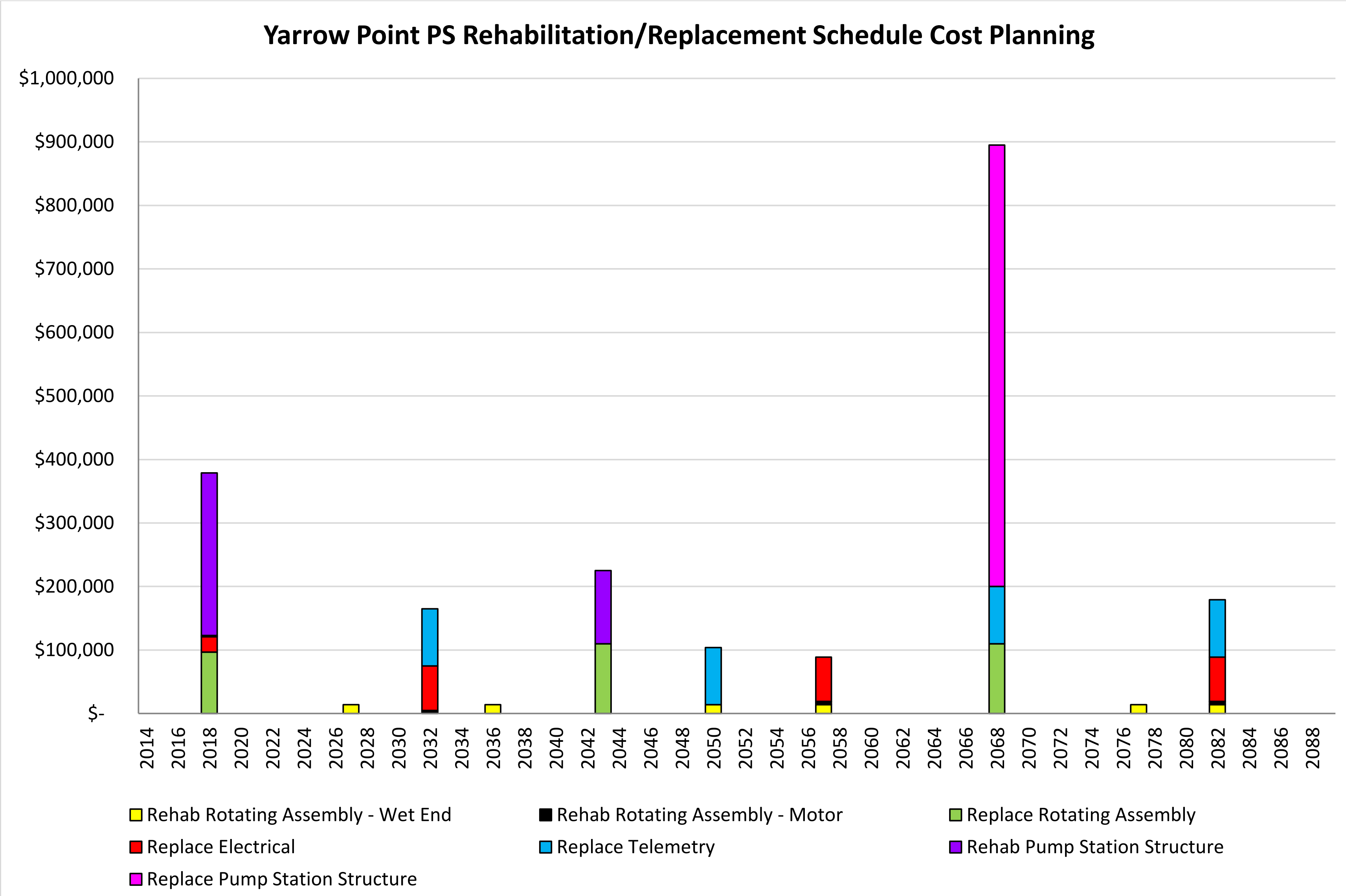
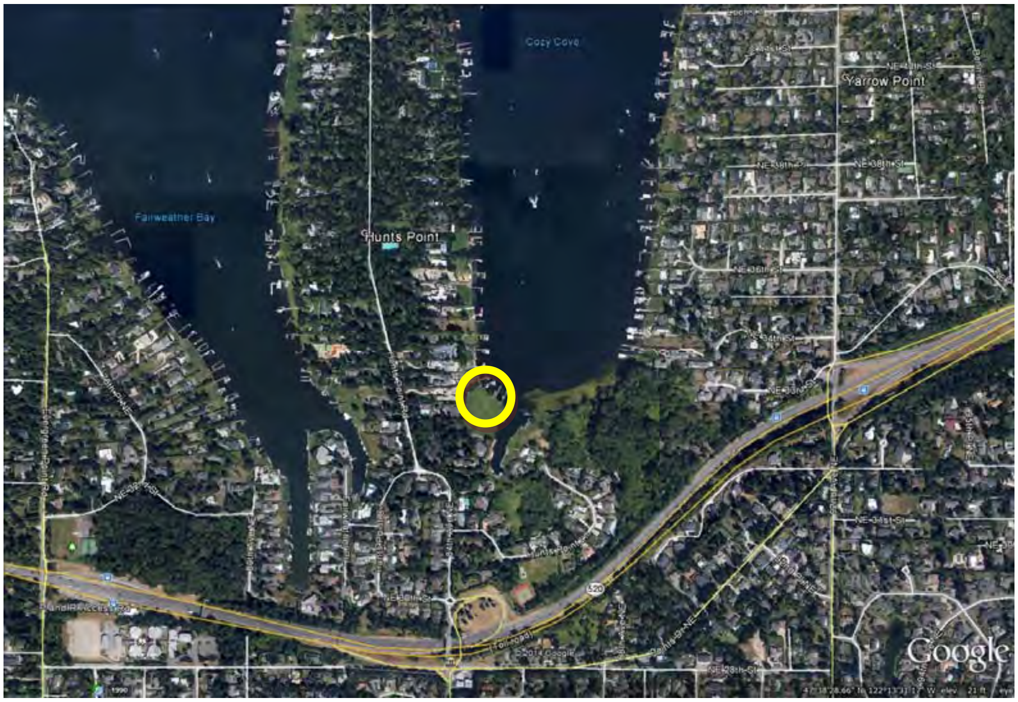


Figure 5-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 6
COZY COVE



6.1 Cozy Cove Pump Station General Description

City of Bellevue Asset No.	187620
Address	3268 Hunts Point Rd
Station Configuration	Wet well/Dry pit
Original Construction	1960
Major Rehabilitation/Upgrade	1988, 1995 (generator vault)
Number of Pumps	3
Pump Horsepower	10
Station Voltage/Phase	480/3 Phase
Standby Power	Onsite generator in underground vault near road
Field-Measured Station Firm Capacity	320-410 gpm

6.1.1 Summary of Findings

Cozy Cove pump station is located in the backyard of a private lot, adjacent to the lake. The generator vault and service cabinet are located adjacent to the street on Hunts Point Road. An overall hatch was installed over the dry pit and wet well when the backyard elevation was raised approximately 2 feet. This station receives flow from Flush 1, Yarrow Point, Flush 2 and Hunts Point pump stations and discharges flow through a dedicated force main. A significant deficiency identified at this site is the rusty service cabinet adjacent to Hunts Point Rd. It is likely this surface rust is due to the wet well vent fan which is in close proximity to the cabinet. This station has reported loss of pump redundancy meaning on occasion all pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the station's level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. With a dedicated force main it is possible to increase the capacity at this station but the downstream capacity should be considered as well.

Table 6-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 6-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2(3)
CC-1	Rusted service cabinet	Rehabilitate service cabinet and relocate wet well vent fan	2015-2018	$18,000
CC-2	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$567,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Electrical clearance issues	Provide adequate clearance where necessary		
	Wet well interior coating failing	Recoat interior of wet well		
	Klockner Moeller motor drive is not a current model	Replace Klockner Moeller motor driver		
	The condition of the pumps and motors are deteriorating	Replace Fairbanks Morse pumps and motors		
	The general electrical equipment including: power phase monitors, transfer switches and panelboard are aging	Replace equipment		
	The instrumentation and control equipment including: sewage pump remote control pendant, primary level indicator and backup level indicator are aging	Replace equipment		
	Standby generator is aging	Replace standby generator		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

6.2 Site

6.2.1 Site Description

Vehicle access to site	Gravel pull off on private lot to access generator vault, home owners driveway to access station
Landscaping	A lot of landscaping, service cabinet overgrown with bushes
Site lighting	None
Fencing/security	Overall hatch to wet well and dry pit locked
Public accessibility to site	Located on private lot, generator vault and service cabinet on side of road

General observations/notes from field visit

- Located in the backyard of a private lot, adjacent to the lakefront
- Overall hatch over wet well and dry pit constructed when backyard elevation raised approximately 2 feet
- Service cabinet overgrown with bushes near front of road
- Difficult access to blower vault due to bushes around hatch

Generator vault on side of road

Service cabinet overgrown with bushes

Overall hatch to wet well and dry pit located in yard

6.3 Station Facilities

6.3.1 Wet Well – Structure and Accessories

6.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid, Olympic Foundry Co. and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	15'x10'*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8", above operating level
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

6.3.1.2 Wet Well Findings

Condition	1	2	**3**	4	5
Criticality	1	2	3	**4**	
Serviceability	1	**2**	3	4	

Condition Rating 3 – Ground surface inspection identified interior coating is delaminating and there is aggregate showing.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Interior of wet well, some exposed aggregate

Wet well manhole lid

6.3.2 Dry Pit – Structure and Accessories

6.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and spiral staircase
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	15'x 8'-6"
Lighting	Yes, one light out at time of evaluation
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch

6.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Interior of dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Must step on metal grating to step onto spiral staircase platform (deflection under load)
- No exhaust fan – required in addition to supply fan to un-classify space per NFPA 820 code

Spiral staircase to dry pit, metal grating used to step onto main platform

Sump pump in dry pit

6.3.3 Aesthetic Top Cover Vault – Structure and Accessories

6.3.3.1 Aesthetic Top Cover Vault General Description

Construction materials	Concrete
Access description	Must step down to original station top elevation approximately 2 feet
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	10’x14’ – approx 2 feet deep to other covers
Lighting	None
Ventilation	None
Ventilation continuous	N/A

6.3.3.2 Aesthetic Top Cover Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

Criticality Rating 1 – Not critical to the function of the station

Serviceability Rating 1 – Easily accessed

General observations/notes from field visit:

- Added a few years ago when property elevation was raised approximately 2 feet – no stairs/steps down to original lift station top elevation from ground surface

Overall aesthetic top cover vault located in yard

6.3.4 Wet Well Blower Vault – Structure

6.3.4.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Hatch and ladder, challenging to access
Access fall protection	Yes, one side
Access locked	Yes
Access intrusion alarm	No
General dimensions	5’-6”x3’-6”*
Lighting	None
Ventilation	None
Ventilation continuous	N/A

*Based on Record Documents, unable to confirm in field.

6.3.4.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

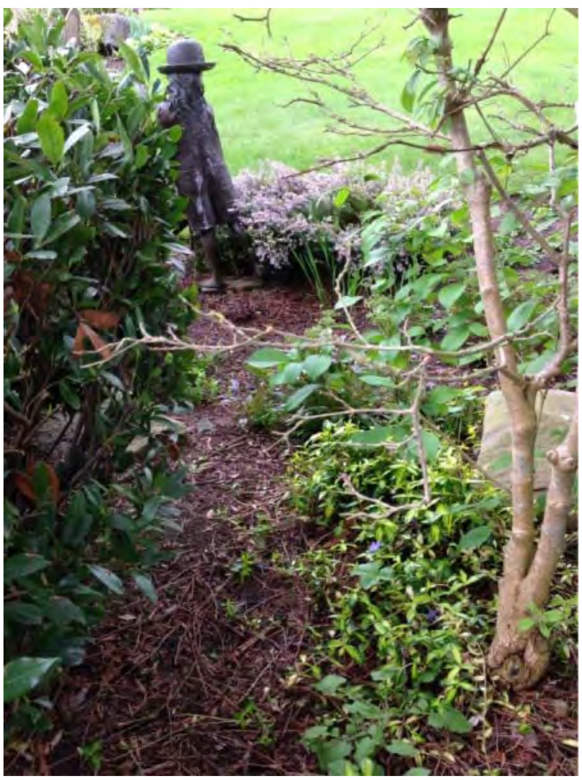
Criticality Rating 1 – Not critical and its failure would not significantly affect pump station

Serviceability Rating 2 – Located behind bushes, challenging access, no clear path to vault

General observations/notes from field visit:

- Components are not rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.
- Wet well blower vault houses supply ventilation fan for wet well
- Duct isolation valve opens and fan starts when switch is activated in the dry pit

Fall protection on one side of wet well blower vault



Path used to access wet well blower vault

Overall aesthetic top cover vault located in yard

6.3.5 Generator Vault – Structure and Accessories

6.3.5.1 Generator Vault General Description

Area	Current Classification	Rationale
Generator Vault	Unclassified	-

Construction materials	Concrete
Access description	Hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	8'x14'x8' deep
Lighting	Yes
Ventilation	Yes
Ventilation continuous	N/A

6.3.5.2 Generator Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

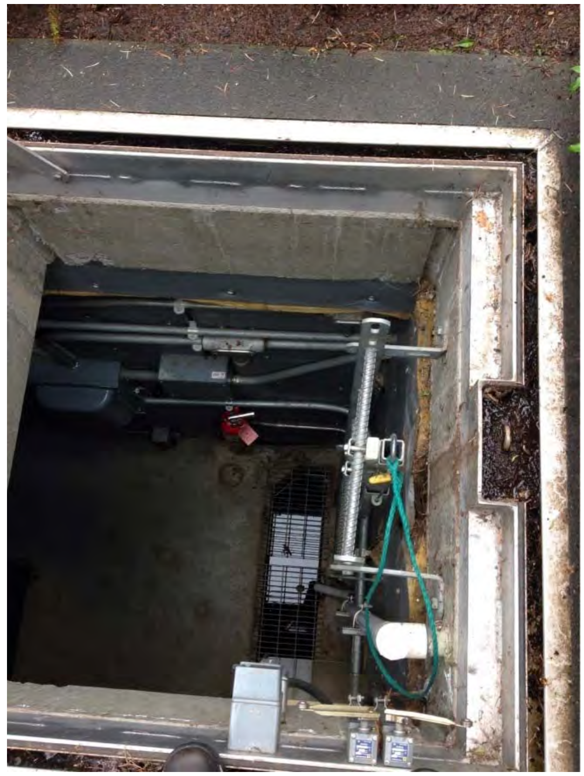
Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed, parts readily available

General observations/notes from field visit:

- Located adjacent to roadway near service cabinet
- Vault drain and cooling water return are piped directly to drain line – no atmospheric connection to wet well

Generator vault located adjacent to street



Hatch opening to generator vault

Interior of generator vault

6.4 Mechanical

6.4.1 Pumps

Pump System Performance

City crews have increased the size of the impellers in the Cozy Cove Pumps from 8.16 inches to 8.475 inches. This was the maximum diameter identified by the manufacturer that would not trigger a motor size increase. The measured flow and head appear to be in reasonable alignment with the original design point and the new, larger impeller. Measuring the flow/head just below the 8.475 inch impeller curve may indicate some wear, but it appears likely that the measured point is within the accuracy of the theoretical data. The drawdown test was completed only for one pump running. With three pumps installed at this facility, two pumps are allowed to run without compromising the system redundancy. Based on available data, two pumps running is estimated as roughly 600 gpm at 65 feet.

The following table documents the pump run hours and starts by month over the past year.

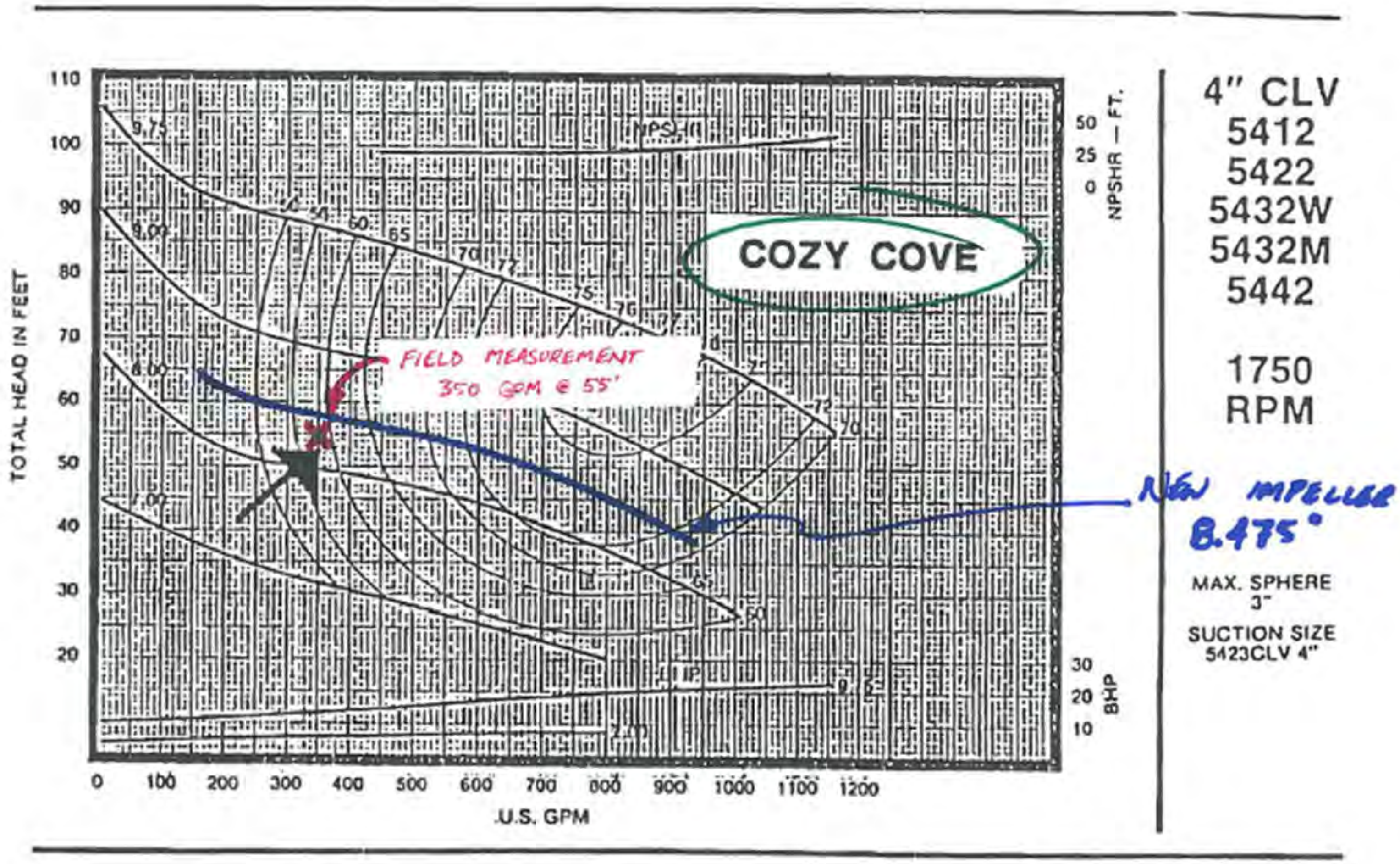
Table 6-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts	P#3 Hours	P#3 Starts
Apr-13	99.54	1,653	92.19	1,656	97.04	1,650
May-13	76.76	1,551	72.85	1,539	76.28	1,537
Jun-13	69.46	1,430	68.29	1,435	68.69	1,433
Jul-13	69.65	1,414	65.57	1,420	67.25	1,420
Aug-13	67.64	1,392	65.87	1,402	67.4	1,399
Sep-13	77.81	1,417	73.41	1,413	73.97	1,416
Oct-13	66.39	1,365	65.62	1,418	68.17	1,395
Nov-13	76.31	1,417	70.68	1,414	72.54	1,419
Dec-13	76.73	1,521	72.59	1,513	72.16	1,503
Jan-14	95.6	1,619	85.13	1,620	81.55	1,620
Feb-14	112.65	1,565	98.48	1,568	103.32	1,571
Mar-14	150.28	1,665	132.88	1,669	136.2	1,654
Total	**1,038.82**	**18,009**	**963.56**	**18,067**	**984.57**	**18,017**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	2.8	2.1	2.6	2.1	2.7	2.1

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Pump Curve:

FIGURE 3



6.4.1.1 Pump 1 – City of Bellevue Asset No. 193831

Pump style	Vertical, centrifugal, non-clog
Make	Fairbanks Morse
Model	B5442CLV-T20*
Serial No.	K3P10567650-5*
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	320 gpm @ 52.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley chain hoist and rail

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable but rehabilitation or replacement will be necessary in 5-10 years

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as all three pumps have been reported as running simultaneously

Serviceability Rating 1 – Easily accessed in dry pit

General observations/notes from field visit:

- Painting over pump name plate made it difficult/impossible to read information for all three pumps
- Hoisting rail is not marked with load capacity, as required by code
- Replaced impeller and volute in 2013
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	48
Calculated pumping capacity	320 gpm -360gpm
Total Dynamic head (feet)	55
Number of tests performed	2

Triplex configuration

Pump name plate, painted over, difficult to read information, typical of all three pumps

Pump and motor #1

6.4.1.2 Pump 2 – City of Bellevue Asset No. 193832

Pump style	Vertical, centrifugal, non-clog
Make	Fairbanks Morse
Model	B5442CLV-T20*
Serial No.	K3P10567650-5*
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	320 gpm @ 52.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley chain hoist and rail

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable but rehabilitation or replacement will be necessary in 5-10 years

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as all three pumps have been reported as running simultaneously

Serviceability Rating 1 – Easily accessed in dry pit

General observations/notes from field visit:

- Painting over pump name plate made it difficult/impossible to read information for all three pumps
- Hoisting rail is not marked with load capacity, as required by code
- Replaced impeller and volute in 2013
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	48
Calculated pumping capacity	320 gpm -370gpm
Total Dynamic head (feet)	55
Number of tests performed	2

Triplex configuration

Pump and motor #2

6.4.1.3 Pump 3 – City of Bellevue Asset No. 193833

Pump style	Vertical, centrifugal, non-clog
Make	Fairbanks Morse
Model	B5442CLV-T20*
Serial No.	K3P10567650-5*
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	320 gpm @ 52.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley chain hoist and rail

*Based on Record Documents, unable to confirm in field.

Condition	1	2	**3**	4	5
Criticality	1	2	3	**4**	
Serviceability	**1**	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable but rehabilitation or replacement will be necessary in 5-10 years

Criticality Rating 4 – Pump 3 is critical to the function of the station and not redundant, as all three pumps have been reported as running simultaneously

Serviceability Rating 1 – Easily accessed in dry pit

General observations/notes from field visit:

- Painting over pump name plate made it difficult/impossible to read information for all three pumps
- Hoisting rail is not marked with load capacity, as required by code
- Replaced impeller and volute in 2013
- Reported loss of pump redundancy

Pump 3 Drawdown Test

Static head	48
Calculated pumping capacity	350 gpm -410gpm
Total Dynamic head	55
Number of tests performed	2

Triplex configuration

Pump and motor #3

6.4.2 Exposed Piping and Valves

6.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Gate valve w/ hand wheel

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Condition could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Pump 1 suction isolation valve replaced 2-3 years ago.

6.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Condition could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

Gate valve with hand wheel on suction piping

Discharge ball check valve, installed vertically

Discharge plug valve

6.4.3 Other Station Piping

Bypass piping?	No
Pig launching?	No
Air release valves?	No
Force main isolation?	Yes, in back yard adjacent to site but inaccessible.

General observations/notes from field visit:

- Force main isolation near lift station in yard, not accessible. When yard elevation was raised, lid over existing valve box was not removed. Excavation required to fix this.

6.4.4 Washdown Water

Supply	Domestic/Metered
Accessed	Hose bib in dry pit
Backflow prevention assembly	¾” reduce pressure backflow device
Enclosure/Freeze protection	In generator vault/Heat tape

Force main isolation valve not accessible

Washdown water supply located in dry pit

6.4.5 Ventilation

6.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Located in adjacent wet well blower vault
Fan type	Centrifugal
Airflow rate	975 CFM @ 0.5” SP*

*Based on Record Documents, not measured in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Condition could not be determined based on visual inspections alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Wet well vent is 18” from service cabinet on side

6.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	Corner of dry pit/ceiling
Fan type	Axial
Airflow rate	975 CFM @ 0.5” SP*

*Based on Record Documents, not measured in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Condition could not be determined based on visual inspections alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

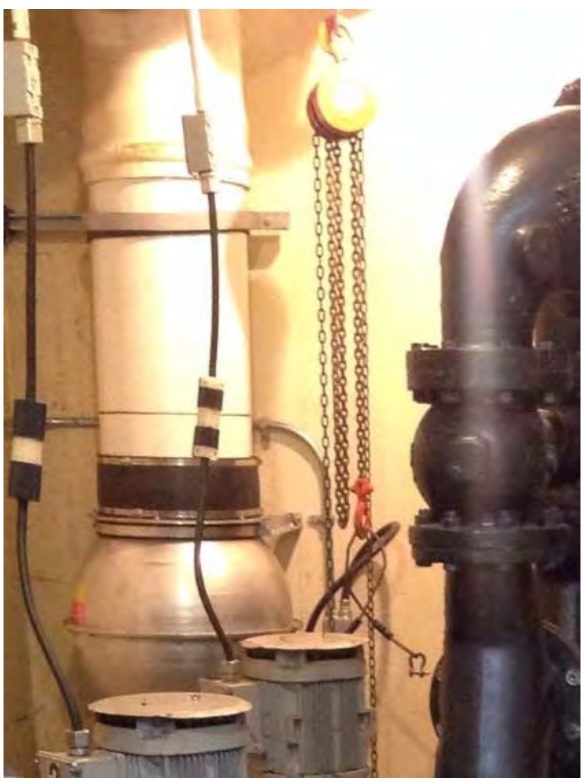
Serviceability Rating 2 – The supply fan can be difficult to access since it is located on the ceiling of the dry pit

General observations/notes from field visit:

- 1 speed vent fan, dry pit vent fan can run on timer
- No outlet air – passive venting through hatch, when open

Wet well vent approximately 18” from service cabinet

Wet well supply fan located in wet well blower vault



Supply fan located in corner of dry pit

6.5 Electrical

6.5.1 Electrical Service

6.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	In generator vault
Service meter location	In service cabinet

6.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused disconnect appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from street

General observations/notes from field visit:

- Service cabinet is in poor condition and rusting, rehabilitation is recommended. Corrosion is likely due to close proximity with wet well vent, relocation of wet well vent recommended.

Rusted service cabinet near vent

Service meter located in rusty service cabinet

Interior of service cabinet

6.5.2 Backup Power

6.5.2.1 Backup Power Description

City of Bellevue Asset No.	193770
Type	Standby Generator (diesel)
Location	Underground generator vault
Manufacturer	Kohler Corporation
Model	50ROZJ71
Serial No.	360533
Age	Approx 24 years
Electrical Capacity (KW)	55 KW/69 KVA
Fuel Storage	120+/- gal
Cooling	Water (Domestic water supply)
Transfer switch type	Manual
Transfer switch location	In generator vault

6.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Transfer switches and generator receptacle appear to be in good condition; standby generator appears to be in good condition but with decreasing useful life

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; genset and transfer switches in generator vault which limits work on the diesel engine generator

General observations/notes from field visit:

- 2 sealed rechargeable batteries
- Service cabinet rusted significantly, right door will not open full 90 degrees

Emergency generator located in underground vault, appears to be in good condition but with decreasing useful life

Transfer switch located in generator vault, appears to be in good condition

6.5.3 Site – Panelboard

6.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/240 VAC
Manufacturer	ITE
Model	CDP-7 Series 8

6.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – ITE panel in station appears to be in good condition, but useful life is decreasing

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 3 – Parts no longer made; equipment is in dry pit; not close to driveway

6.5.4 Site – Starters

6.5.4.1 Starters Description

Starters	120/240 VAC, FVNR Starter

6.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Klockner Moeller starter and circuit breakers appear to be in good condition. None have failed but they have decreasing useful life

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the others will still operate

Serviceability Rating 3 – Parts no longer made; equipment in dry pit is a distance from driveway

General observations/notes from field visit:

- Klockner Moeller starters are obsolete

Power panel for dry pit

Klockner-Moeller starter and circuit breakers appear to be in good condition, but with decreasing useful life and parts are no longer made

6.5.5 Site – Telemetry Control Panel

6.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376866
Location	In dry pit
Configuration	Separate panel
Primary Level Indication	Ultrasonic/Siemens Multiranger 100
Secondary Level Indication	Float switch
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In dry pit control panel

6.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition and well maintained

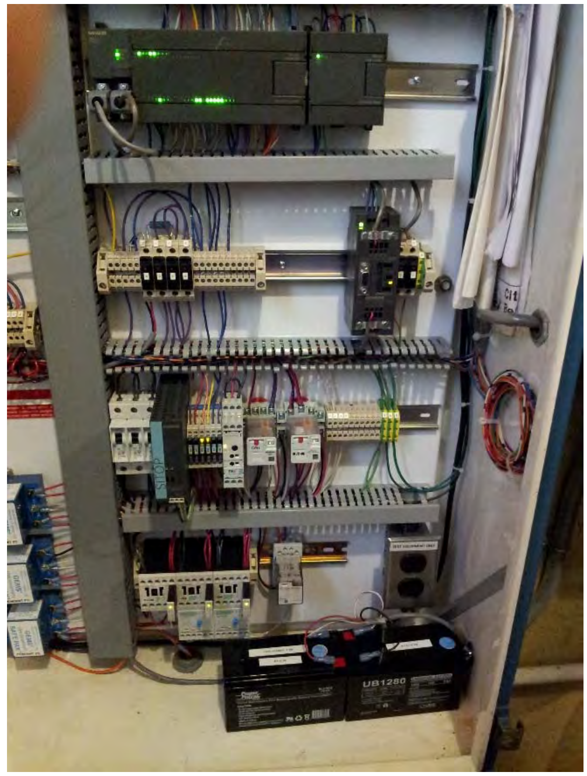
Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- 23” to 480 VAC pump in dry pit, clearance issue
- 20” to 480 VAC pump communication box, clearance issue
- 3’-3” to 480 VAC pump communication box

Telemetry control panel located in dry pit, appears to be in good condition



Interior of telemetry control panel

6.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 6-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Rusted service cabinet, vent in close proximity	May decrease integrity of structure, Does not meet code requirements, possible fire and explosion hazard	• Repair service cabinet, relocate wet well vent fa • Replace service cabinet, relocate wet well vent fan
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classification	Does not meet code requirements, possible fire and explosion hazard	• De-classify wet well blower vault • Re-build to classified area
Electrical clearance issues	Potential safety issue	• Provide adequate clearance where necessary
Wet well interior coating failing	May decrease integrity of wet well structure	• Recoat interior of wet well
Klockner Moeller motor drive is not a current model	Motor drive will not be serviceable	• Replace motor driver with current model
The condition of the pumps and motors are deteriorating	Loss of service at site	• Replace pumps and motors
The general electrical equipment including: utility power phase monitor, standby power phase monitor, manual transfer switch, auto transfer switch and panelboard are aging	Loss of power at site	• Replace equipment
The instrumentation and control equipment including: sewage pump remote control pendant, telemetry cabinet, primary level indicator and backup level indicator are aging	Loss of control at the station	• Replace equipment
Standby generator is aging	Loss of power at site	• Replace standby generator

6.6.1 Project Recommendations

The recommended improvements were grouped into two projects.

The first recommended project is to repair the rusted service cabinet along Hunts Point Rd and relocate the vent that is currently adjacent to the cabinet. Since this is a low impact project, it was grouped alone for simplicity and can be done independently of other work.

The second project includes all other identified deficiencies at this station. Before the replacement of components, an investigation should be done to determine the reason why all pumps sometimes run simultaneously. Since this stations has a dedicated force main it is possible to increase the capacity at this station but the downstream capacity should be considered as well. The results from this investigation will determine the capacity needed at this station which will affect the rotating assembly and electrical equipment selection. Thus the pumps, motors, electrical and telemetry components should be replaced after the investigation is done. The timing of the project is driven by the replacement of the Klockner Moeller motor drivers since they are obsolete and replacement parts are not available. The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, a bypass connection on the force main is strongly recommended. Currently there is no ability to bypass the pump station for construction or emergency purposes. This addition will help enable an emergency response so that the station can continue to provide service if the pump station or the force main fails.

Along with a bypass connection and emergency response plan, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and project recommendations is presented in Table 6-4 and represents the most cost effective alternative based on engineering judgment.

Table 6-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
CC-1	Rusted service cabinet	Rehabilitate service cabinet and relocate wet well vent fan	2015-2018	$18,000
CC-2	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$567,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Electrical clearance issues	Provide adequate clearance where necessary		
	Wet well interior coating failing	Recoat interior of wet well		
	Klockner Moeller motor drive is not a current model	Replace Klockner Moeller motor driver		
	The condition of the pumps and motors are deteriorating	Replace Fairbanks Morse pumps and motors		
	The general electrical equipment including: power phase monitors, transfer switches and panelboard are aging	Replace equipment		
	The instrumentation and control equipment including: sewage pump remote control pendant, primary level indicator and backup level indicator are aging	Replace equipment		
	Standby generator is aging	Replace standby generator		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

6.6.2 Project Justification

The first project is necessary to insure that the service cabinet is sound and continues to protect the electrical and instrumentation components from corrosion that would otherwise result in failure of the control and/or power system resulting in loss of service to the station. The vent located adjacent to the service cabinet does not meet code clearance issues and is likely contributing to the corrosion of the service cabinet. Relocation of the vent would prevent further damage to the new cabinet structure.

The second project is recommended due to the continued wear on equipment over time and the obsolescence of the Klockner Moeller motor drivers. The consequence of failure of this equipment, including the motor drivers, is a reduced level of service at the station, below industry standards and regulatory requirements that could result in loss of redundancy and/or loss of operation of the entire station.

6.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 6-5 have been implemented in the timeline identified.

6.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 6-5 and 6-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 6-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 6-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	3	1	0	-	3	10-15
Electrical System	2	1	0	-	2	10-15
Telemetry System	3	1	0	-	3	0-5
Generator	2	3	0	-	3	5-10
Rotating Assembly	3	1	0	-	3	5-10

Table 6-6 includes project estimated remaining useful life when the recommended projects provided in Table 6-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 6-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	0	0	-	1	10-15
Generator	0	0	0	-	0	40
Rotating Assembly	0	0	0	-	0	30

6.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 6-1 graphically represents the rehabilitation and replacement cost projections for the Cozy Cove Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 6-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 6-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 6-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	$10,000 $5,000	$15,000 $10,000	$20,000 $15,000	$25,000 $20,000	$30,000 $25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 6-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

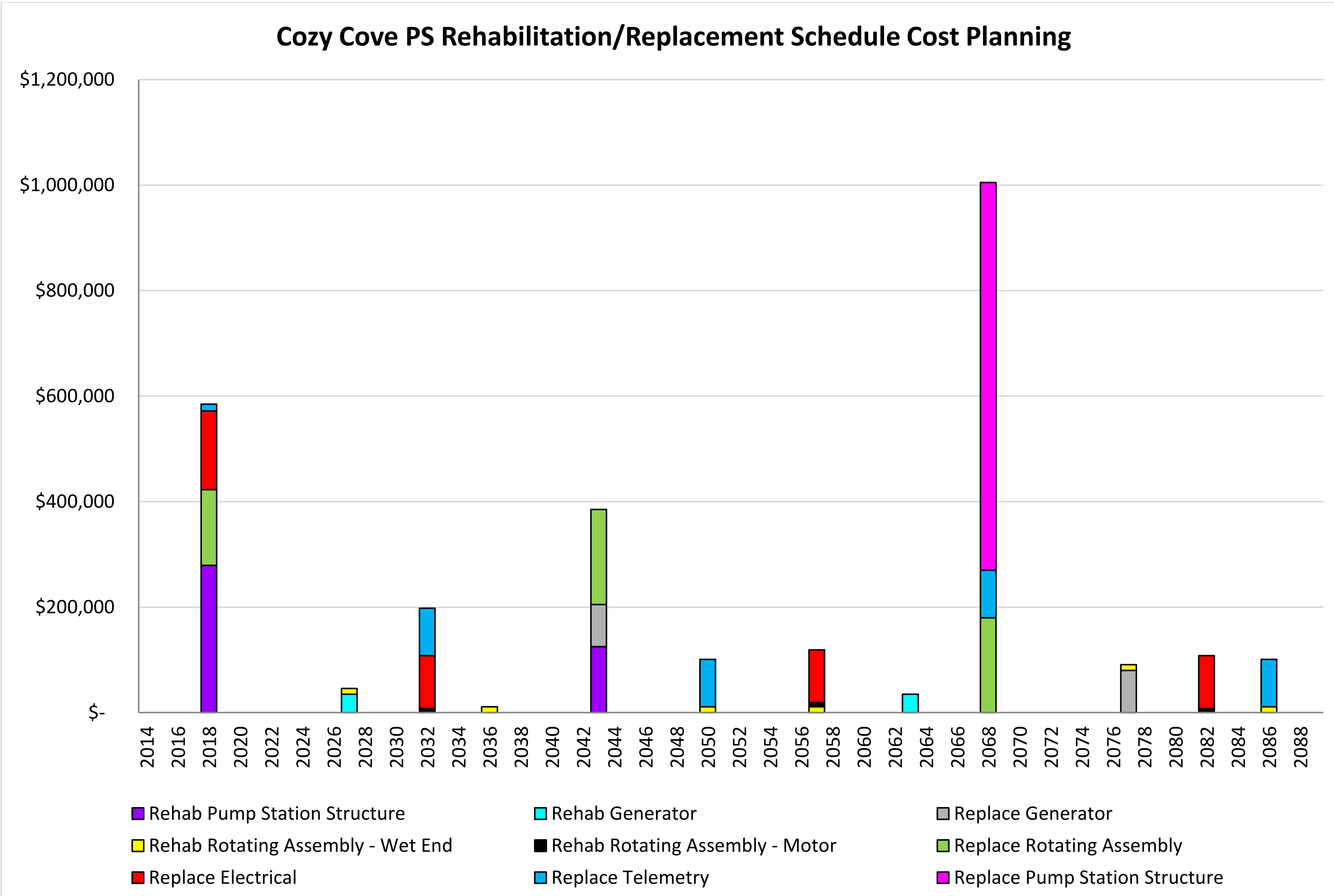
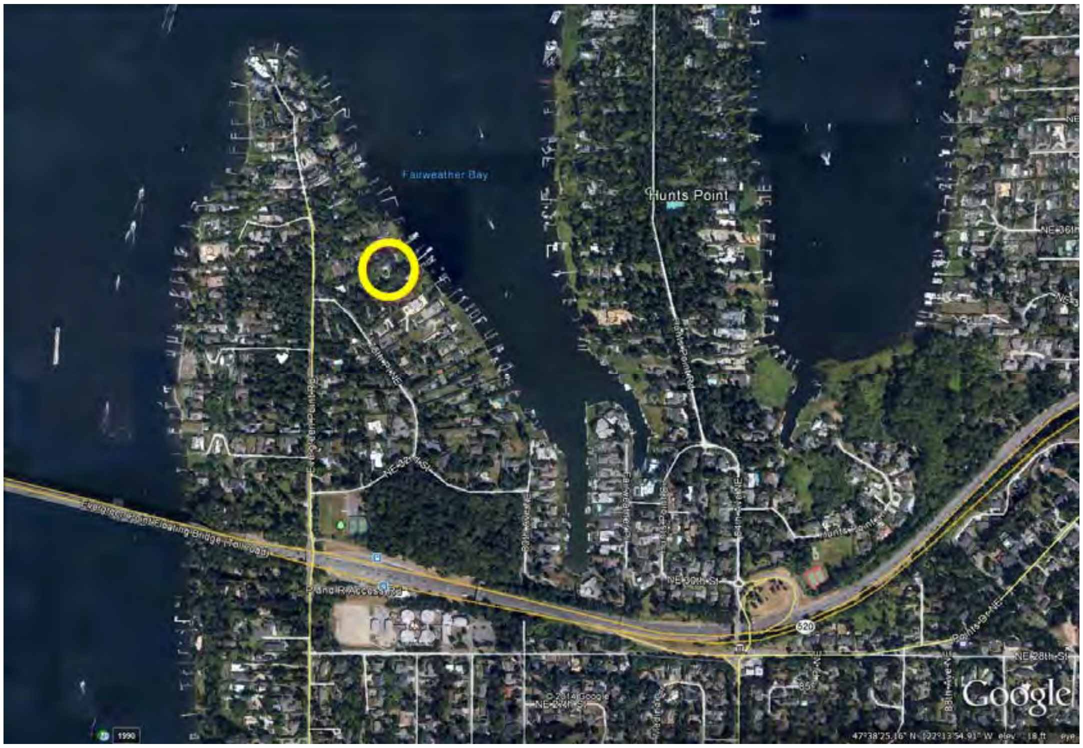


Figure 6-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 7
EVERGREEN EAST



7.1 Evergreen East Pump Station General Description

Date of Visit	April 16th, 2014
City of Bellevue Asset No.	187607
Address	3334 Lake Ln (NE 78th Pl)
Station Configuration	Wet well/Dry pit
Original Construction	1960
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	208/3 Phase
Standby Power	Generator Receptacle
Field-Measured Station Firm Capacity	490-540 gpm

7.1.1 Summary of Findings

Evergreen East pump station is located down a narrow street leading to the lake and public dock. This station receives flow from Flush 3 and Evergreen West and discharges to the lake line. There are two Paco pumps at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech). This station also has reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the station's level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Table 7-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 7-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
EE-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$344,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Paco pumps are obsolete and likely operating at end of pump curve	Replace Paco pumps and motors		
	Wet well interior coating failing	Recoat interior of wet well		
	The condition of the instrumentation and control equipment including: sewage pump remote control pendant, telephone network interface termination box, primary and backup level indicators are aging	Replace equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

7.2 Site

7.2.1 Site Description

Vehicle access to site	Direct, must back down narrow one lane street, no turn around
Landscaping	Gravel
Site lighting	None
Fencing/security	Vault hatches locked
Public accessibility to site	Public path to dock

Station is located within a gravel access way that is open to the public

78th Pl NE intersects with one lane paved road to station and on to lake access

7.3 Station Facilities

7.3.1 Wet Well – Structure and Accessories

7.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid Olympic Foundry Co. and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8” above operating level*
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch (manually operated)

*Based on Record Drawings, unable to confirm in field.

7.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Ground surface inspection identified interior appears to be in fair condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Wet well manhole lid (locking)

Interior of wet well

7.3.2 Dry Pit – Structure and Accessories

7.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete, coated
Access description	Lift assist hatch and spiral staircase
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8’-6”
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch (automatic)

7.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – The dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Wall leaking behind panel, also leaking at header drain penetration to wet well
- Some odor in dry pit – possibly attributed to inadequate washdown of facility following removal of rags from pump, or similar activity.
- No exhaust fan – required in addition to supply fan to un-classify space per NFPA 820 code

Pumps and piping in dry pit

Evidence of water damage behind panel –
no new leakage observed

7.3.3 Wet Well Blower Vault – Structure and Accessories

7.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	9’-2”x3’-6”x4’ deep
Lighting	No
Ventilation	None
Ventilation continuous	N/A

7.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation.

Serviceability Rating 2 – Ladder location presents a slightly challenging access.

General observations/notes from field visit:

- Not all components are rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.

No fall protection for blower vault

Interior of blower vault shows concrete in good shape,
but ladder location presents a slightly challenging access

7.4 Mechanical

7.4.1 Pumps

Pump System Performance

The field tested performance of the Evergreen East pumps indicate that the flow is twice the design rate (500 gpm vs. 250 gpm), and the pressure head is half of the design rate (7 ft vs. 14 ft). Without an available pump curve, little can be determined regarding the pumping system. However, given that the flow is double the listed design rate, it is likely that the pump is operating near the end of its curve. Operation at that point for any pump is inefficient and potentially problematic from a cavitation perspective.

The following table documents the pump run hours and starts by month over the past year.

Table 7-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	39	1,033	38.35	1,029
May-13	27.14	766	26.42	760
Jun-13	24.3	706	24.18	703
Jul-13	23.53	689	24.01	694
Aug-13	23.46	661	23.47	658
Sep-13	26.19	723	25.8	723
Oct-13	24.07	671	24.49	677
Nov-13	26.31	695	24.58	695
Dec-13	26.32	709	25.26	710
Jan-14	32.48	871	31.9	866
Feb-14	44.62	1,053	43.86	1,054
Mar-14	65.58	1,436	64.68	1,439
Total	**383**	**10,013**	**377**	**10,008**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.0	1.1	1.0	1.1

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Name plate data on pump

~~Medina GPM 350 TDH 67.5 imp dia 8.1~~

~~Evergreen West GPM 250 TDH 16 imp dia 7.5~~

Evergreen East GPM 250 TDH 14 imp dia 7.5

FIELD MEASUREMENT: 500 GPM @ 7'

Figure 7-1: No pump curves were located or available by the manufacturer, but this design point listing provided some useful information

7.4.1.1 Pump 1 – City of Bellevue Asset No. 193760

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-SX46D60-01
Serial No.	88A0224301-B
Horsepower	3
Voltage/phase	208/3
Date of installation	1989
Design Conditions	250 gpm @ 14 feet TDH
Able to isolate pump	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both the manufacturer (Grundfos) and the manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	1
Calculated pumping capacity	490 gpm -530 gpm
Total Dynamic head (feet)	7
Number of tests performed	2

General observations/notes from drawdown test:

- Likely that the pump is operating near the end of its curve, potentially problematic from a cavitation perspective.

Duplex configuration (Pump 1 in foreground)

Pump 1

Minor rag removal from Pump 1 was performed during evaluation visit

7.4.1.2 Pump 2 – City of Bellevue Asset No. 193855

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-SX46D60-01
Serial No.	88A0224301-A
Date of installation	1989
Design Conditions	250 gpm @ 14 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both the manufacturer (Grundfos) and the manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	1
Calculated pumping capacity	490 gpm -540 gpm
Total Dynamic head (feet)	7
Number of tests performed	2

General observations/notes from drawdown test:

- Likely that the pump is operating near the end of its curve, potentially problematic from a cavitation perspective.

Duplex configuration (Pump 2 in background)

Pump 2

7.4.2 Exposed Piping and Valves

7.4.2.1 Suction Piping/Valve(s) Description

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

7.4.2.2. Discharge Piping/Valve(s) Description

Size	4”
Material	DI
Valve Type(s)	Ball check valve and plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- No issues noted

Suction plug valve – horizontal axis of rotation with seat to pump

Discharge ball check valve, installed vertically

Discharge plug valve – set up to prevent debris collection in valve

7.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

7.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in dry pit
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	Concrete meter box

General observations/notes from field visit:

- Backflow assembly adjacent to dry pit above ground in concrete meter box, drains to daylight

Backflow assembly adjacent to dry pit in above ground concrete meter box

7.4.5 Ventilation

7.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Located in adjacent wet well blower vault
Fan type	Belt driven, axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown - Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

7.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	Ceiling of dry pit
Fan type	Belt driven, axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located on the ceiling of the dry pit

Wet well supply fan in adjacent wet well blower vault

7.5 Electrical

7.5.1 Electrical Service

7.5.1.1 Electrical Service Description

Voltage	208
Phases	3
Utility transformer	Pad mounted
Service meter location	Outdoor pedestal

7.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused manual transfer switch appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway

General observations/notes from field visit:

- Power meter base on outdoor pedestal, no rust, PVC conduit

7.5.2 Backup Power

7.5.2.1 Backup Power Description

Type	Generator receptacle
Location	On Qwest pole out on roadway
Transfer switch type	Manual
Transfer switch location	Outdoor pedestal, built into main disconnect

7.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Generator receptacle appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts

General observations/notes from field visit:

- Generator receptacle along roadway before one lane road to station

Power meter base and service entrance disconnect equipment, appears to be in good condition

Generator receptacle located on Qwest pole near roadway, appears to be in good condition

7.5.3 Site – Panelboard

7.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/208/3 phase
Manufacturer	Siemens
Model	CDP-7 Series 8

7.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Cutler Hammer panel appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel

General observations/notes from field visit:

- Panelboard has a hole in right side-close up

7.5.4 Site – Starters

7.5.4.1 Starters Description

Starters	208/280, 3 phase, FVNR Starter

7.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Both the Furnas starter and replacement Siemens starter appear to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard located in dry pit, appears to be in good condition

Hole in panelboard

Starters located in dry pit appears to be in good condition

7.5.5 Site – Telemetry Control Panel

7.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376830
Location	In dry pit, integral w/ power panel
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Hydroranger 100
Secondary Level Indication	High level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In power and control panel

7.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel under roof

General observations/notes from field visit:

- Some corrosion near bottom of power and control panel

Some corrosion on telemetry control panel but other than that appears to be in good condition

Telemetry control panel with operator interface

Interior of telemetry control panel

7.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 7-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirement, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classification	Does not meet code requirement, possible fire and explosion hazard	• De-classify • Re-build to classified area
Paco pumps are obsolete and likely operating at end of pump curve	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps and motors
Wet well interior coating failing	May decrease integrity of structure	• Recoat interior of wet well
The condition of the instrumentation and control equipment including: sewage pump remote control pendant, telephone network interface termination box, primary and backup level indicators are aging	Loss of control at the site	• Replace equipment

7.6.1 Project Recommendations

Due to the location of the pump station and its impact to the general public, it is recommended that one project should be completed to address all deficiencies identified. The timing of the recommended project is driven by the reported loss of pump redundancy at this station which speeds the projects up to the first time frame from 2015 to 2018. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replacing all equipment with components intended for the Class 1, Division 2 space, which is cost prohibitive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and project recommendations is presented in Table 7-4 and represents the most cost effective alternative based on engineering judgment.

Table 7-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
EE-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$344,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Paco pumps are obsolete and likely operating at end of pump curve	Replace Paco pumps and motors		
	Wet well interior coating failing	Recoat interior of wet well		
	The condition of the instrumentation and control equipment including: sewage pump remote control pendant, telephone network interface termination box, primary and backup level indicators are aging	Replace equipment		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

7.6.2 Project Justification

The timing of the recommended project is driven by the reported loss of pump redundancy. This does not meet regulatory requirements and the station does not meet the minimum level of service.

In addition to the loss of redundancy, the Paco pumps at this station are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

7.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 7-4 have been implemented in the timeline identified.

7.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 7-5 and 7-6 is based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 7-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 7-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	3	1	0	-	3	10-15
Electrical System	2	1	0	-	2	10-15
Telemetry System	3	1	0	-	3	0-5
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 7-6 includes project estimated remaining useful life when the recommended projects provided in Table 7-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 7-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	0	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

7.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 7-1 graphically represents the rehabilitation and replacement cost projections for the Evergreen East Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 7-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 7-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 7-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 7-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

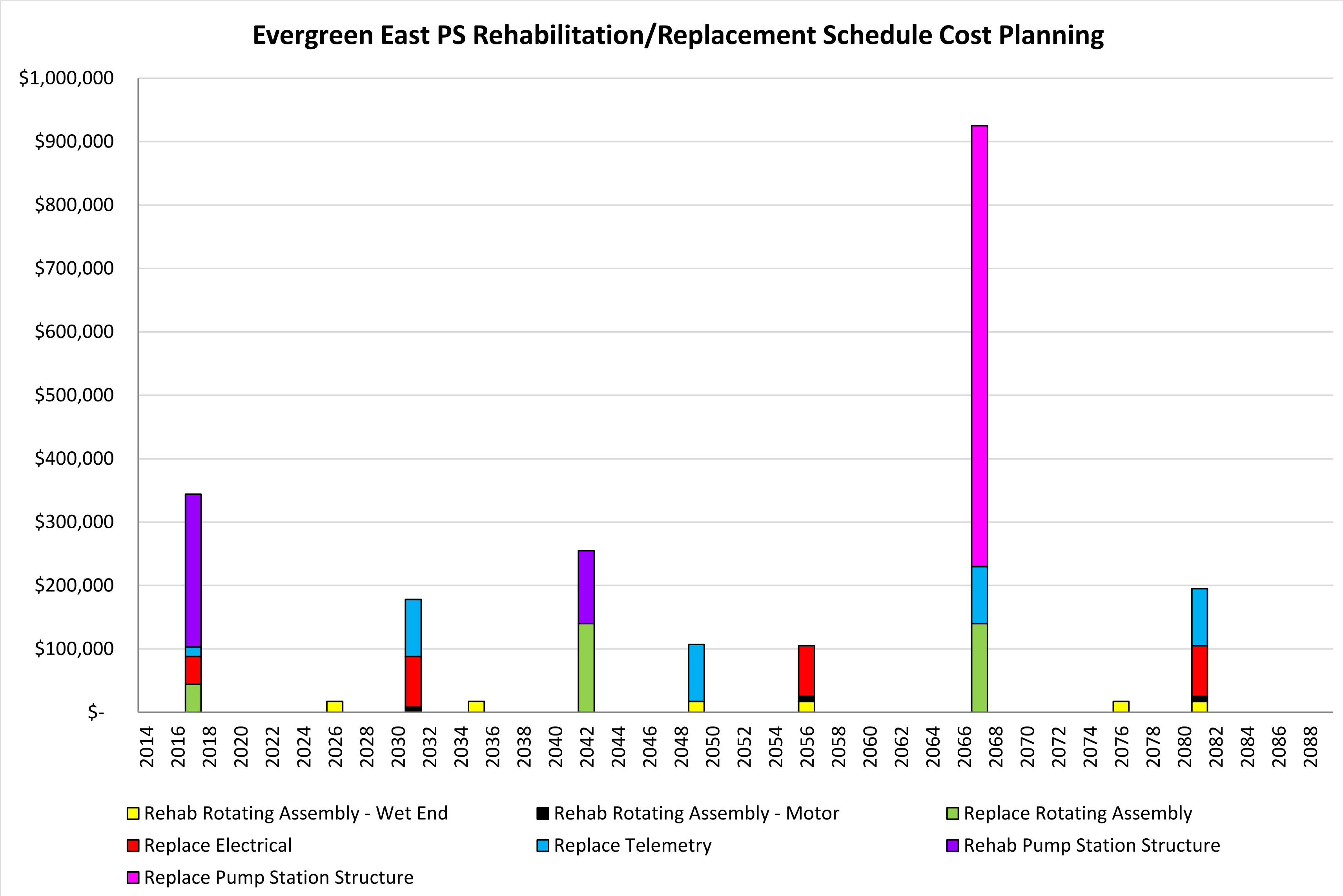
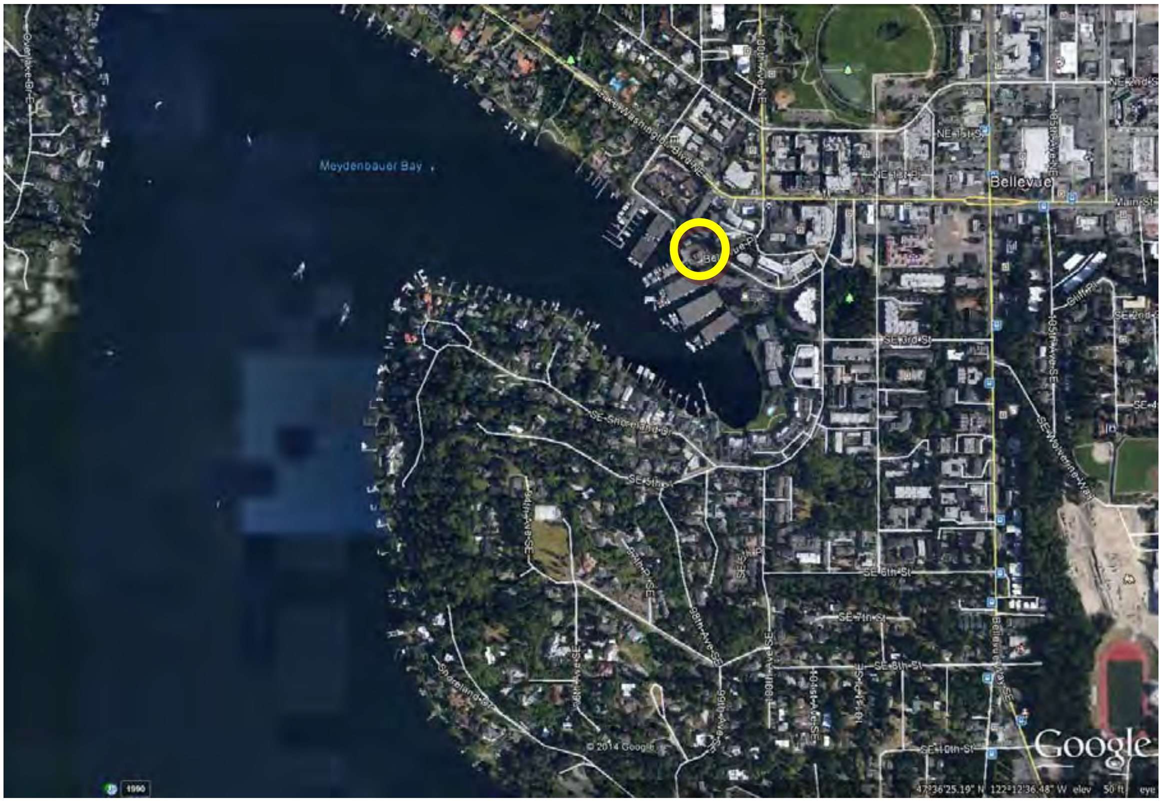


Figure 7-2: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 8
GRANGE



8.1 Grange Pump Station General Description

Date of Visit	April 23rd, 2014
City of Bellevue Asset No.	187621
Address	9927 Meydenbauer Way
Station Configuration	Wet well/Dry pit
Original Construction	1994
Major Rehabilitation/Upgrade	1994 relocation
Number of Pumps	2
Pump Horsepower	20
Station Voltage/Phase	277/480/3 Phase
Standby Power	Onsite generator in underground vault
Field-Measured Station Firm Capacity	220-260 gpm

8.1.1 Summary of Findings

This station is located at the intersection of SE Bellevue Place and Meydenbauer Way adjacent to the Bellevue Yacht Basin. This station receives flow from Parkers pump station and discharges flow through a dedicated force main. A significant deficiency identified at this site include the Paco pumps used at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech).

Table 8-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 8-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
G-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$234,000
	Drain in generator vault goes to wet well, no automatic primer	Install automatic primer		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Rust showing interior of dry pit structure	Recoat interior		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
	The general electrical equipment including: meter base, transfer switches, standby generator, dry transformer and panel board are aging	Replace equipment		
	The instrumentation and control equipment including: sewage pump remote control pendant, standby power phase monitor, telephone network interface termination box and backup level indicator are aging	Replace equipment		
	Starter panel is currently customized	Replace starter panel (within power and control panel)		
	Utility power phase monitor currently located in power and control panel, not standard	Relocate and replace		
	Sound-proof/insulation in generator vault falling off	Replace sound-proof insulation material		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements

8.2 Site

8.2.1 Site Description

Vehicle access to site	Easily accessible, two parking stalls reserved for City staff
Parking distance to site	10’
Landscaping	Rock retaining wall 3-6” high along one side, station area paved, bushes surrounding
Site lighting	None
Fencing/security	All vaults locked
Public accessibility to site	Near marina, public access to site

General observations/notes from field visit:

- Steps down to station
- Future City park area

Two dedicated parking stalls for City staff in front of station

General site, stairs leading down to station
– station is lower than adjacent parking

8.3 Station Facilities

8.3.1 Wet Well – Structure and Accessories

8.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, PVC Liner
Access description	Manhole lid, Olympic Foundry Co. and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inner diameter, 20’ deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	10”, above operating level*
Lighting	Yes, limited
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch

*Based on Record Drawings, unable to confirm in field.

8.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior coating, ladder and grating appear to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Wet well manhole lid

Interior of wet well

8.3.2 Dry Pit – Structure and Accessories

8.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	8’ Diameter, 20’ Deep
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch

8.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Dry pit appears to be in good condition, however there are a lot of rust and epoxy injections on the wall indicating previous leakage.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Tight space, two levels for panels and pumps, only a couple of feet between pumps
- A lot of rust and epoxy injections on wall indicate previous leakage – no current leakage identified
- Pulling pumps challenging, needs boom truck to pull fully out of dry pit
- Hatch on one side difficult to access. Staff had to open one side then reach under to open other side
- No exhaust fan – required in addition to supply fan to un-classify space per NFPA 820 code

Entry to dry pit, no fall protection

Rusting and epoxy injections on interior wall

8.3.3 Wet Well Blower Vault – Structure and Accessories

8.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5'x5'x5' deep
Lighting	No
Ventilation	None
Ventilation continuous	N/A

8.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Supply intake needs to be cleared
- Drain in vault goes to wet well. P-trap but no automatic primer

Interior of wet well blower vault appears to be in good condition

8.3.4 Generator Vault – Structure and Accessories

8.3.4.1 Generator Vault General Description

Area	Current Classification	Rationale
Generator Vault	Unclassified	-

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	14’x8’x8’H
Lighting	Yes, adequate
Ventilation	Yes, Supply and Exhaust Fan
Ventilation continuous	No, Auto on w/ hatch

8.3.4.2 Generator Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition though some insulation is falling off.

Criticality Rating 1 – Not critical, its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed, parts readily available

General observations/notes from field visit:

- Insulation in vault falling off
- Drain in generator vault goes to wet well, no automatic primer
- Sewage has been found in generator vault, hydraulic limitation on outfall reportedly backs up into wet well and subsequently into generator vault

Interior of wet well blower vault appears to be in good condition

Interior of generator vault, no fall protection

Insulation in generator vault falling off

8.5 Mechanical

8.5.1 Pumps

Pump System Performance

The field tested performance of the pumps at the Grange Pump Station indicates that the facility is pumping at about two-thirds of the intended design pumping capacity (~240 gpm vs. 350 gpm). Given that this point generally falls along the designated impeller curve, it is likely that the current head condition is greater than the anticipate design and/or original installation. Additionally, the location of the measured operating point, and even the design operating point, is extremely far to the left of the curve. Operating at this end of the curve has the potential to experience a number of hydraulic problems, largely surrounding low velocities through the pump that may contribute to ragging and recirculation.

The following table documents the pump run hours and starts by month over the past year.

Table 8-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	51.16	2,481	53.17	2,469
May-13	51.27	2,493	53.58	2,490
Jun-13	48.52	2,397	51.68	2,397
Jul-13	49.71	2,408	52.05	2,411
Aug-13	47.2	2,329	50.16	2,332
Sep-13	48.46	2,378	51.24	2,373
Oct-13	48.31	2,359	53.86	2,359
Nov-13	48.19	2,326	49.83	2,328
Dec-13	48.05	2,316	49.84	2,310
Jan-14	49.39	2,364	54.99	2,360
Feb-14	49.67	2,331	52.92	2,335
Mar-14	67.19	3,030	71.19	3,033
	607.12	**29,212**	**644.51**	**29,197**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.7	3.3	1.8	3.3

The pump run hours for this facility seem to be reasonable, however the average starts per hour appear to be high with the station cycling every nine minutes on average. This condition is typically attributed to a limited pumping volume between the pump on and pump off levels in the wet well. ***Recommendation:*** *Although the starts per hour are still within industry standards, the City should investigate the feasibility of increasing the pumping volume between the pump on and off levels to reduce wear on the electrical equipment.*

Pump Model #: PACO 49513/14 Type NCP

Design RPM: 1750

Performance: See pump curves below

350 GPM @ 84 ft. TDH

Motor Horsepower: 20 HP

Local Representative

PACO Pumps, Inc.
3215 South 116th Street
Seattle, Wa. 98168
Ph: 433-2600

Manufacturer

Same as above

DESIGN POINT

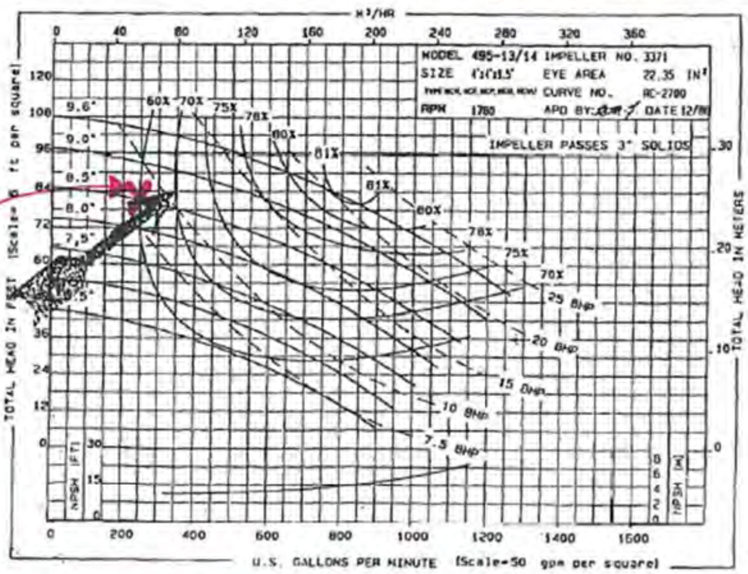
PACO PUMPS

PACO Pumps, Inc.
P.O. Box 12924 • 845 92nd Avenue
Oakland, California 94604-2924

350 GPM @ 84 FT. TDH

D2b.1
DRY PIT
NON-CLOG PUMPS

PERFORMANCE CURVES — 1750 RPM, 60 HERTZ



FIELD MEASUREMENT: ~240 GPM @ 82'

Operation & Maintenance Manual
Grange Sewage Pump Station

FIGURE 6
Pump Inventory

9

8.5.1.1 Pump 1 – City of Bellevue Asset No. 193828

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49514-S46D64-01-NCF
Serial No.	TH93A0083401A
Horsepower	20
Voltage/phase	460/3
Date of installation	1994
Design Conditions	350 gpm @ 84 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, crane/boom truck for full removal, lifting eye at top for partial

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Subsequent to the field evaluation, City staff noted that the lifting eye does not align vertically with the pumps, creating challenges for pump removal.

Pump 1 Drawdown Test

Static head (feet)	78
Calculated pumping capacity	230gpm -260 gpm
Total Dynamic head (feet)	82
Number of tests performed	2

General observations/notes from field visit:

- Pump appears to be operating at far left of curve, potential to experience a number of hydraulic problems, largely surrounding low velocities through the pump that may contribute to ragging and recirculation.

Pump 1 showing signs of aging on exterior

Pump and motor #1

8.5.1.2 Pump 2 – City of Bellevue Asset No. 193758

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49514-S46D64-01-NCF
Serial No.	TH93A0083401B
Horsepower	20
Voltage/phase	460/3
Date of installation	1994
Design Conditions	350 gpm @ 84 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, crane/boom truck for full removal, lifting eye at top for partial

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Subsequent to the field evaluation, City staff noted that the lifting eye does not align vertically with the pumps, creating challenges for pump removal.

Pump 2 Drawdown Test

Static head (feet)	78
Calculated pumping capacity	220 gpm -260 gpm
Total Dynamic head (feet)	82
Number of tests performed	2

General observations/notes from drawdown test:

- Pump appears to be operating at far left of curve, potential to experience a number of hydraulic problems, largely surrounding low velocities through the pump that may contribute to ragging and recirculation.

Pump 2 showing signs of aging on exterior

Pump and motor #2

8.5.2. Exposed Piping and Valves

8.5.2.1 Suction Piping/Valve(s) Description

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Some paint chipping

8.5.2.2 Discharge Piping/Valve(s) Description

Size	4” independent 6” common
Material	DI
Valve Type(s)	Check valve and plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Some paint chipping off on discharge pipe

Suction plug valve, vertical shaft orientation – not desirable

Discharge ball check valve and plug valve

8.5.3 Other Station Piping

Bypass piping?	No
Pig launching?	No
Air release valves?	No
Force main isolation?	None known

8.5.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in upper level of dry pit (MCC floor)
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In generator vault

General observations/notes from field visit:

- Backflow prevention assembly in generator vault, not to code, does not drain to daylight
- Provides water to both vault and dry pit
- Serves generator cooling (flow through) and water supply
- Vault drain does not include automatic primer – recommend adding to avoid potential gas venting from wet well

Backflow prevention assembly in
generator vault

8.5.5 Ventilation

8.5.5.1 Wet Well Ventilation (Supply Fan)

Location	Blower vault
Fan type	Centrifugal
Airflow rate	200 CFM @ 0.5” SP*

*Based on Record Documents, not measured in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

8.5.5.2 Dry Pit Ventilation (Supply Fan)

Location	Upper level of dry pit (MCC floor)
Fan type	Axial
Airflow rate	500 CFM @ 0.125” SP*

*Based on Record Documents, not measured in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Noisy, potential bearing issue – may reduce fan life
- Intake vent needs to be cleared of brush outside

Wet well supply fan located in wet well blower vault

Intake needs to be cleared of brush

8.6 Electrical

8.6.1 Electrical Service

8.6.1.1 Electrical Service Description

Voltage	277/480
Phases	3
Utility transformer	Pad mounted
Service meter location	Pedestal back to back with disc

8.6.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base and fused disconnect appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible close to street

Utility service cabinet

Service meter located on outdoor
pedestal, appears to be in good condition

8.6.2 Backup Power

8.6.2.1 Backup Power Description

City of Bellevue Asset No.	193762
Type	Standby Generator (diesel)
Location	Underground generator vault
Manufacturer	Cummins
Model	60 DG CB
Serial No.	F930 512 182
Age	Approx. 21 years
Electrical Capacity (KW)	60 KW/74 KVA
Fuel Storage	Approx 90 gal
Cooling	Water (Domestic water supply)
Transfer switch type	Auto
Transfer switch location	In generator vault

8.6.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Transfer switches and generator receptacle appear to be in good condition; standby generator appears to be in good condition but with decreasing useful life

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; genset, transfer switches in vault which limits work on the diesel engine generator

General observations/notes from field visit:

- City water cooled generator, supplied using 2 solenoid valves,
- Utility power phase monitor located in power and control panel, non-standard

Emergency generator located in underground vault, appears to be in good condition but with decreasing useful life

Transfer switch located in generator vault

Generator receptacle and transfer switch appear to be in good condition but aging

8.6.3 Site – Panelboard

8.6.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/240/1 phase
Manufacturer	Square D
Model	NQOD2OL1OOC

8.6.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Square D panel in station appears to be in good condition, but useful life is decreasing

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Parts available; equipment is in dry pit; not close to driveway

8.6.4 Site - Starters

8.6.4.1 Starters Description

Starters	120/240, 1 phase, FVNR Starter

8.6.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Cutler Hammer starters and circuit breakers appear to be in good condition. None have failed but they have decreasing useful life.

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Parts available; equipment in dry pit is a distance from the driveway

Panelboard located in dry pit, appears to be in good condition, but have decreasing useful life

Starters located in dry pit, appears to be in good condition but have decreasing useful life

Cutler Hammer starters located in telemetry control panel

8.6.5 Site – Telemetry Control Panel

8.6.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376869
Location	In dry pit, integral w/ power panel
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Hydro ranger 100
Secondary Level Indication	High level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In dry pit

8.6.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition and well maintained, but needs corrosion repair

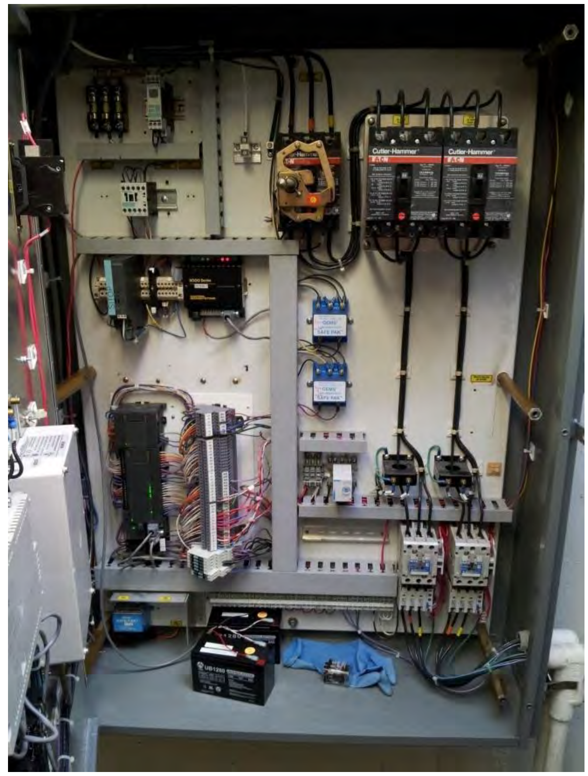
Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry generator vault

General observations/notes from field visit:

- Starter panel is customized, part of power and control panel

Telemetry control panel located in dry pit with operator interface



Interior of telemetry control panel appears to be in good condition

8.7 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 8-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirement, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Drain in generator vault goes to wet well, no automatic primer	Sewage found in generator vault	• Install automatic primer
Paco pumps are obsolete and condition is deteriorating	Paco pumps will not be serviceable in near future	• Replace pumps, motor and motor driver
Rust showing interior of dry pit structure	May decrease structural integrity	• Recoat interior
Backflow assembly enclosure requires drain to daylight	Does not meet code, potential for cross-connection	• Install drain • Install device above grade in an enclosure
The general electrical equipment including: meter base, transfer switches, standby generator, dry transformer and panel board are aging	Loss of power at site	• Replace equipment
The instrumentation and control equipment including: sewage pump remote control pendant, standby power phase monitor, telephone network interface termination box and backup level indicator are aging	Loss of instrumentation and control at site	• Replace equipment
Starter panel is currently customized	Potential issues with replacement parts/repair	• Replace starter panel (within power and control panel)
Utility power phase monitor currently located in power and control panel, not standard	Not standard, potential issues with replacement/repair	• Relocate and replace utility power phase monitor
Sound-proof/insulation in generator vault falling off	Possible public nuisance	• Replace sound-proof insulation material

8.7.1 Project Recommendations

Due to the location of the pump station and its impact to the general public, it is recommended that one project should be completed to address all deficiencies identified. The timing of the recommended project is driven by the replacement of the Paco pumps due to its criticality rating.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. It is also recommended to install an automatic primer in the generator vault drain to address issues involving sewage in the vault.

In addition to addressing these deficiencies, a bypass connection on the force main is strongly recommended. Currently there is no ability to bypass the pump station for construction or emergency purposes. This addition will help enable emergency response so that the station can continue to provide service if the pump station or the force main fails.

Along with a bypass connection and emergency response plan, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and project recommendations is presented in Table 8-4 and represents the most cost effective alternative based on engineering judgment.

Table 8-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
G-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$234,000
	Drain in generator vault goes to wet well, no automatic primer	Install automatic primer		
	Paco pumps are obsolete and condition is deteriorating	Replace pumps, motors and motor driver		
	Rust showing interior of dry pit structure	Recoat interior		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
	The general electrical equipment including: meter base, transfer switches, standby generator, dry transformer and panel board are aging	Replace equipment		
	The instrumentation and control equipment including: sewage pump remote control pendant, standby power phase monitor, telephone network interface termination box and backup level indicator are aging	Replace equipment		
	Starter panel is currently customized	Replace starter panel (within power and control panel)		
	Utility power phase monitor currently located in power and control panel, not standard	Relocate and replace		
	Sound-proof/insulation in generator vault falling off	Replace sound-proof insulation material		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

8.7.2 Project Justification

The timing of the recommended project is driven by the replacement of the Paco pumps due to their criticality and serviceability ratings. The consequence of failure of these components will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pumps are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

8.8 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 8-4 have been implemented in the timeline identified.

8.8.1 Asset Scoring

The trigger and asset scoring shown in Tables 8-5 and 8-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 8-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 8-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	2	1	0	-	2	10-15
Telemetry System	2	1	0	-	2	5-10
Generator	3	3	0	-	3	5-10
Rotating Assembly	3	5	0	-	5	5-10

Table 8-6 includes project estimated remaining useful life when the recommended projects provided in Table 8-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 8-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	0	0	-	1	10-15
Generator	0	0	0	-	0	20-25
Rotating Assembly	0	0	0	-	0	30

8.8.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 8-1 graphically represents the rehabilitation and replacement cost projections for the Grange Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 8-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 8-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 8-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	\$30,000 \$15,000 \$10,000	\$40,000 \$20,000 \$15,000	\$50,000 \$25,000 \$20,000	\$60,000 \$30,000 \$25,000	\$70,000 \$35,000 \$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	\$10,000 \$5,000	\$15,000 \$10,000	\$20,000 \$15,000	\$25,000 \$20,000	\$30,000 \$25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	\$5,000 \$5,000	\$8,000 \$8,000	\$11,000 \$11,000	\$14,000 \$14,000	\$17,000 \$17,000

Table 8-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

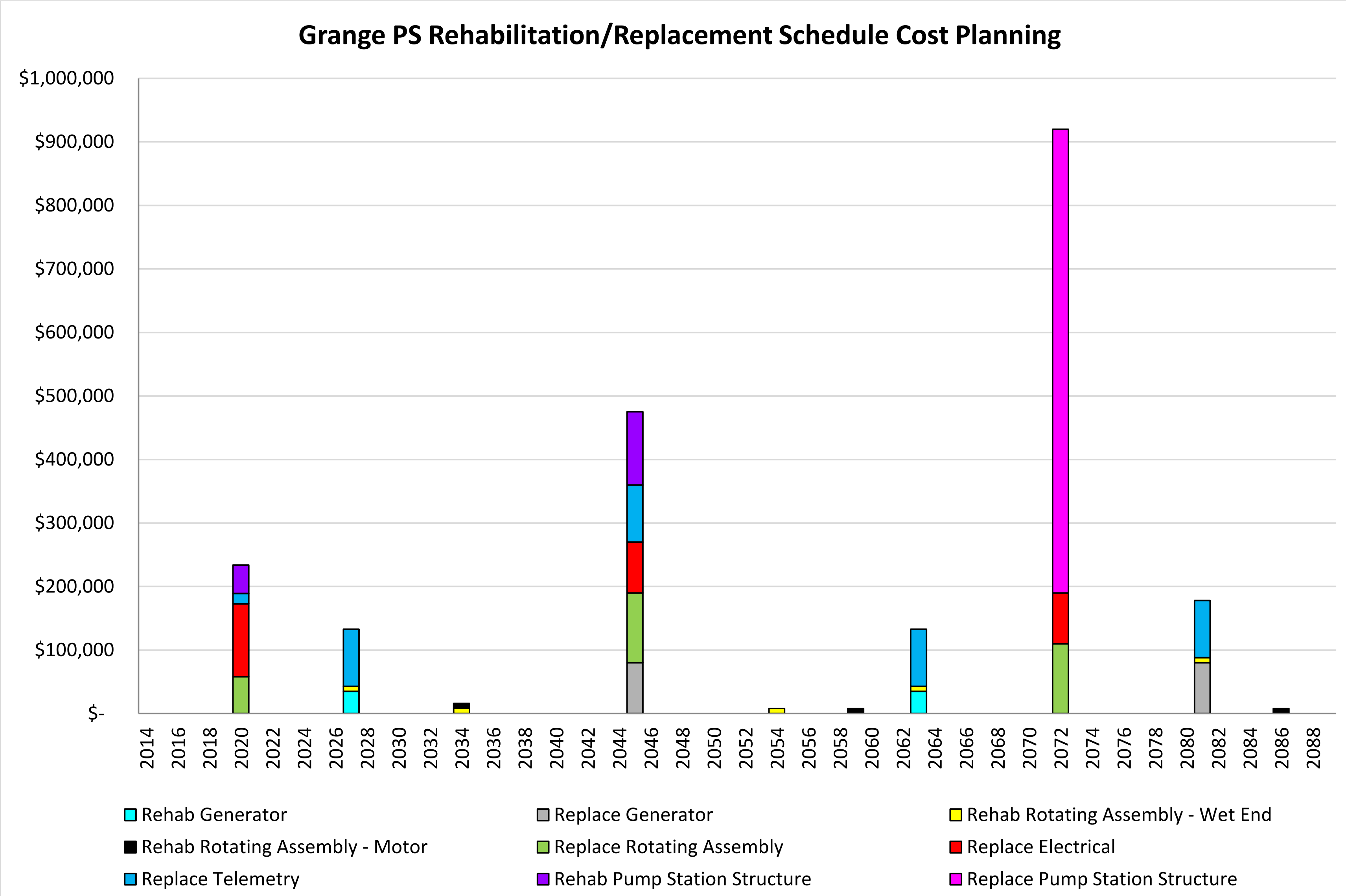
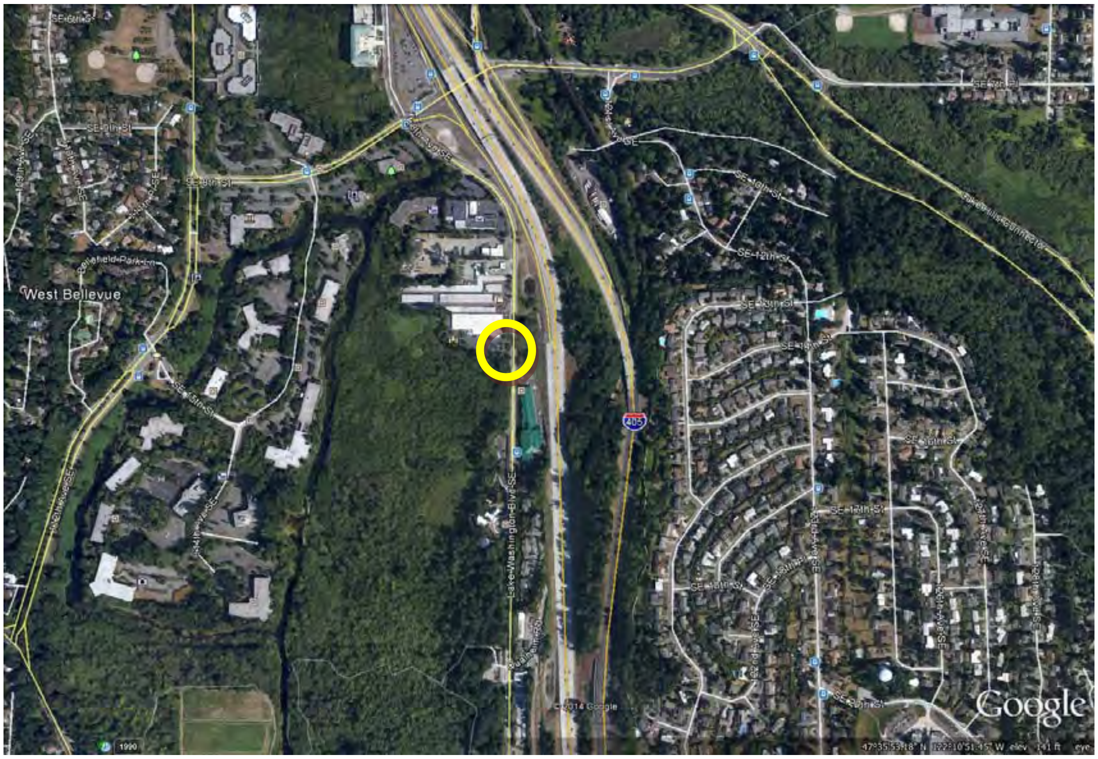


Figure 8-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 9
WILBURTON



9.1 Wilburton Pump Station General Description

Date of Visit	April 23rd, 2014
City of Bellevue Asset No.	187614
Address	1331 118th Ave SE
Station Configuration	Vacuum prime-sits on top of wet well
Original Construction	1978
Major Rehabilitation/Upgrade	N/A
Number of Pumps	2
Pump Horsepower	10
Station Voltage/Phase	272/480/ Unknown
Standby Power	Generator Receptacle
Field-Measured Station Firm Capacity	400-480 gpm

9.1.1 Summary of Findings

This station is located adjacent to 118th Ave SE and is secured with a chain link fence and barbed wire topping. This station does not receive flow from other stations and discharges to a gravity line. This station has vacuum prime pumps that sit on top of the wet well. The pumps wet ends are located below the metal plate that sits on top of the wet well making access to the pumps extremely difficult.

Table 9-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 9-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
W-1	City owned meter base is old and condition is deteriorating	Replace City owned meter base	2018-2022	$358,000
	The condition of the pumping system and platform are deteriorating	Convert to submersible station		
	The general electrical equipment including: service entrance disconnect, MTS, starter panel, motor driver, generator receptacle and dry transformer are aging	Replace equipment		
	The instrumentation and control equipment including: backup level indicator, primary level indicator, utility power phase monitor, telephone network interface termination box are aging	Replace equipment		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

9.2 Site

9.2.1 Site Description

Vehicle access to site	On side of 118th Ave, 2 lane busy road, parking 20’ from site
Landscaping	Gravel, rock within fence, arborvitae on outside of fence.
Site lighting	None
Fencing/security	6’ high chain link fence with 3 strands barbed wire topping
Public accessibility to site	Padlocked gate, 3’ gate only

General observations/notes from field visit:

- 2 spaces for vehicles in front of station on 118th Ave
- Small station site within fence, approximately 25’x 20’

Access to station through locking personnel gate. No vehicle gate access to station

Two parking stalls directly in front of station

9.3 Station Facilities

9.3.1 Wet Well – Structure and Accessories

9.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, metal cover
Access description	Hatch metal plate, not hinged, ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6' diameter over 8' diameter*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8", above operating level*
Lighting	None
Ventilation	None
Ventilation continuous	N/A

*Based on Record Drawings, unable to confirm in field.

9.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior of wet well, ladder and grating appear to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structural, wall repair, ladder and grating materials are available but must be special ordered and are not stocked by the City.

General observations/notes from field visit:

- Sections of grating platform have been removed from the wet well and stacked in corner of site
- Some corrosion on metal cover and access hatch
- Access hatch is a metal plate not connected to cover

Interior of wet well, small opening for access
– underside of hatch showing corrosion

Some sections of grating platform in corner of site

9.3.2 Above-Grade Housing – Structure and Accessories

9.3.2.1 Above-Grade Housing General Description

Area	Current Classification	Rationale
Above-Grade Housing	Class 1, Division 2	NFPA 820, table 4.2, row 19a

Construction materials	Fiberglass top, steel base
Access description	At grade, open shell cover
Access fall protection	Not applicable
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’x6’x3’-6”
Lighting	None
Ventilation	Ventilation only
Ventilation continuous	No, temperature controlled

9.3.2.2 Above-Grade Housing Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The steel plate that the above-grade housing sits on is corroding.

Criticality Rating 2 – Somewhat critical

Serviceability Rating 1 – Easily accessed

General observations/notes from field visit:

- Temperature controlled ventilation, unknown if thermostat functioning
- Steel plate access to wet well rusting
- Ventilation inadequate to un-classify space per NFPA 820 code

Pumping system sits on top of wet well

Some rusting on interior of steel plate – likely indicates corrosion on underside of metal floor. Wet well hatch is not sized to prevent dropping into wet well.

9.4 Mechanical

9.4.1 Pumps

Pump System Performance

The field tested performance of the Wilburton pumps indicate that the flow is nearly one third greater than the design rate (450 gpm vs. 350 gpm), and the pressure head is approximately 4 feet lower (38 ft vs. 42 ft). Without an available pump curve, little can be determined regarding the pumping system. However, given that the flow is greater and the head is slightly less than the design condition, it is possible that the design for this station over-estimated the head loss and the pumps are operating on a different point of their curve similar to the original design intent.

The following table documents the pump run hours and starts by month over the past year.

Table 9-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	7.41	281	7.32	282
May-13	7.41	273	7.04	272
Jun-13	6.32	241	6.18	242
Jul-13	8.08	292	7.9	292
Aug-13	7.77	280	7.53	281
Sep-13	8.51	301	8.17	302
Oct-13	6.48	251	6.41	264
Nov-13	6.39	246	6.28	250
Dec-13	5.9	228	5.8	228
Jan-14	7.16	263	6.8	264
Feb-14	7.28	262	6.9	262
Mar-14	9.49	330	337	337
	88.2	**3,248**	**413.33**	**3,276**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.2	0.4	1.1	0.4

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

WILBURTON P.S.

[illegible] Corporation
Smith & Loveless Division
An Affiliate of Trans Union Corporation

6" WET WELL MOUNTED
PUMP STATION ENGINEERING ORDER

Form No. 04-0-18 (Rev. 8/77)

LOCATION Bellevue, Washington	STATION SERIAL NO. 16-1800-H
OWNER Frank Coluccio Construction	ENGINEER Horton Dennis and Associates

OUTLINE DRAWING NO.

1. Station Size 3' – 4" X 4' – 11" Height 2' – 10-3/8"
2. Suction Piping Pump 1 8" Pump 2 8"
3. Pump Discharge Valve Pump 1 6" Pump 2 6"
4. Common Discharge Outlet · Size 8"
5. Main Conduit Size 2"
6. Electrical Service System Data: 3 Phase 60 Cycle 460 Volts, 4 Wire
115V Single Phase Supply (not) Available No Wiring Diagram No. DIG-1800-30
2 KVA Transformer Req'd. 460 Volt to 115 Volt AC.

PUMP & MOTOR DATA DESIGN POINT FIELD MEASUREMENT: 450 GPM @ 38'

PUMP DATA	PUMP 1	PUMP 2
Design Characteristics (GPM@TDH)	350 @ 42'	350 @ 42'
Pump Model	6B3B	6B3B
Impeller Diameter	10 3/8"	10 3/8"
Rotation (CW) (CCW)	CW	CCW
S&L Mech. Seal-Filter Ass'y (Size)	1-7/8"	1-7/8"
Static Suction Lift	17'	17'
MOTOR DATA (INVENTORY CODE)		
Horsepower	10	10
R.P.M.	1170	1170
Phase/Cycle/Volts	3/60/460	3/60/460
Motor Serial No. (Code Ltr.)		
NEMA I CONTROL PANEL EQUIPMENT	**PUMP 1**	**PUMP 2**
Circuit Breaker – Trip Rating 30 Amps	4L258CD	4L258CD
Magnetic Starter – Nema Size 2	4L204C	4L204C
O.L. Coil No. 10177H – & Quan. 1040	3)4L54BC	3)4L54BC

STANDARD EQUIPMENT:
1. Automatic Alternator
2. Vacuum Pumps
3. NEMA 3-Wire - 1 Phase Duplex Receptacle
4. S&L Damtite Seal (Spare)
5. Control Circuit Breaker
6. Station Operating Instructions and Maintenance Chart
7. Spare Volute Gaskets
8. Float Check Valve
9. Ventilating Fan with Thermostat
10. Heater with Thermostat

OPTIONAL EQUIPMENT:
1. Aux. Space Heater 4L84 (Yes) (No)
2. High Water Alarm Sensor (Yes) (No) *
3. 115 Volt Alarm Light (Yes) (No)
4. 115 Volt Alarm Horn (Yes) (No)
5. Running Time Meters (Yes) (No)
6. 2 KVA Transformer (Yes) (No)
7. Model "S" Piping (Yes) (No)

* Local and remote indication.

CONTROL SYSTEM SWITCH SETTINGS	LOW LEVEL OFF	HIGH LEVEL ON	BOTH PUMPS OFF	ALARM
Switch – S&L Part No.	4L291A	4L291A	4L291A	4L291B
Cut-In (feet)	3.0	3.5		
Cut-Out (feet)			1.5	4.0

APPLICATION ENGINEERING		Maintenance Manuals Required Quant. 7	COMPANION JOB SERIAL NOS.
PREPARED BY	DATE		
H. Bartlett	4-26-78		

9.4.1.1 Pump 1 – City of Bellevue Asset No. 193759

Pump style	Vacuum Prime
Make	Smith and Loveless
Model	6B3B*
Serial No.	87D96*
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1989
Design Conditions	350 gpm @ 42 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Would need to bring in boom truck

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 4 – The pump is located beneath the steel plate and could not be observed but at more than 35 years of life, the remaining life is expected to be limited. Could be operating near end of curve (no curve available).

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is difficult to access since it is located below the surface plate

General observations/notes from field visit:

- Could not observe pump, below steel plate
- Operators indicated loss of prime approximately once per year
- Vacuum prime system is an additional potential point of failure

Pump 1 Drawdown Test

Static head (feet)	32
Calculated pumping capacity	400 gpm -450 gpm
Total Dynamic head (feet)	38
Number of tests performed	2

General observations/notes from field visit:

- Pump is conveying substantially more flow than original design. Could be operating near end of curve (no curve available)

Pumps below steel plate, could not observe

Motor #1

9.4.1.2 Pump 2 – City of Bellevue Asset No. 193878

Pump style	Vacuum Prime
Make	Smith and Loveless
Model	6B3B*
Serial No.	87D96*
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1989
Design Conditions	350 gpm @ 42 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Would need to bring in boom truck

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 4 – The pump is located beneath the steel plate and could not be observed but at more than 35 years of life, the remaining life is expected to be limited. Could be operating near end of curve (no curve available).

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is difficult to access since it is located below the surface plate

General observations/notes from field visit:

- Could not observe pump, below steel plate
- Operators indicated loss of prime approximately once per year
- Vacuum prime system is an additional potential point of failure

Pump 2 Drawdown Test

Static head (feet)	32
Calculated pumping capacity	470 gpm -480 gpm
Total Dynamic head (feet)	38
Number of tests performed	2

General observations/notes from field visit:

- Pump is conveying substantially more flow than original design. Could be operating near end of curve (no curve available)

Pumps below steel plate, could not observe

Motor #2

9.4.2 Exposed Piping and Valves

9.4.2.1 Suction Piping/Valve(s) Description

Size	8” column to 6” pump suction
Material	DI
Valve Type(s)	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Vacuum prime system

9.4.2.2 Discharge Piping/Valve(s) Description

Size	6” individual to 8” common
Material	DI
Valve Type(s)	Swing check valve and plug valve installed vertical

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Paint chipping, significant rust, likely unable to disassemble without damaging piping
- Check valves installed partially in metal cover, access for service or replacement challenging

Plug valves, vertical shaft orientation is not desirable
due to sediment settling in bottom bearing

Significant rust on discharge piping

9.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	Yes, isolation valve adjacent to station, unknown if operable

9.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in above grade housing
Backflow prevention assembly	1" reduced pressure backflow device
Enclosure/Freeze protection	Cabinet adjacent to station/Heat tape

General observations/notes from field visit:

- Backflow preventer enclosure adjacent to station in above ground enclosure

Backflow preventer in above ground enclosure

Isolation valve adjacent to site, unknown if operable

9.4.5 Ventilation

9.4.5.1 Above-Grade Housing Ventilation (Supply Fan)

Location	On side within above ground enclosure
Fan type	Unknown
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 2 – Somewhat critical, controls heat in above ground enclosure

Serviceability Rating 1 – Easily accessed

General observations/notes from field visit:

- Ventilation for cooling, thermostat controlled, attempt to activate heat sensor did not succeed

Supply fan on steel plate

Heat sensors for ventilation cooling on power and control panel

9.5 Electrical

9.5.1 Electrical Service

9.5.1.1 Electrical Service Description

Voltage	480
Phases	Unknown
Utility transformer	Unknown, not accessible
Service meter location	Outdoor steel rack

9.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Meter base and fused disconnect in corroded cabinets

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; located on outdoor rack

9.5.2 Backup Power

9.5.2.1 Backup Power Description

Type	Generator receptacle
Location	On manual transfer switch side
Transfer switch type	Manual
Transfer switch location	Outdoor steel rack within fenced site

9.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Generator receptacle appears to be in good condition but manual transfer switch cabinet is corroded

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; located on outdoor rack

General observations/notes from field visit:

- Clearance issues with wooden pole in front of panels

Utility service and generator receptacle, clearance issue with wood pole

Rust on main disconnect

9.5.3 Site – Panelboard

9.5.3.1 Panelboard Description

Location	In Smith and Loveless Power and control panel
Voltage/Phase	120 VAC
Manufacturer	-
Model	-

9.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – 120 VAC CBs appear to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is within Smith and Loveless control panel

9.5.4 Site – Starters

9.5.4.1 Starters Description

Starters	120 VAC, FVNR Starters

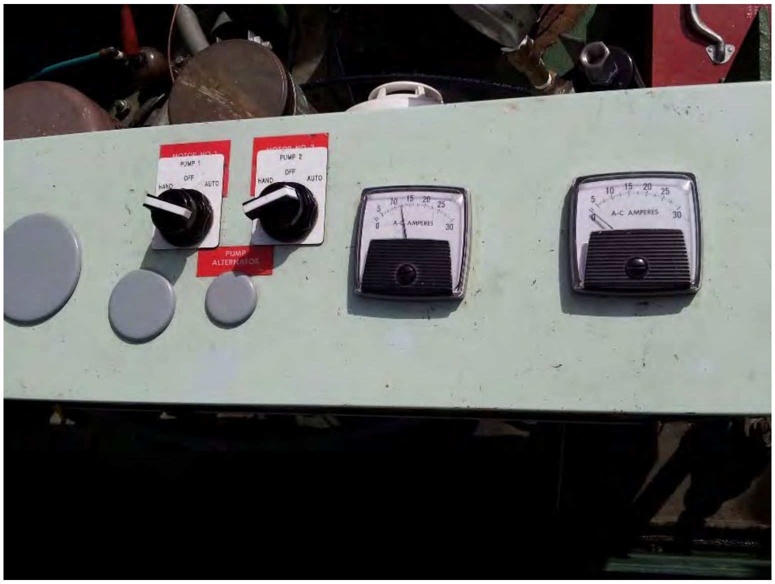
9.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Both the Cutler Hammer starters are in fair condition, but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in Smith and Loveless power and control panel



Starters located on telemetry control panel within fiberglass enclosure, appear to be in good condition but aging

Interior of power and control panel with Cutler Hammer starters

9.5.5 Site – Telemetry Control Panel

9.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376851
Location	On steel plate
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float, ISR
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystem/5000 Series Option F
Telephone Network Interface	On steel rack

9.5.5.2 Telemetry Control Panel Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition, new

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel on rack

General observations/notes from field visit:

- Telephone network interface termination box wired directly into TEL CP

Operator interface located on steel rack

Exterior of telemetry control panel, located on steel plate

Interior of telemetry control panel, appears to be in good condition

9.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 9-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Housing not classified, no continuous ventilation	Does not meet code requirements, possible fire and explosion hazard	• Install continuous ventilation • Convert to a submersible station
City owned meter base is old and condition is deteriorating	Loss of power at site	• Replace City owned meter base
Condition of the station, metal cover, piping and pumps is deteriorating	Loss of service	• Keep current configuration, replace pumps, valves and piping, refurbish cover • Convert to a submersible station, with submersible pumps
The general electrical equipment including: service entrance disconnect, MTS, starter panel, motor driver, generator receptacle and dry transformer are aging	Loss of power to site	• Replace equipment
The instrumentation and control equipment including: backup level indicator, primary level indicator, utility power phase monitor, telephone network interface termination box are aging	Loss of station operation and control	• Replace equipment
No interior wet well coating	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

9.6.1 Project Recommendations

A deficiency that was not noted in the previous table is the clearance issue near the electrical equipment on the steel rack. It is recommended to cut down the wood pole currently within the electrical envelope to comply with code requirements. This was not included in the summary of project recommendations since this issue can be resolved by city staff during a visit to the station.

Since most if not all of the components at this station are eventually being replaced, it is recommended to convert this station to a submersible station to improve access and ease of maintenance, and be more compatible with other stations operated by the City.

In addition to addressing these deficiencies, a bypass connection on the force main is strongly recommended. Currently there is no ability to bypass the pump station for construction or emergency purposes. This addition will help enable emergency response so that the station can continue to provide service if the pump station or the force main fails.

The summary of deficiencies and project recommendations is presented in Table 9-4 and represents the most cost effective alternative based on engineering judgment.

Table 9-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
W-1	City owned meter base is old and condition is deteriorating	Replace City owned meter base	2018-2022	$358,000
	Condition of the pumping system and platform are deteriorating	Convert to submersible station		
	The general electrical equipment including: service entrance disconnect, MTS, starter panel, motor driver, generator receptacle and dry transformer are aging	Replace equipment		
	The instrumentation and control equipment including: backup level indicator, primary level indicator, utility power phase monitor, telephone network interface termination box are aging	Replace equipment		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

9.6.2 Project Justification

If the City owned meter base is not replaced, there will be loss of power at the site requiring a portable generator at the site for an undisclosed amount of time.

Accessibility and ease of maintenance is a big issue at this station. Should a component fail within the wet well, including but not limited to the pumps, isolation valve and or piping, repairing or replacing the components would be challenging and it would be in the City's best interest to convert this to a submersible station.

9.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 9-4 have been implemented in the timeline identified.

9.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 9-5 and 9-6 is based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 9-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 9-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	3	1	0	-	3	5-10
Telemetry System	3	1	0	-	3	0-5
Generator	no onsite generator at this facility					
Rotating Assembly	3	1	1	-	3	5-10

Table 9-6 includes project estimated remaining useful life when the recommended projects provided in Table 9-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 9-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	0	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	0	1	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

9.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 9-1 graphically represents the rehabilitation and replacement cost projections for the Wilburton Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 9-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 9-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 9-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 9-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

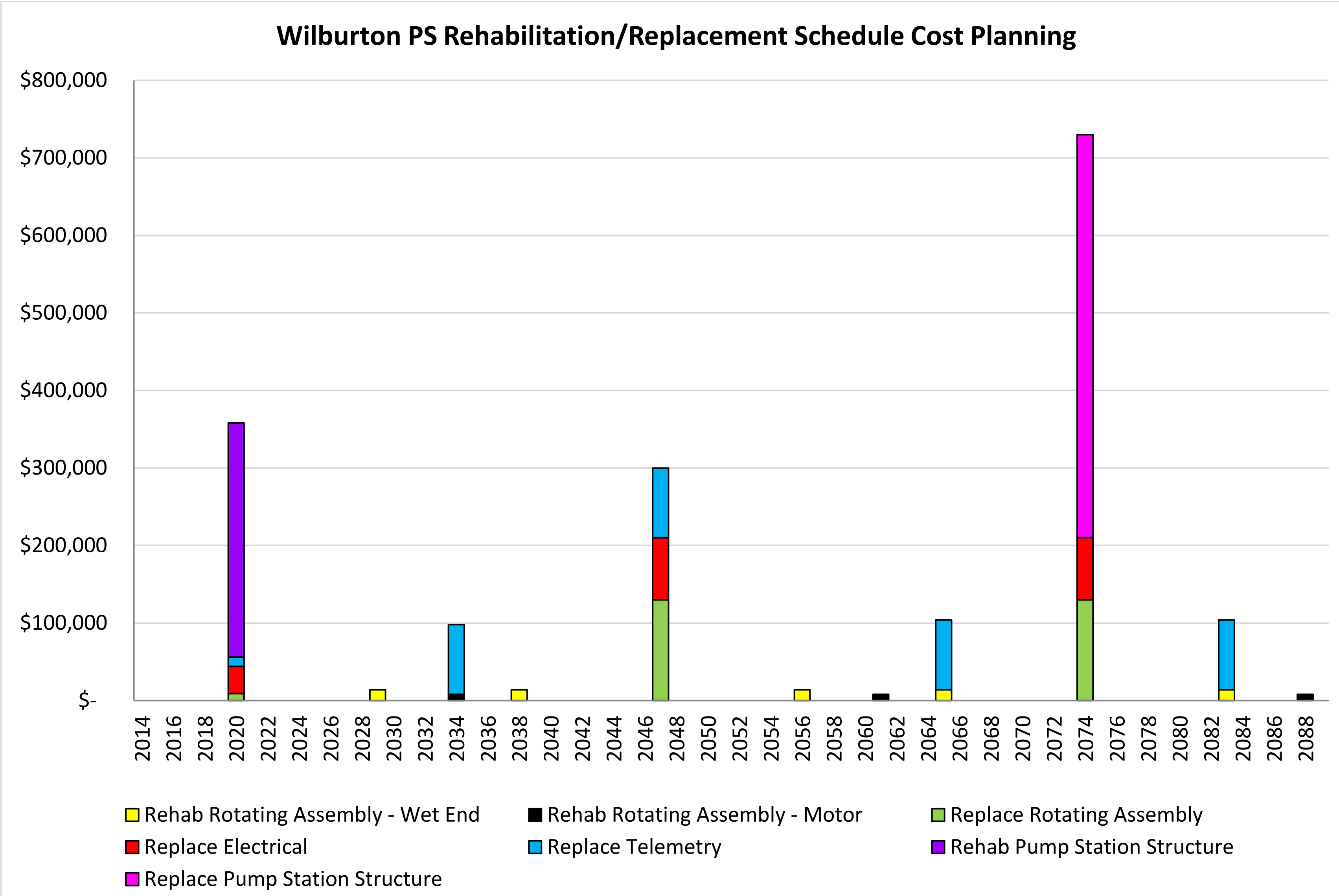
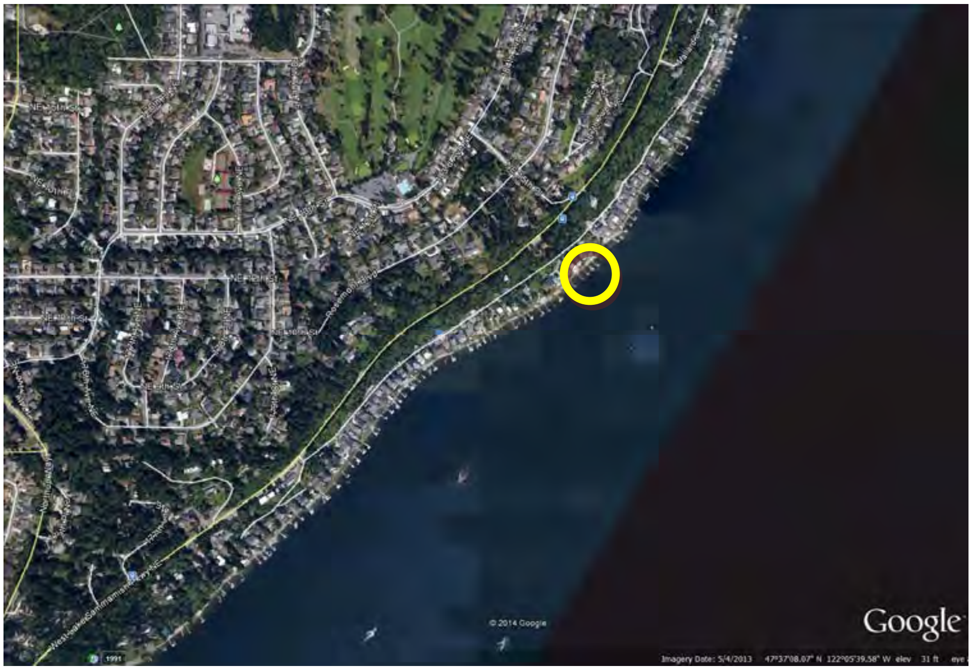


Figure 9-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 10
STATION 18



10.1 Station 18 General Description

Date of Visit	April 23rd, 2014
City of Bellevue Asset No.	187629
Address	1082 W Lake Sammamish Parkway NE
Station Configuration	Submersible
Original Construction	1966
Major Rehabilitations	1989
Number of Pumps	2
Pump Horsepower	2
Station Voltage/Phase	240/120 VAC/3 Phase
Standby Power	Generator Receptacle
Field-Measured Station Firm Capacity	210-220 gpm

10.1.1 Summary of Findings

This station is located down a private path adjacent to two private residences. There are steep stairs with many steps separating the station which is adjacent to the lake from the power and control panel which is adjacent to the roadway. This station receives flow from Station 19 and discharges to the lake line. A significant deficiency observed at this site is the intrinsically safe relay clearance issue that creates a potentially unsafe condition. The power and control panel also does not have a vent fan and there has been a report of controls tripping.

Table 10-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 10-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S18-1	Retaining wall drops down to lake	Install railing	2015-2018	$22,000
	Intrinsically safe relay does not have required clearance or barriers, no vent fan in cabinet	Provide separate panel for intrinsically safe relay, install fan in power and control panel		
S18-2	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters	2020-2025	$120,000
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

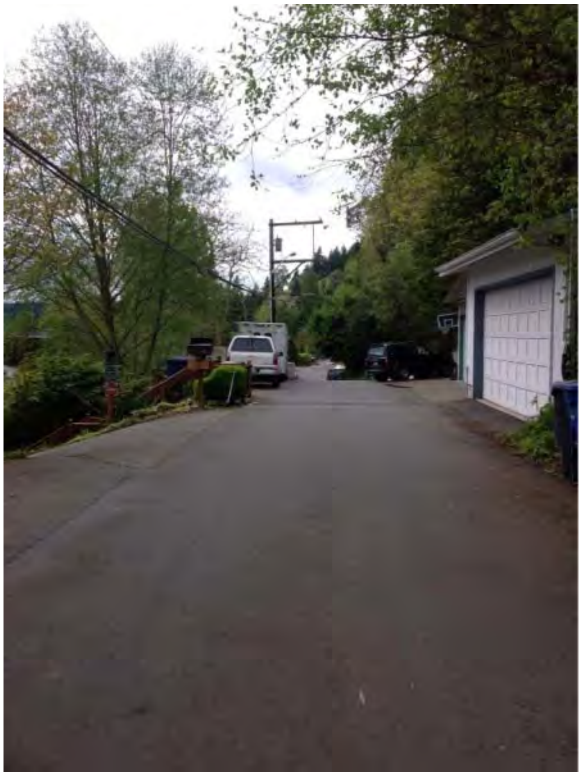
10.2 Site

10.2.1 Site Description

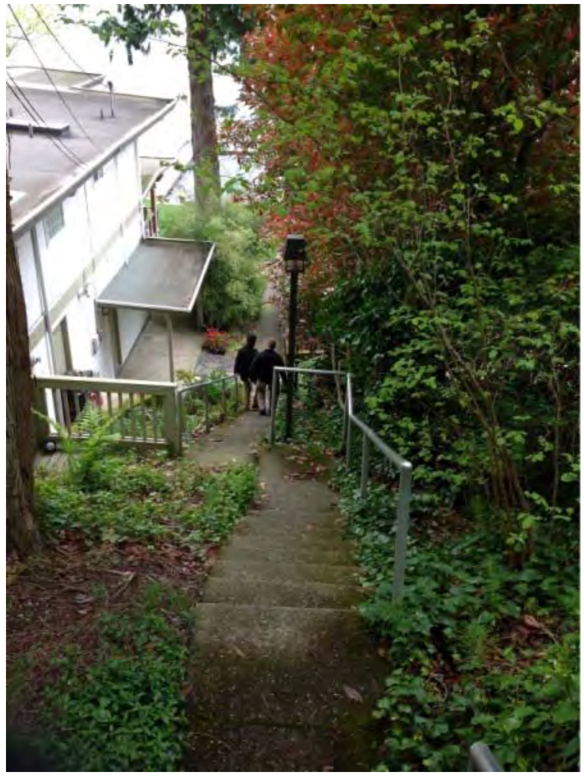
Vehicle access to site	One lane paved private road with steep slope, parking first come first served, parking 300’ from station
Landscaping	Near edge of lake, wood chips
Site lighting	Yes
Fencing/security	No, adjacent to private yard
Public accessibility to site	Limited, accessible from private yards, and lake

General observations/notes from field visit:

- Steep stairs with many steps, narrow path from power and control panel to lift station
- Behind station, drops down to lake, potential public safety issue



Unreserved parallel parking approximately 300’ from station is all that is available



Steps from parking to station present a potential safety issue when hauling large tools and equipment

Station adjacent to waterfront

10.3 Station Facilities

10.3.1 Wet Well – Structure and Accessories

10.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Light weight hatch H-10
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6' inside diameter, 19'-6" deep*
Ladder/grating platform	None
Sewer invert(s)	8" above operating level*, 6"above operating level*
Lighting	None
Ventilation	None
Ventilation continuous	N/A

*Based on Record Drawings, unable to confirm in field.

10.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

Wet well is located directly adjacent to lake

Interior of wet well appears to be in good condition

10.3.2 Check Valve and Isolation Valve Vault – Structure and Accessories

10.3.2.1 Check Valve and Isolation Valve Vault General Description

Area	Current Classification	Rationale
Check Valve and Isolation Valve Vault	Class 1, Division 2	NFPA 820, table 4.2, row 31a

Construction materials	Concrete
Access description	Steel manhole lid and ladder
Access fall protection	No
Access locked	No
Access intrusion alarm	No
General dimensions	4'x4'*
Lighting	Yes, extension cord to be plugged in to nearby power
Ventilation	None
Ventilation continuous	N/A

*Based on Record Documents, unable to confirm in field.

10.3.2.2 Check Valve and Isolation Valve Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Interior of vault appears to be in good condition.

Criticality Rating 4 – Station could not operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- No drain in vault, must be pumped out
- Some water infiltration evident upon visit

Underground vault accessed through manhole lid. Standing water present.

10.4 Mechanical

10.4.1 Pumps

Pump System Performance

The field measured performance of the pumps at Station 18 only captured flow rates, as operating pressures were not provided. Without the pressure information, little can be understood regarding the operation of the pumps, but with the measured flow similar to the design flow (~220 gpm vs. 245 gpm), it is assumed that the pumps are operating similar to the original design intent.

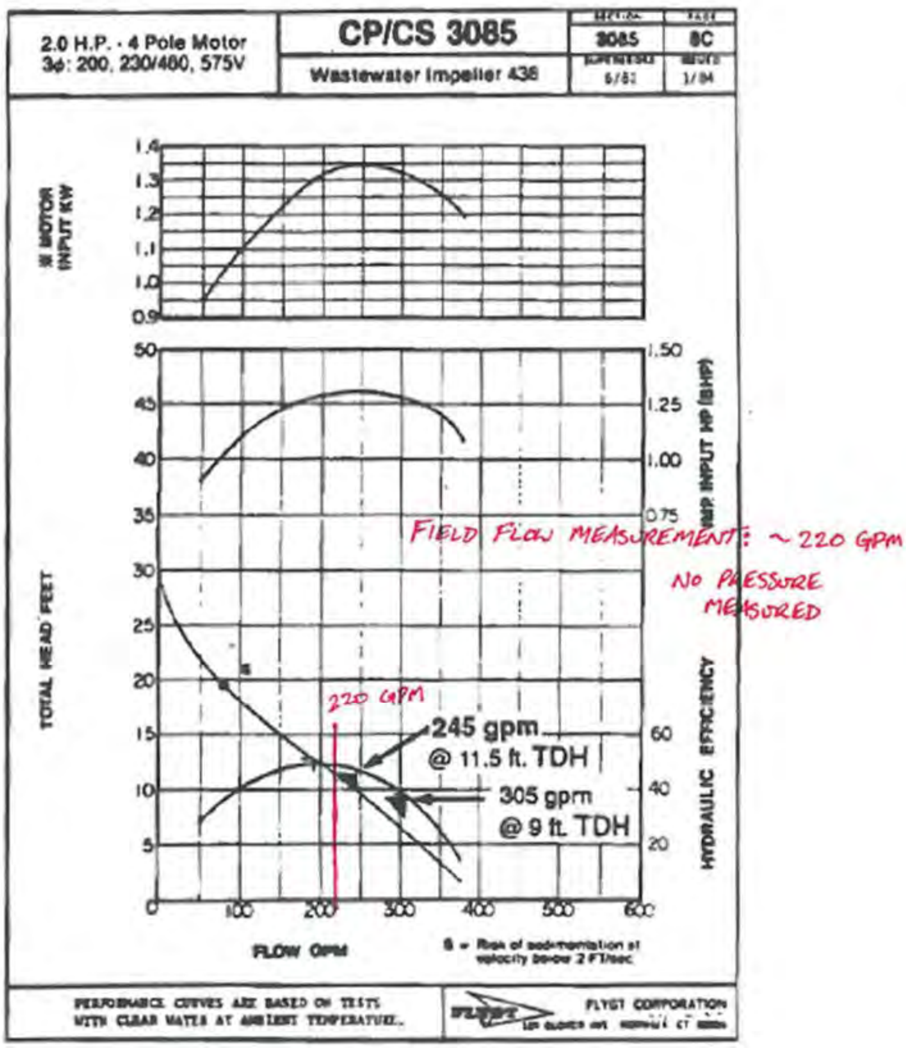
The following table documents the pump run hours and starts by month over the past year.

Table 10-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	26.77	784	27.25	783
May-13	24.88	737	25.81	736
Jun-13	22.2	661	22.94	659
Jul-13	22.2	665	23.01	665
Aug-13	21.27	646	21.96	645
Sep-13	21.38	650	22.08	651
Oct-13	21.06	641	22.01	642
Nov-13	20.08	600	26.46	762
Dec-13	24.32	739	29.89	861
Jan-14	26.95	780	27.1	779
Feb-14	23.86	694	23.87	693
Mar-14	27.43	796	27.96	798
Total	**282.4**	**8,393**	**300.34**	**8,674**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.8	1.0	0.8	1.0

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Stations: Lake Hills No. 17, No. 18 and No. 19
Pump Model No.: CP 3085-438X with 4-inch discharge
Design RPM: 1750 **Impeller Type: 438**
Specified Performance: 245 gpm at 11.5 feet TDH and
305 gpm at 9 feet TDH
Motor Horsepower: 2 HP



10.4.1.1 Pump 1 – City of Bellevue Asset No. 193823

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Horsepower	2
Voltage/phase	230 VAC/Unknown
Date of installation	1989
Design Conditions	245 gpm @ 11.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane and stair climbing dolly, assemble on site all portable, challenging to haul up many steep steps

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 25 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but pump 2 is a currently installed redundant component

Serviceability Rating 2 – Submersible station, pumps are somewhat difficult to access due to location of station and steep steps to access along with the rental of a gantry crane and stair climbing dolly to remove and transport components

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	220 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Pumping capacity appears to be near design flow

Submersible station, unable to observe pumps

10.4.1.2 Pump 2 – City of Bellevue Asset No. 193824

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Date of installation	1989
Design Conditions	245 gpm @ 11.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane and stair climbing dolly, assemble on site all portable, challenging to haul up many steep steps

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 25 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 2 is critical to the function of the station but pump 1 is a currently installed redundant component

Serviceability Rating 2 – Submersible station, pumps are somewhat difficult to access due to location of station and steep steps to access along with the rental of a gantry crane and stair climbing dolly to remove and transport components

Pump 2 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	210 gpm -220 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Pumping capacity appears to be near design flow

Submersible station, unable to observe pumps

10.4.2 Exposed Piping and Valves

10.4.2.1 Discharge Piping/Valve(s) Description

Size	4”
Material	PVC, possibly ABS
Valve Type(s)	Swing check valve and gate valve w/ hand wheel

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Gate valves and check valves in valve vault
- Piping is dark grey or black plastic

10.4.3 Other Station Piping

Wash down water supply?	Yes, adjacent to wet well above ground
Backflow prevention assembly?	Yes
Bypass piping?	No
Pig launching?	No
Air release valves?	No
Force main isolation?	None known

10.4.4 Washdown Water

Supply	Domestic/Metered
Access	Adjacent to wet well above ground
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In underground valve vault/None

General observations/notes from field visit:

- Backflow assembly located in valve vault, no drain to daylight, water service meter up on street 300 feet away – does not meet code for installation

Swing check valves and gate valves with hand wheel

Backflow preventer in check valve and isolation vault

Discharge piping in wet well, piping is grey

10.5 Electrical

10.5.1 Electrical Service

10.5.1.1 Electrical Service Description

Voltage	240/120 VAC
Phases	3
Utility transformer	Overhead along west Lake Sammamish
Service meter location	Outdoor enclosure

10.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused manual transfer switch appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway

General observations/notes from field visit:

- Built by Omega 1½ years ago

10.5.2 Backup Power

10.5.2.1 Backup Power Description

Type	Generator receptacle
Location	Side of outer enclosure
Transfer switch type	Manual
Transfer switch location	Power and control panel

10.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Generator receptacle appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; generator receptacle is installed on power and control panel

Utility meter base

Generator receptacle

Overhead utility transformer

10.5.3 Site - Panelboard

10.5.3.1 Panelboard Description

Location	In power and control panel
Voltage/Phase	120/240 VAC/1 phase
Manufacturer	Siemens
Model	E0816ML

10.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Siemens panel appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is accessible at street level

10.5.4 Site – Starters

10.5.4.1 Starters Description

Starters	120/240 VAC, FVNR Starter

10.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Both Siemens starter are new and in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is accessible at street level

Panelboard located adjacent to street

Starters located in cabinet, appears to be in good condition

10.5.5 Site – Telemetry Control Panel

10.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376896
Location	Adjacent to road near stairs
Configuration	Integral w/ telemetry
Primary Level Indication	Druck Submersible
Secondary Level Indication	High level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	Telephone

10.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition, new

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel

General observations/notes from field visit:

- 8 circuit panel, open terminals in power and control panel, utility 1082
- Intrinsically safe relays do not have required clearance or barriers, code violation

10.5.6 Site - Submersible Cable Termination Enclosure

10.5.6.1 Submersible Cable Termination Enclosure Description

Location	Above grade at the water front
Material	Unknown

10.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Small new termination cabinet appears to be in good condition

Criticality Rating 3 – Critical but redundant, transmits power from the starters to the pump cords but if one cord or termination fails the other pair will still operate

Serviceability Rating 1 – Standard parts and ready accessible

Telemetry control panel with operator interface

Submersible cable termination enclosure above grade at waterfront

10.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there may be alternatives for other deficiencies observed at this station, not all are discussed since some are considered impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 10-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Retaining wall drops down to lake	Potential safety issue to public	• Install railing
Intrinsically safe relay does not have required clearance or barriers, no vent fan in cabinet	Intrinsically safe relay clearance does not meet code requirements, tripping issues	• Provide separate panel for ISR relay and install vent fan
Rotating assembly degrading based on perceived age	Loss of service at site	• Replace pumps, motors and motor starters
Backflow assembly enclosure requires drain to daylight.	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure
No interior wet well coating	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

10.6.1 Project Recommendations

The deficiencies identified at this site pose potential safety issues which drove the project recommendations. The first project includes the installation of a railing along the lake side of the wet well structure and providing a barrier or clearance to the intrinsically safe relay wiring components along with a fan to prevent relays from overheating and inadvertently tripping. The second project includes all other deficiencies identified including: replace the rotating assembly, provide a proper backflow assembly enclosure to meet code and inspect/evaluate the wet well for corrosion.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the wet well and valve vault to provide safety for the public and staff when the hatches are in the open position.

The summary of deficiencies and project recommendations is presented in Table 10-5 and represents the most cost effective alternative based on engineering judgment.

Table 10-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S18-1	Retaining wall drops down to lake	Install railing	2015-2018	$22,000
	Intrinsically safe relay does not have required clearance or barriers, no vent fan in cabinet	Provide separate panel for intrinsically safe relay, install fan in power and control panel		
S18-2	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters	2020-2025	$120,000
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

10.6.2 Project Justification

The recommended timing of the first project is driven by safety concerns at the station along with addressing the significant electrical issues at this site to ensure service levels are maintained. There is a significant public safety issue at this site that needs to be addressed to ensure potential hazardous conditions are eliminated. Serious injury may result if this issue is not addressed.

The recommended timing of the second project is driven by the replacement of the rotating assembly.

10.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 10-4 have been implemented in the timeline identified.

10.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 10-5 and 10-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 10-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement project.

Table 10-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 10-6 includes the estimated remaining useful life when the recommended projects provided in Table 10-4 are complete. Note the estimated remaining useful life for the asset groups do not change following the capital improvement project implementation since the recommended project does not address replacement of equipment. Instead the project includes modifications to the station to ensure potential safety issues are no longer a concern.

Table 10-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

10.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 10-1 graphically represents the rehabilitation and replacement cost projections for Station 18 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 10-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 10-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 10-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	\$30,000 \$15,000 \$10,000	\$40,000 \$20,000 \$15,000	\$50,000 \$25,000 \$20,000	\$60,000 \$30,000 \$25,000	\$70,000 \$35,000 \$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	\$5,000 \$5,000	\$8,000 \$8,000	\$11,000 \$11,000	\$14,000 \$14,000	\$17,000 \$17,000

Table 10-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

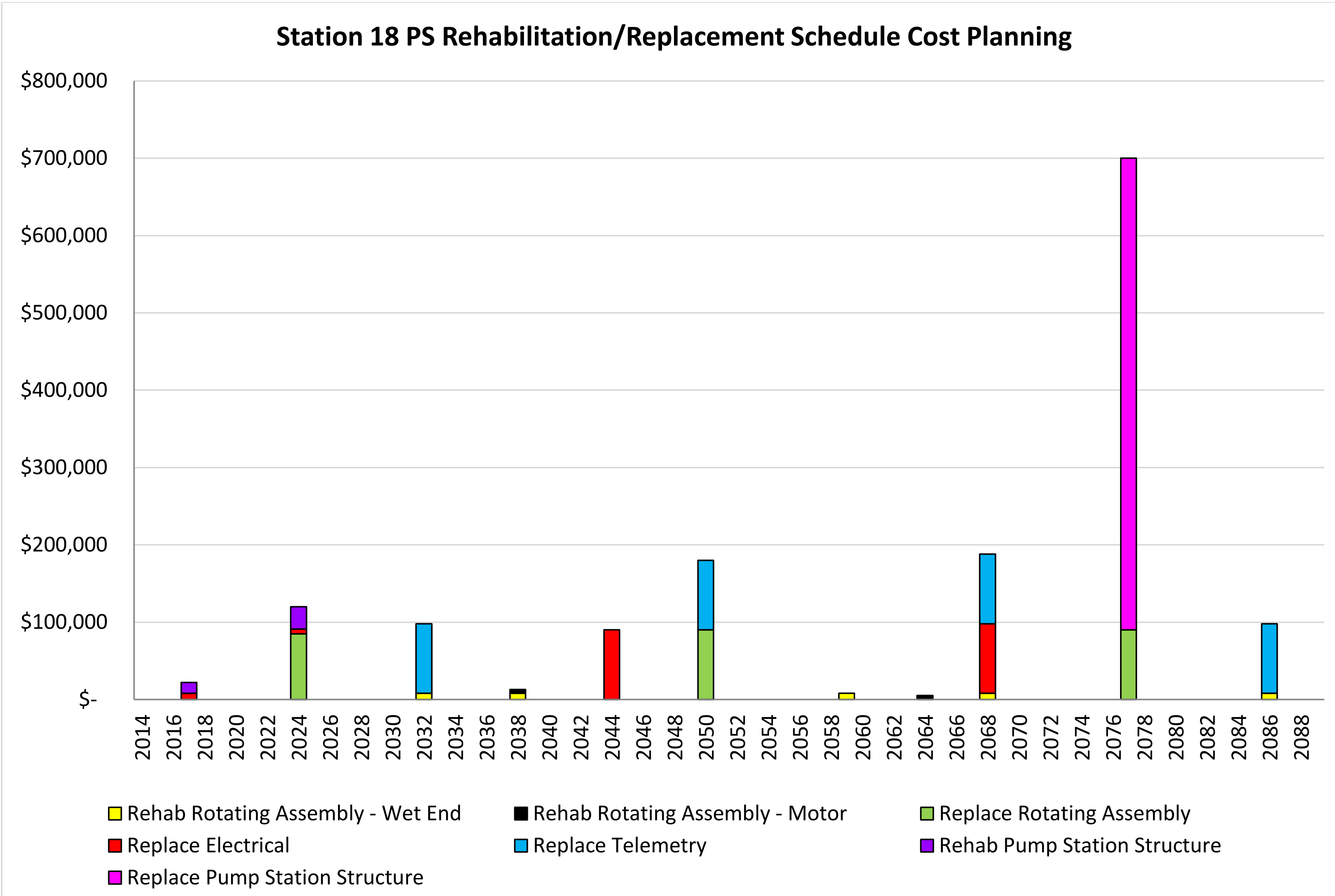
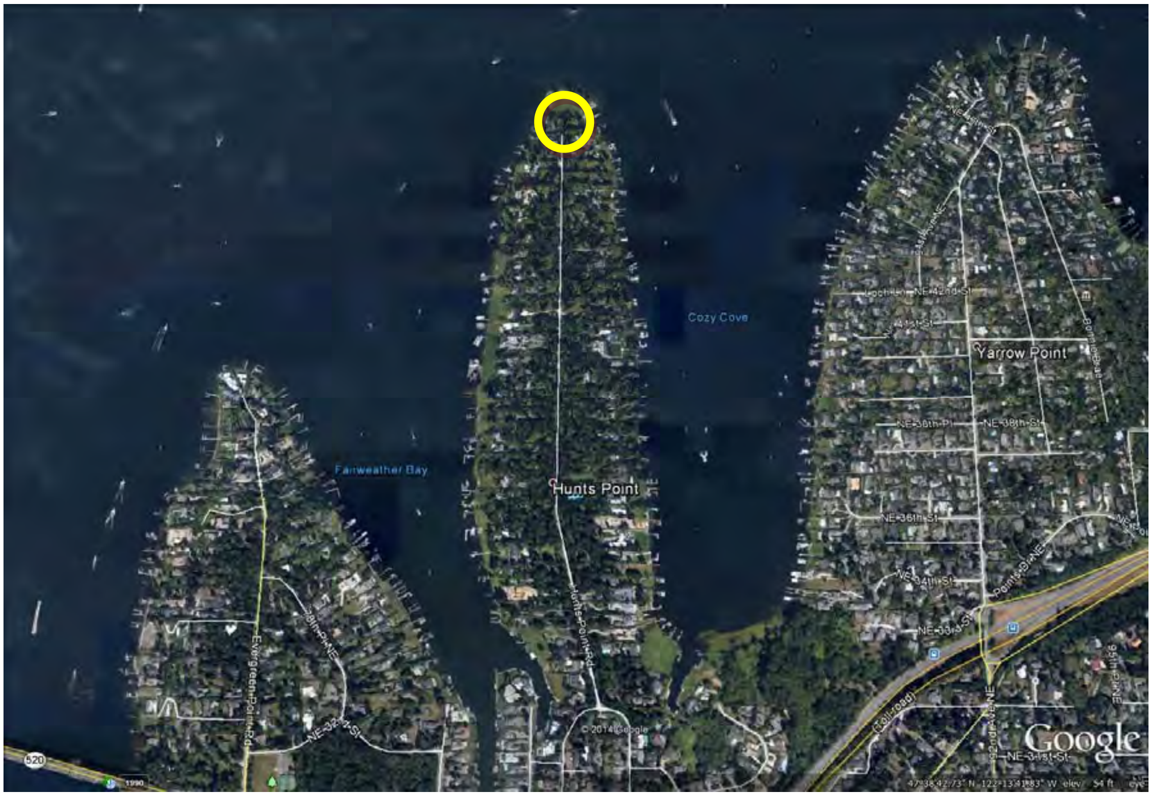


Figure 10-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 11
HUNTS POINT



11.1 Hunts Point Pump Station General Description

Date of Visit	May 19th, 2014
City of Bellevue Asset No.	187611
Address	4344 Hunts Point Rd
Station configuration	Wet well/Dry Pit
Original Construction	1960
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	208/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	270-300 gpm

11.1.1 Summary of Findings

This station is located in the middle of a cul-de sac at the north end of Hunts Point Rd. The station has potential blocking access to the cul-de sac when hatches are open. All vaults are bolted down due to fatiguing issues from large service trucks. The station receives flow from Flush 2 and discharges to the lake line. This station has reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the station's level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Table 11-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 11-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
HP-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$373,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan to provide continuous ventilation		
	Wet well blower vault not built to area classifications	Replace components to meet classification requirements		
	Paco Pumps are obsolete and condition is deteriorating	Replace Paco Pumps (2), US Motor (2) and motor drivers		
	Wet well interior coating showing signs of degradation	Re-coat interior of wet well		
	City owned meter base is weathered	Replace City owned meter base		
	Panelboard circuit breaker load center near end of its useful life	Replace panelboard		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Service entrance disconnect equipment is weathered	Replace service entrance disconnect equipment		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

11.2 Site

11.2 Site Description

Vehicle access to site	End of Hunts Pt. Rd, cul-de sac, parking adjacent to station
Landscaping	Concrete pavement
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access to site, turn around access to several homes

General observations/notes from field visit:

- Potentially blocking access to several homes with large service truck and with vault hatches open

End of Hunts Point Road, turn around

Potentially blocking access to several homes with large service truck and with vault hatches open

11.3 Station Facilities

11.3.1 Wet Well – Structure and Accessories

11.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1 Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch, H-20
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8.5’x12.5’ deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8”, above operating level*
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

11.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified interior coating showing signs of degradation and the hatch is fatiguing.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Hatch is fatiguing – due to trucks (garbage and others)

Wet well lift assist hatch, fatiguing evident

Interior of wet well

11.3.2 Dry Pit – Structure and Accessories

11.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1 Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch, H-20
Access fall protection	Yes, one side only
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8.5’
Lighting	Yes, adequate for visibility/maintenance
Ventilation	Supply Fan
Ventilation continuous	No,

11.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Hatch is fatiguing – due to trucks (garbage and others)

Access fall protection on one side of hatch opening

Dry pit hatch, fatiguing evident

11.3.3 Wet Well Blower Vault – Structure and Accessories

11.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1 Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch, H-20
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5’x5’x5’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

11.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Drains to wet well
- Tacked up re-hinged hatch, fatiguing – due to trucks (garbage and others)
- Equipment does not appear to be rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.

Interior of wet well blower vault

Wet well blower vault hatch, tacked up/re-hinged

11.4 Mechanical

11.4.1 Pumps

Pump System Performance

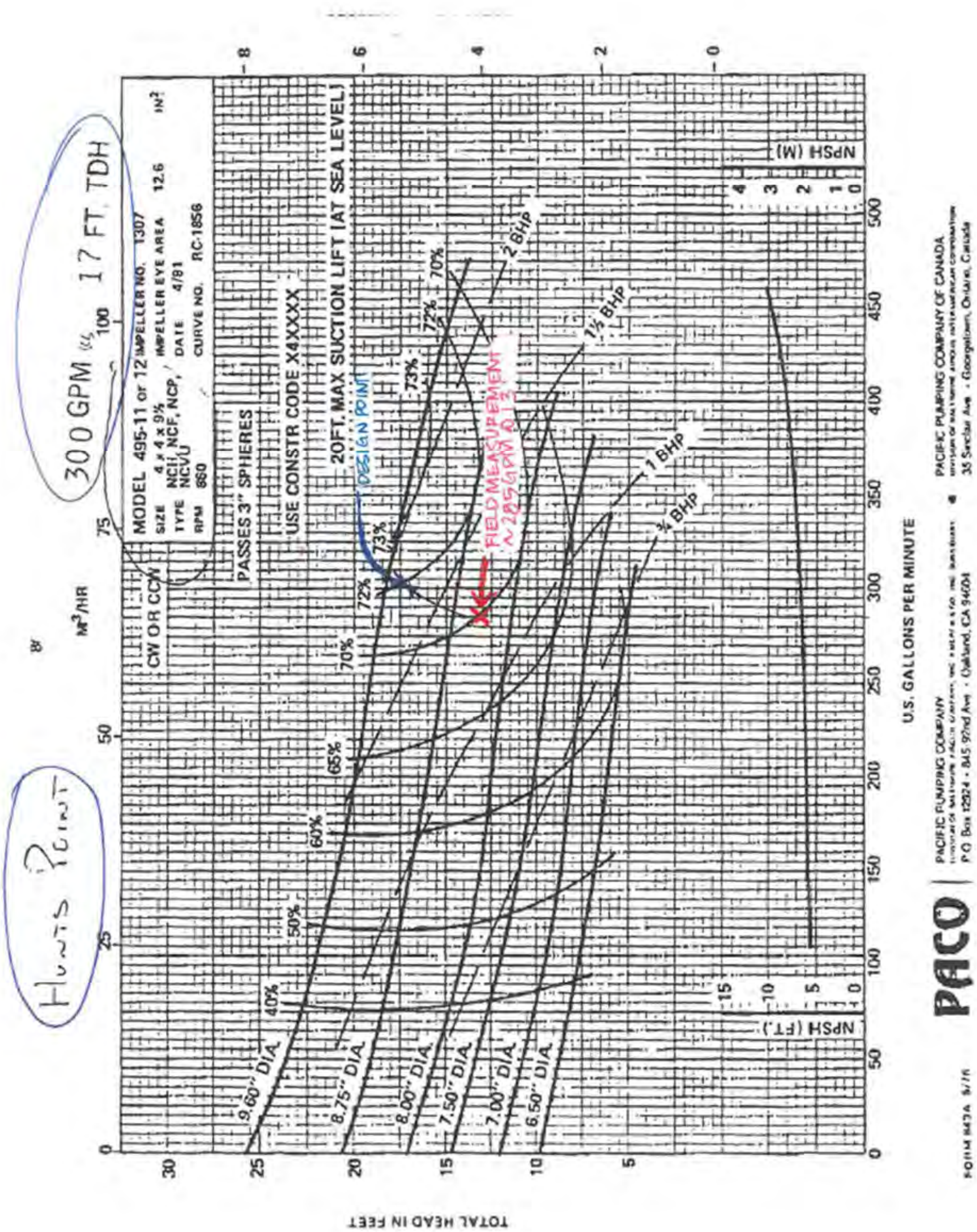
The field tested performance of the pumps at Hunts Point Pump Station measured a slightly lower flow (~285 gpm vs. 300 gpm) and lower head (~13 ft vs. 17 ft). Measuring the flow and head just below the curve may indicate some wear, but it appears likely that the measured point is within the accuracy of the theoretical data. As this apparent degradation of capacity continues, it will be important for the City to confirm that the pumping capacity does not drop below the peak design influent flow rate.

The following table documents the pump run hours and starts by month over the past year.

Table 11-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	24.71	415	25.43	422
May-13	19.8	378	20.61	382
Jun-13	18.33	386	20.36	284
Jul-13	21.92	411	22.79	413
Aug-13	25.83	460	27.02	462
Sep-13	25.16	485	27.47	487
Oct-13	31.29	437	32.47	444
Nov-13	27.39	398	34.86	399
Dec-13	38.67	363	39.26	366
Jan-14	41.75	364	39.75	367
Feb-14	44.38	441	43.24	438
Mar-14	51.23	534	48.4	533
Total	**370.46**	**5,072**	**381.66**	**4,997**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.0	0.6	1.0	0.6

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.


Hunts Point
300 GPM @ 17 FT. TDH
MODEL 495-11 or 12
SIZE 4 x 4 x 9½
TYPE NCII, NCF, NCP, NCVU
RPM 860
IMPELLER NO. 1307
IMPELLER EYE AREA 12.6 IN²
DATE 4/81
CURVE NO. RC-1856
CW OR CCW
PASSES 3" SPHERES
USE CONSTR CODE X4XXXXX
20FT. MAX SUCTION LIFT (AT SEA LEVEL)
DESIGN POINT
FIELD MEASUREMENT ~285GPM @ 13'
TOTAL HEAD IN FEET
U.S. GALLONS PER MINUTE
M³/HR
NPSH (FT.)
NPSH (M)
PACO
PACIFIC PUMPING COMPANY
P.O. Box 12924 • 845 92nd Ave. • Oakland, CA 94604
PACIFIC PUMPING COMPANY OF CANADA
35 Sinclair Ave. • Georgetown, Ontario, Canada

11.4.1.1 Pump 1 – City of Bellevue Asset No. 193829

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A0171301A
Horsepower	3
Voltage/phase	230/460/3
Date of installation	1989
Design Conditions	300 gpm @ 17 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 - Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech)

General observations/notes from field visits:

- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	7
Calculated pumping capacity	295 gpm – 300 gpm
Total Dynamic head (feet)	12.5
Number of tests performed	2

General observations/notes from drawdown test:

- Pumping capacity appears to be near design flow but with a slightly lower flow and head which may indicate some wear

Duplex configuration, Pump 1 in foreground

Pump and motor #1

Pump 1 showing signs of aging on exterior

11.4.1.2 Pump 2 – City of Bellevue Asset No. 193830

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A0171301B
Horsepower	3
Voltage/phase	230/460/3
Date of installation	1989
Design Conditions	300 gpm @ 17 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 - Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech)

General observations/notes from field visits:

- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	7
Calculated pumping capacity	270 gpm – 285 gpm
Total Dynamic head (feet)	12.8
Number of tests performed	2

General observations/notes from drawdown test:

- Pumping capacity appears to be near design flow but with a slightly lower flow and head which may indicate some wear

Duplex configuration, Pump 2 in background

Pump and motor #2

Pump 2 showing signs of aging on exterior

11.4.2 Exposed Piping and Valves

11.4.2.1 Suction Piping/Valve(s)

Size	8”
Material	DI
Valve Type(s)	Gate valve w/ hand wheel

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

11.4.2.2 Discharge Piping/Valve(s)

Size	4” through ball check valve and plug valve increase to 6”, wye into 8”
Material	DI
Valve Type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Some rattling of ball check valve

Gate valve isolation for suction piping

Ball check valve vertical installation on discharge piping

Plug valve on discharge piping

Common discharge piping

11.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

11.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in bottom and top of dry pit
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	Two stacked water meter boxes, above grade/foam boards and heat tape

General observations/notes from field visit:

- Back flow assembly located between supply vents, adjacent to street

Backflow prevention assembly in two stacked water meter boxes between supply vents

Backflow prevention assembly above grade

11.4.5 Ventilation

11.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Located in adjacent wet well blower vault
Fan type	Centrifugal
Airflow rate	560 CFM @ 0.5" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

11.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	10' AFF in dry pit
Fan type	Centrifugal
Airflow rate	820 CFM @ 1" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located 10' AFF in the dry pit

Wet well supply fan located in wet well blower vault

Supply fan located near ceiling of dry pit

11.5 Electrical

11.5.1 Electrical Service

11.5.1.1 Electrical Service Description

Voltage	208
Phases	3
Utility transformer	Underground
Service meter location	On pole base

11.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Equipment is older, outdoors and subject to weathering

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; equipment is mounted on old power pole with unistrut

11.5.2 Backup Power

11.5.2.1 Backup Power Description

Type	Generator receptacle
Location	Below manual transfer switch
Transfer switch type	Manual
Transfer switch location	On unistrut

11.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition though outdoors weathered

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; equipment is pole mounted, but close nippled to old unistrut

Utility service and generator receptacle located in raised landscaping area

Service meter located on wood pole

Generator receptacle located below manual transfer switch

11.5.3 Site – Panelboard

11.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/240/1 phase
Manufacturer	Crouse Hinds BB
Model	Unknown

11.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Old circuit breaker panel nearing end of its useful life

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 2 – Outdated parts; equipment is in dry pit

11.5.4 Site – Starters

11.5.4.1 Starters Description

Starters	(2) FVNR Starters

11.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Original starters are nearing end of useful life

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 2 – Outdated parts; equipment is in dry pit

Panelboard located in dry pit, nearing end of its useful life

Original starters located in dry pit, nearing end of useful life

11.5.5 Site – Telemetry Control Panel

11.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376842
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger
Secondary Level Indication	High level float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystem/Series 5000 Option F
Telephone Network Interface	In oversized outdoor panel

11.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Starter/control panel with operator interface

Telephone network interface located in oversized outdoor panel

Starter/control panel located in dry pit

11.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 11-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classifications	Does not meet code requirements, possible fire and explosion hazard	• De-classify • Re-build to classified area
Paco Pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/ repair delays	• Replace pumps, motors and motor drivers
Wet well interior coating showing signs of degradation	May decrease integrity of wet well structure	• Recoat interior of wet well
City owned meter base is weathered	Loss of power at the site	• Replace City owned meter base
Panelboard circuit breaker load center near end of its useful life	Loss of power at the site	• Replace panelboard
Primary and backup level indicators are aging	Loss of level control	• Replace primary and backup level indicators
Telephone network interface termination box is aging	Loss of control at the site	• Replace telephone network interface termination box
Service entrance disconnect equipment is weathered	Loss of power at site	• Replace service entrance disconnect equipment

11.6.1 Project Recommendations

Due to the location of the pump station and its impact to private residents, it is recommended that one project should be complete to address all deficiencies identified. The timing of the recommend projects is driven by the reported loss of pump redundancy at this station which speeds the projects up to the first time frame from 2015 to 2018. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replacing all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 11-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
HP-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$373,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan to provide continuous ventilation		
	Wet well blower vault not built to area classifications	Replace components to meet classification requirements		
	Paco Pumps are obsolete and condition is deteriorating	Replace Paco Pumps (2), US Motor (2) and motor drivers		
	Wet well interior coating showing signs of degradation	Re-coat interior of wet well		
	City owned meter base is weathered	Replace City owned meter base		
	Panelboard circuit breaker load center near end of its useful life	Replace panelboard		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Service entrance disconnect equipment is weathered	Replace service entrance disconnect equipment		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

11.6.2 Project Justification

The timing of the recommended projects is driven by the reported loss of redundancy at this station which does not meet regulatory requirements and the station does not meet the minimum level of service.

In addition to the loss of redundancy, the Paco pumps at this station are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump which is challenging since this station on occasion relies on both pumps to keep up with flows.

11.7 Station Long Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 11-4 have been implemented in the timeline identified.

11.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 11-5 and 11-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 11-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 11-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	3	1	0	-	3	5-10
Telemetry System	2	1	0	-	2	0-5
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 11-6 includes the estimated remaining useful life when the recommended projects provided in Table 11-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for all asset groups will increase significantly.

Table 11-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

11.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 11-1 graphically represents the rehabilitation and replacement cost projections for the Hunts Point Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 11-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 11-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 11-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	**Replacement Component**	**Estimated Complexity/Size Cost Range**				
		Low →				**High**
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 11-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

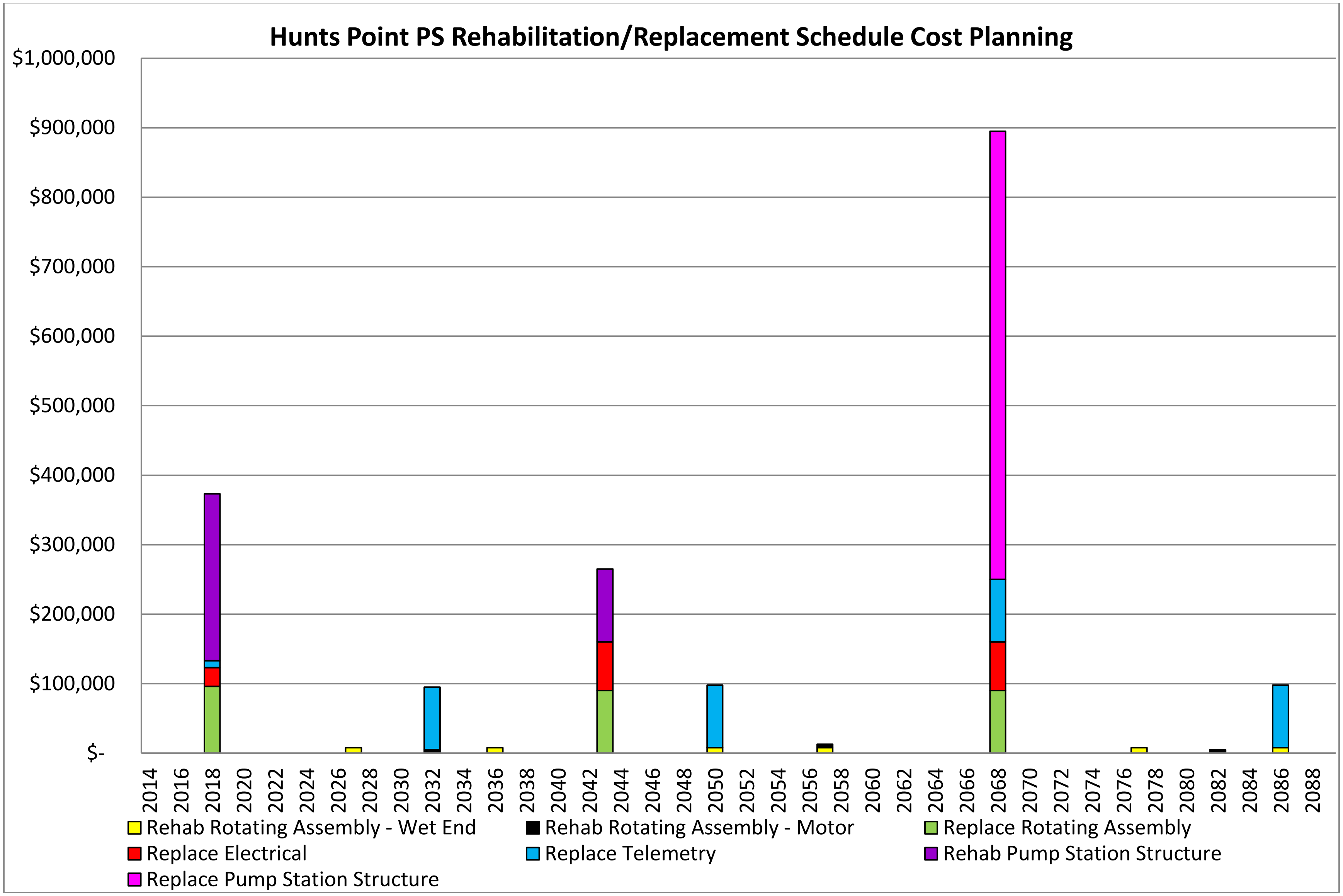
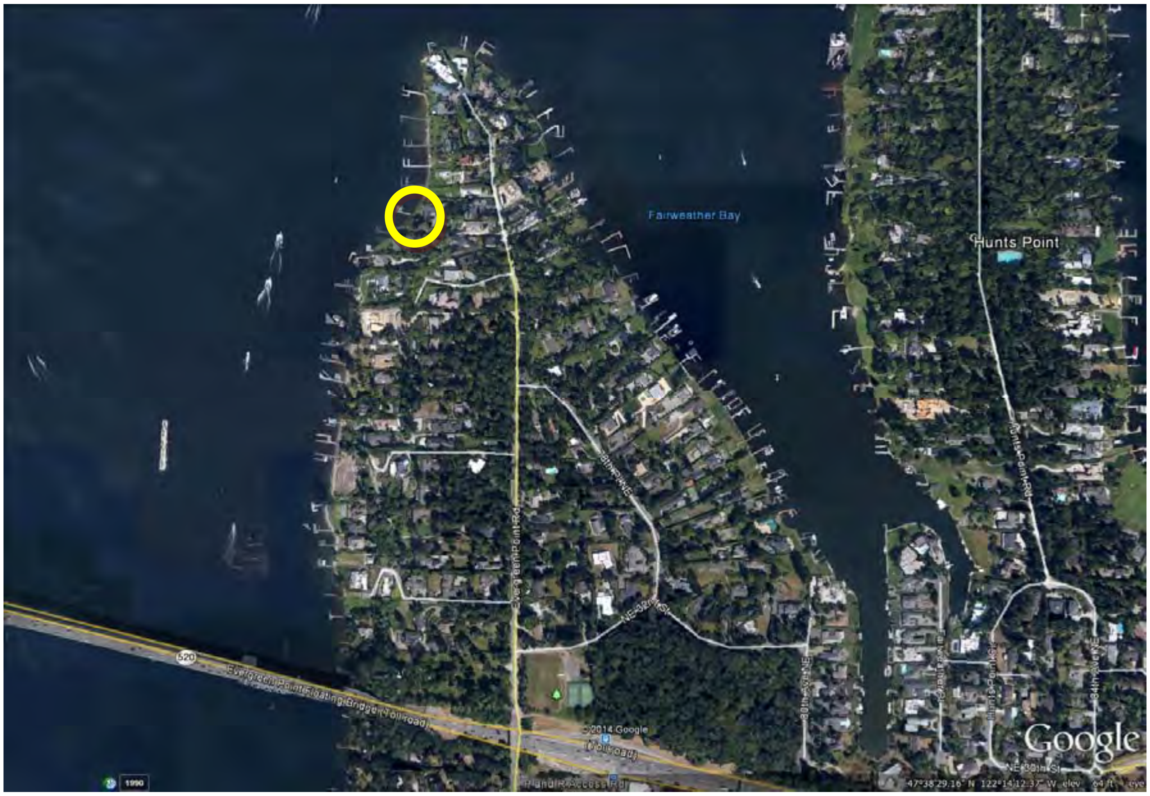


Figure 7-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 12
EVERGREEN WEST



12.1 Evergreen West Pump Station General Description

Date of Visit	May 19th, 2014
City of Bellevue Asset No.	187602
Address	3603 Evergreen Point Rd
Station configuration	Wet well/Dry pit
Original Construction	1960
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	208/3 Phase
Standby Power	Generator receptacle
Field-measured Station Firm Capacity	230-260 gpm

12.1.1 Summary of Findings

Evergreen West is located adjacent to a private residence surrounded by laurel bushes for privacy that the City maintains. This station receives flow from Flush 3 and discharges to the lake line. This station has reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the station's level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Table 12-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 12-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
EW-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$352,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan to provide continuous ventilation		
	Wet well blower vault not built to area classifications	Replace components to meet classification requirements		
	Intrinsically safe relays do not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco Pumps (2), US Motor (2) and motor drivers		
	Wet well interior showing signs of degradation	Recoat interior of wet well		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		

<u>Note:</u>

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

12.2 Site

12.2 Site Description

Vehicle access to site	One lane steep driveway, parking adjacent to station near private residence
Landscaping	Laurel bushes surround station to obscure view of vault hatches, City needs to maintain
Site lighting	None
Fencing/security	None, in residents garden
Public accessibility to site	Full access to site

General observations/notes from field visit:

- Consider installing fence
- Overhead power lines above hatches – potential issue when pulling pumps and equipment
- Slippery hatches due to biological growth

Steep one lane driveway, access to site

Laurel bushes around surround station to obscure view of vault hatches

12.3 Station Facilities

12.3.1 Wet Well – Structure and Accessories

12.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1 Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid, Olympic Foundry Co. ladder down to platform grating
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8”, above operating level
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	No

12.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified some delamination of interior coating.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- 30” back from ladder to 12” diameter PVC vent pipe – possible clearance requirement issue
- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Wet well manhole lid

Interior of wet well, 30” back from ladder to 12” diameter PVC vent pipe

12.3.2 Dry Pit – Structure and Accessories

12.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1 Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and spiral staircase
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8’-6”
Lighting	Yes, adequate for visibility/maintenance
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch (automatic)

12.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Some new paint interior near hatch and opening
- Very clean dry pit with good lighting

Some new paint interior near hatch and
opening

Interior of dry pit appears to be in good
condition with good lighting

12.3.3 Wet Well Blower Vault – Structure and Accessories

12.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1 Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x8’x5’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

12.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Drains to dry pit
- Equipment does not appear to be rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.

Interior of wet well blower vault appears to be in good condition

12.4 Mechanical

12.4.1 Pumps

Pump System Performance

The field tested performance of the Evergreen West pumps indicate that the flow is slightly lower than the design rate (245 gpm vs. 250 gpm) and the pressure head is approximately a third of the design point (5 ft vs. 16 ft). Without an available pump curve, little can be determined regarding the pump system. However, given the flow is near the design rate but the pressure head is significantly lower, it is possible that the original design overestimated the downstream pressure losses, which would have originally delivered a greater flow rate. As pump wear has taken place, the flow rate would be reduced. As the capacity is similar to the original design, there are no concerns with the current pump.

The following table documents the pump run hours and starts by month over the past year.

Table 12-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	26.2	435	29.56	437
May-13	25.74	384	27.49	386
Jun-13	25.57	386	22.85	384
Jul-13	24.23	348	22.29	344
Aug-13	24.41	322	39.5	319
Sep-13	25.96	339	27.08	338
Oct-13	26.18	287	27.5	291
Nov-13	29.83	274	27.78	281
Dec-13	29.35	303	29.86	304
Jan-14	60.68	348	31.03	24
Feb-14	28.91	401	31.21	399
Mar-14	34.08	585	37.42	584
Total	**361.14**	**4,412**	**353.57**	**4,091**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.0	0.5	1.0	0.5

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Name plate data on pump

~~Medina GPM 350 TDH 67.5 imp dia 8.1~~

Evergreen West GPM 250 TDH 16 imp dia 7.5

FIELD MEASUREMENT: ~245 GPM @ 5' TDH

~~Evergreen East GPM 250 TDH 14 imp dia 7.5~~

Figure 12-1: No pump curves were located or available by the manufacturer, but this design point listing provided some useful information

12.4.1.1 Pump 1 – City of Bellevue Asset No. 193853

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A022401A
Horsepower	3
Voltage/phase	208/3
Date of installation	1989
Design Conditions	250 gpm @ 16 feet TDH
Able to isolate pump?	Yes, plug valve on suction and discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Indication of recirculation occurring
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	3
Calculated pumping capacity	230 gpm – 245 gpm
Total Dynamic head (feet)	5
Number of tests performed	3

General observations/notes from drawdown test:

- Pumping capacity appears to be near design flow, but significantly lower pressure head may indicate some wear

Duplex configuration, Pump 1 in foreground

Pump 1 showing signs of aging on exterior

12.4.1.2 Pump 2 – City of Bellevue Asset No. 193845

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A022401B
Horsepower	3
Voltage/phase	208/3
Date of installation	1989
Design Conditions	250 gpm @ 16 feet TDH
Able to isolate pump?	Yes, plug valve on suction and discharge
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	3
Calculated pumping capacity	225 gpm-260 gpm
Total Dynamic head (feet)	5
Number of tests performed	3

General observations/notes from drawdown test:

- Pumping capacity appears to be near design flow, but significantly lower pressure head may indicate some wear

Duplex configuration, Pump 2 in background

Pump and motor #2

Pump 2 showing signs of aging on exterior

12.4.2 Exposed Piping and Valves

12.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve installed with horizontal axis of rotation, plug rotates up, seats to pump

12.4.2.2 Discharge Piping/Valve(s)

Size	4” through check valve and plug valve increase to 6”, wye into 8”
Material	DI
Valve Type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats away from pump in vertical position – should seat up to avoid debris build up on backside of plug

Plug valve isolation for suction piping, horizontal axis of rotation

Ball check valve vertical installation and plug valve isolation on discharge piping

Common discharge piping

12.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

12.4.4 Washdown Water

Supply	Domestic, metered. Shared service with the home adjacent to station.
Access	Hose bibb in dry pit in two locations
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In dry pit near opening/dry pit insulation

Backflow prevention assembly located
near dry pit opening

12.4.5 Ventilation

12.4.5.1Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

12.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	10' AFF in dry pit
Fan type	Belt driven axial (assumed)
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located 10' AFF in the dry pit

General observations/notes from field visit:

- Very noisy fan, rattling possibly due to sheet metal

Wet well supply fan located in wet well
blower vault

Supply fan located near ceiling of dry pit

12.5 Electrical

12.5.1 Electrical Service

12.5.1.1 Electrical Service Description

Voltage	208
Phases	3
Utility transformer	Adjacent to site on pole
Service meter location	Adjacent to site on pole

12.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition though outdoors and subject to weathering

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; equipment is pole mounted

12.5.2 Backup Power

12.5.2.1 Backup Power Description

Type	Generator receptacle
Location	Utility pole on Evergreen Point Rd
Transfer switch type	Manual
Transfer switch location	Adjacent to site on pole

12.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Appears to be in good condition though outdoors and subject to weathering

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is pole mounted

Utility service, service meter and manual transfer switch located on pole adjacent to site

Generator receptacle located on pole near Evergreen Point Road

12.5.3 Site – Panelboard

12.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/208/3 phase
Manufacturer	Siemens
Model	CDP-7 Series 8

12.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

12.5.4 Site – Starters

12.5.4.1 Starters Description

Starters	208, (2) FVNR starters

12.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – One original starter is approaching end of useful life; one has been replaced with a newer model

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Panelboard located in dry pit, appears to be in good condition

Starters located in dry pit, one original starter approaching end of useful life, the other has been replaced with a newer model

12.5.5 Site – Telemetry Control Panel

12.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376811
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High level float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/Series 5000 Option F
Telephone Network Interface	In outdoor junction box

12.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- Intrinsically safe relays do not have required clearance or barriers, code violation

Telemetry control panel located in dry pit, appears to be in good condition

Telephone network interface located in outdoor junction box

12.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 12-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classifications	Does not meet code requirements, possible fire and explosion hazard	• De-classify • Re-build to classified area
Intrinsically safe relays do not have required clearance or barriers	Does not meet code requirements	• Provide barrier for intrinsically safe relays
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps, motors and motor drivers
Wet well interior showing signs of degradation	May decrease integrity of wet well structure	• Recoat interior of wet well
Primary and backup level indicators are aging	Loss of level control at site	• Replace primary and backup level indicators
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box

12.6.1 Project Recommendations

Due to the location of the pump station and its impact to the resident adjacent to the station, it is recommended that one project should be complete to address all deficiencies identified. The timing of the recommended projects is driven by the reported loss of pump redundancy at this station which speeds the projects up to the first time frame from 2015 to 2018. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 12-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
EW-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$352,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan to provide continuous ventilation		
	Wet well blower vault not built to area classifications	Replace components to meet classification requirements		
	Intrinsically safe relays do not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco Pumps (2), US Motor (2) and motor drivers		
	Wet well interior showing signs of degradation	Recoat interior of wet well		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

12.6.2 Project Justification

The timing of the recommended projects is driven by the reported loss of redundancy at this station which does not meet regulatory requirements and the station does not meet the minimum level of service.

In addition to the loss of redundancy, the Paco pumps at this station are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump which is challenging since this station on occasion relies on both pumps to keep up with flows.

12.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 12-4 have been implemented in the timeline identified.

12.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 12-5 and 12-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 12-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 12-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	2	1	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 12-6 includes project estimated remaining useful life when the recommended projects provided in Table 12-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups will increase significantly.

Table 12-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

12.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 12-1 graphically represents the rehabilitation and replacement cost projections for the Evergreen West Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 12-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 12-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 12-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	\$30,000 \$15,000 \$10,000	\$40,000 \$20,000 \$15,000	\$50,000 \$25,000 \$20,000	\$60,000 \$30,000 \$25,000	\$70,000 \$35,000 \$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	\$5,000 \$5,000	\$8,000 \$8,000	\$11,000 \$11,000	\$14,000 \$14,000	\$17,000 \$17,000

Table 12-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

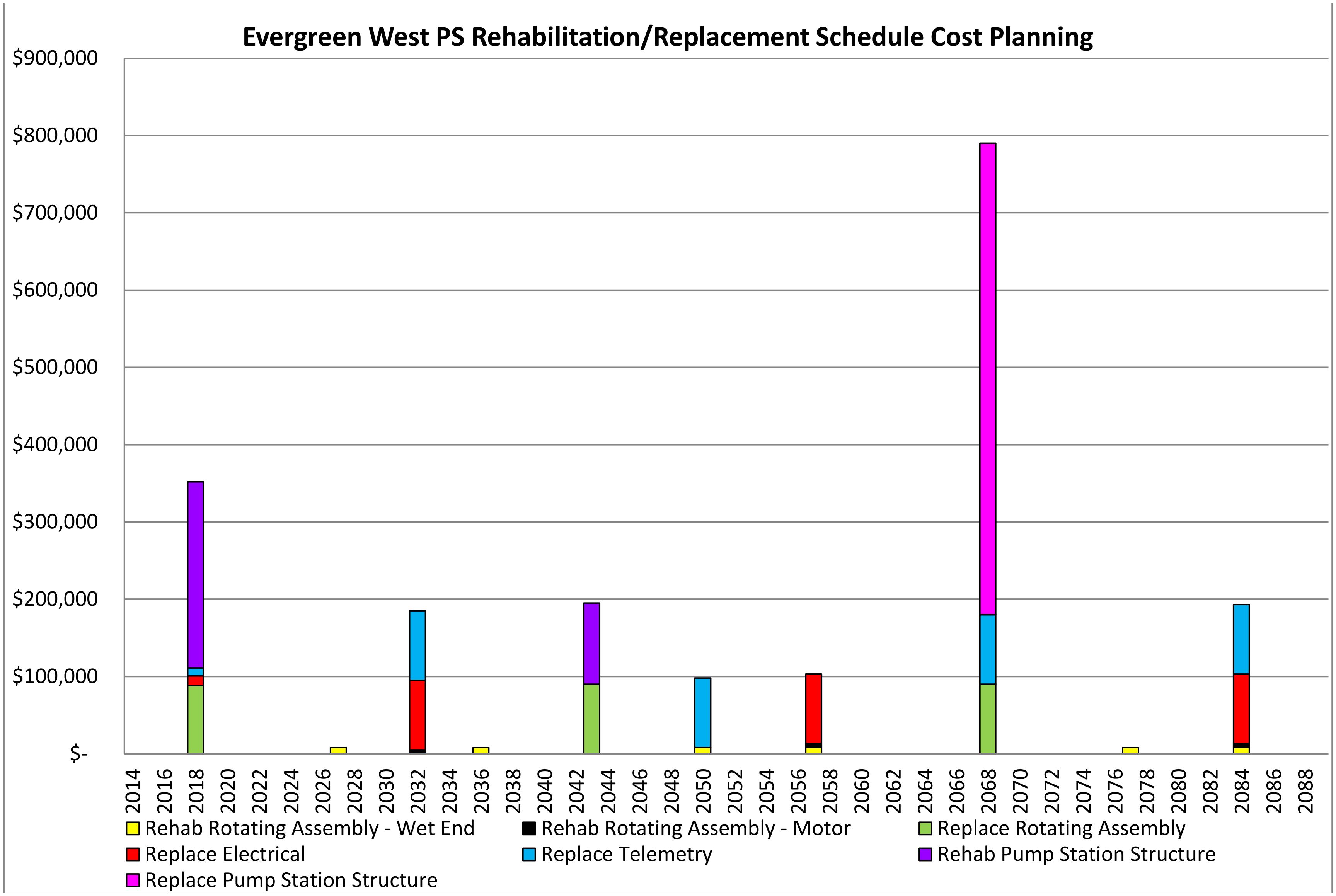
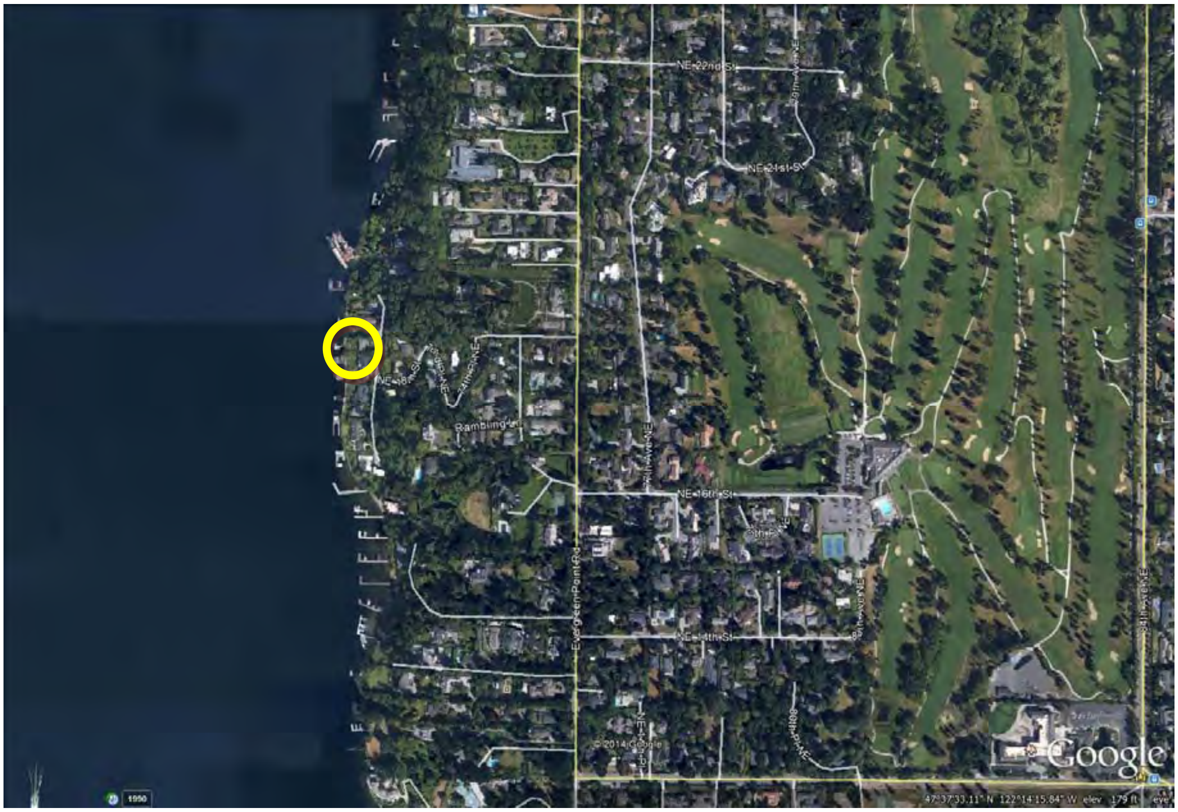


Figure 12-2: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 13
LAKE CREST



13.1 Lake Crest Pump Station General Description

Date of Visit	May 19th, 2014
City of Bellevue Asset No.	187609
Address	1823 73rd Ave NE
Station configuration	Wet well/Dry pit
Original Construction	1960
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	208/3 Phase
Standby Power	Generator receptacle
Field-measured Station Firm Capacity	360 – 380 gpm

13.1.1 Summary of Findings

Lake Crest pump station is located adjacent to the Bill Gate's residence contractor entrance on 73rd Ave NE. There are a lot of shrubs surrounding the station that are maintained by others. The station receives flow from Flush 3 and discharges to the lake line with a dedicated force main back to the lake line. A significant deficiency identified at this site are the two Paco pumps at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech).

Table 13-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 13-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
LC-1	Must step over open space to access staircase landing – fall issue	Access pump station from far side – requires clearing of brush	As soon as possible	N/A - Maintenance
LC-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$360,000
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Intrinsically safe relay does not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Wet well interior is aging	Recoat interior of wet well		
	Service entrance disconnect equipment is aging	Replace service entrance disconnect equipment		
	Panelboard Cutler Hammer load center nearing end of useful life	Replace panelboard		
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

13.2 Site

13.2.1 Site Description

Vehicle access to site	Narrow paved road, parking adjacent to station
Landscaping	A lot of shrubs surrounding, maintained by others
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access to site – heavy security near Bill Gates home

General observations/notes from field visit:

- Dry Pit access to top of spiral stair case on opposite side of accessibility – staff currently steps over open space to landing

Dry pit access to top of spiral stair case
on opposite side of accessibility

Vehicle access to site and landscaping
around station

13.3 Station Facilities

13.3.1 Wet Well – Structure and Accessories

13.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1 Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”x12’ deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8”, above operating level*
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	No,

*Based on Record Drawings, unable to confirm in field.

13.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified interior of wet well appears to be in good condition with some delamination of the interior coating.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Interior of wet well appears to be in good condition with some degradation

13.3.2 Dry Pit – Structure and Accessories

13.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1 Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and spiral stair case, landing on other side of access
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8’-6”x12’ deep*
Lighting	Yes, adequate for visibility/maintenance
Ventilation	Supply Fan
Ventilation continuous	No, dry pit hatch switch

*Based on Record Drawings, unable to confirm in field.

13.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Safety issue when stepping over to spiral staircase landing
- Sump pump has grating and wire mesh, removes hazard for stepping into sump

Potential safety issue, stepping over to spiral staircase landing

Metal grating and wire mesh on sump, no hazard for stepping into sump

13.3.3 Wet Well Blower Vault – Structure and Accessories

13.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1 Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5'x5'x5' deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

13.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Equipment does not appear to be rated for Class 1, Division 2 space (NFPA 820). Equipment was grandfathered-in so replacement is needed upon the next major rehabilitation project. See section 2 for grandfathered term reference.

Wet well blower vault hatch

Interior of wet well blower vault

13.4 Mechanical

13.4.1 Pumps

Pump System Performance

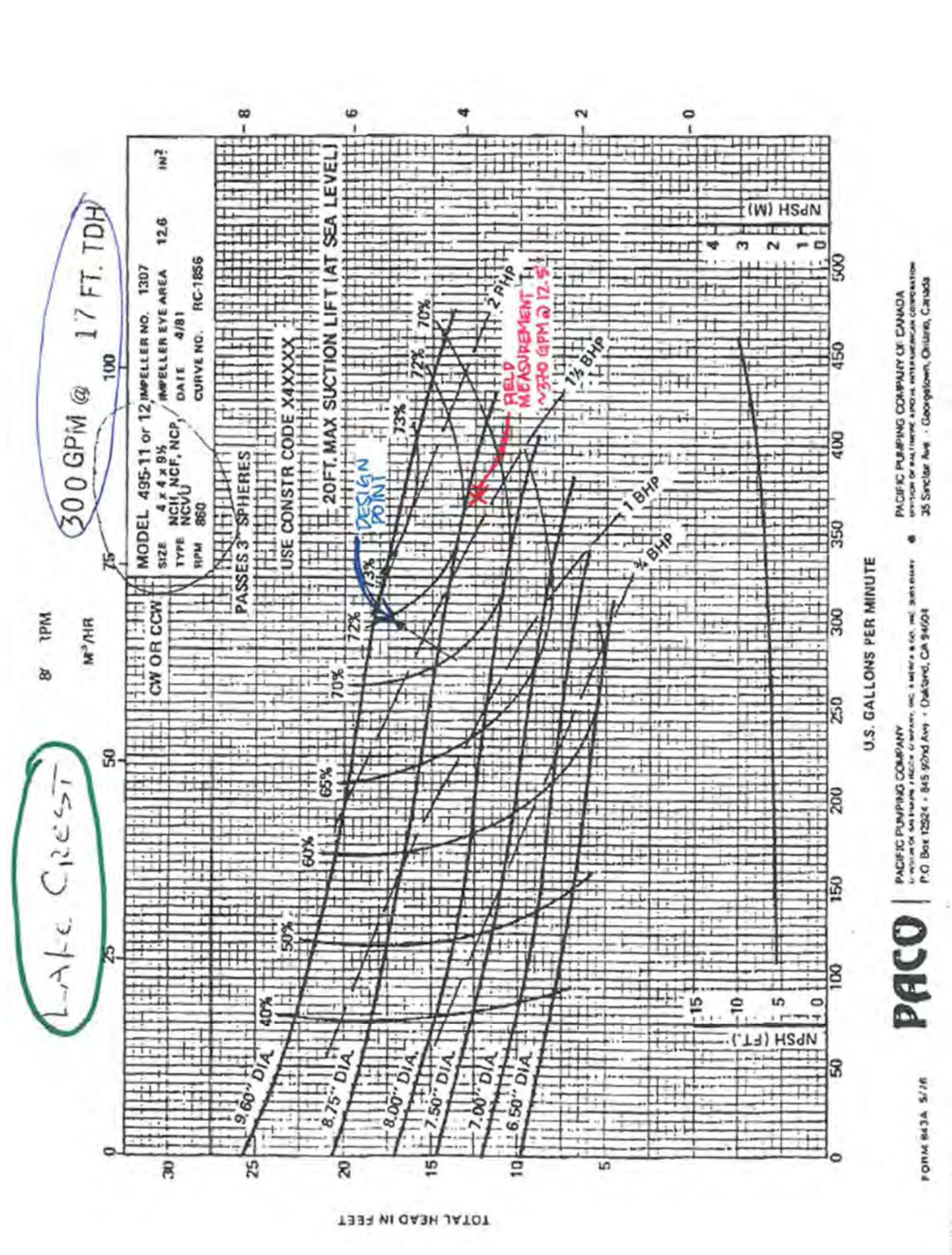
The field tested performance of the pumps at the Lake Crest Pump Station measured considerably higher flow (~370 gpm vs. 300 gpm) and lower head (12.5 ft vs. 17 ft) than the design point. Assuming the accuracies of the measurements are reasonable and based on the pumping system head comparison in the following figure, it is possible that the design system head condition was overestimated relative to the current situation. Regardless, this pump appears to be operating near the end of the pump curve where cavitation could be a potential concern.

The following table documents the pump run hours and starts by month over the past year.

Table 13-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	23.9	185	24.21	182
May-13	25.57	211	25.67	212
Jun-13	24.7	236	25.26	235
Jul-13	22.13	187	21.8	186
Aug-13	17.79	186	17.97	182
Sep-13	21.85	189	21.22	192
Oct-13	20.88	182	20.65	184
Nov-13	27.38	192	19.93	189
Dec-13	22.83	231	22.02	226
Jan-14	22.43	247	16.78	244
Feb-14	19	193	14.36	192
Mar-14	22.63	259	13.4	258
Total	271.09	2,498	243.27	2,482
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.7	0.3	0.7	0.3

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.



Lake Crest
300 GPM @ 17 FT. TDH
MODEL 495-11 or 12
IMPELLER NO. 1307
IMPELLER EYE AREA 12.6
DATE 4/81
CURVE NO. RC-1856
CW OR CCW
PASSES 3" SPHERES
USE CONSTR CODE X4XXXX
20FT. MAX SUCTION LIFT (AT SEA LEVEL)
DESIGN POINT
FIELD MEASUREMENT ~370 GPM @ 12.5'
9.60" DIA.
8.75" DIA.
8.00" DIA.
7.50" DIA.
7.00" DIA.
6.50" DIA.
2 BHP
1½ BHP
1 BHP
¾ BHP
NPSH (FT.)
NPSH (M)
U.S. GALLONS PER MINUTE
TOTAL HEAD IN FEET
PACO
PACIFIC PUMPING COMPANY
PACIFIC PUMPING COMPANY OF CANADA

13.4.1.1 Pump 1 – City of Bellevue Asset No. 193800

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A01715A
Horsepower	3
Voltage/phase	230/460/3 phase
Date of installation	1989
Design Conditions	300 gpm @ 17 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist and trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Hoisting rail is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	8.3
Calculated pumping capacity	370 gpm – 380 gpm
Total Dynamic head (feet)	12.4
Number of tests performed	2

General observations/notes from drawdown test:

- Pump operating below the pump curve and at a lower head condition, most likely the result of wet end wear and differing head conditions from the original design.

Duplex configuration, Pump 1 in foreground

Pump 1 showing signs of aging on exterior

13.4.1.2 Pump 2 – City of Bellevue Asset No. 193864

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-49511-X46D60-01
Serial No.	88A01715B
Horsepower	3
Voltage/phase	230/460/3 phase
Date of installation	1989
Design Conditions	300 gpm @ 17 feet TDH
Able to isolate pump?	Yes, gate valve on suction, plug valve on discharge
Ability to access/remove pump from station	Yes, chain hoist and trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from drawdown test:

- Hoisting rail is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	8.3
Calculated pumping capacity	360 gpm – 370 gpm
Total Dynamic head (feet)	12.4
Number of tests performed	3

General observations/notes from drawdown test:

- Pump operating below the pump curve and at a lower head condition, most likely the result of wet end wear and differing head conditions from the original design.

Duplex configuration, Pump 2 in background

Pump 2 showing signs of aging on exterior

13.4.2. Exposed Piping and Valves

13.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Gate valve w/ hand wheel

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

13.4.2.2 Discharge Piping/Valve(s)

Size	4” through check valve and plug valve increase to 6”, wye into 8”
Material	DI
Valve Type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats up – ideal installation

Gate value isolation for suction piping

Ball check valve vertical installation and plug valve on discharge piping

13.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

13.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in dry pit in two locations
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In dry pit near access/insulated

Backflow prevention assembly near top of dry pit

13.4.5 Ventilation

13.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	560 CFM @ 0.5” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

13.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	12’ AFF in dry pit
Fan type	Centrifugal
Airflow rate	820 CFM @ 1” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located 12’ AFF in the dry pit

Wet well supply fan located in wet well blower vault

Supply fan located near ceiling of dry pit

13.5 Electrical

13.5.1 Electrical Service

13.5.1.1 Electrical Service Description

Voltage	208
Phases	3
Utility transformer	Pad mount
Service meter location	On steel rack near gate

13.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Older disconnect equipment, needs replacement

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway on outdoor rack

13.5.2 Backup Power

13.5.2.1 Backup Power Description

Type	Generator receptacle
Location	On steel rack near gate, under manual transfer switch
Transfer switch type	Manual
Transfer switch location	On steel rack near gate

13.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is accessible from driveway in power cabinet

Utility service and generator receptacle located on steel rack near gate, disconnect equipment needs replacement

Utility service meter

Generator receptacle located below manual transfer switch

13.5.3 Site – Panelboard

13.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/208/3 phase
Manufacturer	Cutler Hammer
Model	Safety breaker load center

13.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Old Cutler Hammer load center is nearing end of useful life

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

13.5.4 Site - Starters

13.5.4.1 Starters Description

Starters	(2) FVNR Starters

13.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Original Cutler Hammer starters and GE circuit breakers appear to be in good condition but have limited remaining life

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Panelboard and starters located in dry pit

Original Cutler Hammer starters and GE circuit breakers appear to be in good condition but have limited remaining life

Cutler Hammer Load Center is nearing end of useful life

13.5.5 Site – Telemetry Control Panel

13.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376836
Location	In dry pit
Configuration	Integral with telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High level float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/Series 5000 Option F
Telephone Network Interface	None, nothing above pedestal across street

13.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel and other electrical equipment located in dry pit

Telemetry control panel appears to be in good condition

13.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 13-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Must step over open space to access staircase landing – fall issue	Potential fall and safety issue	• Trim trees to provide clearance and access on opposite side
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Wet well blower vault not built to area classification	Does not meet code requirements, possible fire and explosion hazard	• De-classify • Re-build to classified area
Intrinsically safe relay does not have required clearance or barriers	Does not meet code	• Isolate/provide barrier
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps, motors and motor drivers
Wet well interior is aging	May decrease integrity of wet well structure	• Recoat interior of wet well
Service entrance disconnect equipment is aging	Loss of power at site	• Replace service entrance disconnect equipment
Panelboard Cutler Hammer load center nearing end of useful life	Loss of power at site	• Replace panelboard
Standby power phase monitor is aging	Loss of power at site	• Replace standby power phase monitor
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

13.6.1 Project Recommendations

Due to the simplicity of project LC-1, it is recommended to be done when the operations and maintenance make their next routine visit to this station. The other deficiencies identified at this station should be lumped together into one project due to the location of the station and its impact to private residents. The timing of the recommended project is driven by the replacement of the Paco pumps which is critical to the operation of the station.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive. With the limited amount of components located in the wet well blower vault, installing Class 1, Division 2 rated components is less expensive than adding ventilation and therefore recommended.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 13-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
LC-1	Must step over open space to access staircase landing – fall issue	Access pump station from far side – requires clearing of brush	As soon as possible	N/A - Maintenance
LC-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$360,000
	Wet well blower vault not built to area classification	Replace components to meet classification requirements		
	Intrinsically safe relay does not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Wet well interior is aging	Recoat interior of wet well		
	Service entrance disconnect equipment is aging	Replace service entrance disconnect equipment		
	Panelboard Cutler Hammer load center nearing end of useful life	Replace panelboard		
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

13.6.2 Project Justification

The first project is a potential life - safety issue that directly affects the operation and maintenance staff. This project will be complete by City staff and the costs associated with this project will not be included in the improvement project recommendations.
The timing of the second recommended project is driven by the replacement of the Paco pumps due to its serviceability rating. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pumps are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

13.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 13-4 have been implemented in the timeline identified.

13.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 13-5 and 13-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 13-5 includes the current estimated remaining useful life prior to the completion of the capital improvement projects.

Table 13-5
Current Estimated Remaining Useful Life

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	2	1	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 13-6 includes project estimated remaining useful life when the recommended projects provided in Table 13-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups will increase significantly.

Table 13-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

13.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 13-1 graphically represents the rehabilitation and replacement cost projections for the Lake Crest Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 13-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 13-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 13-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 13-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

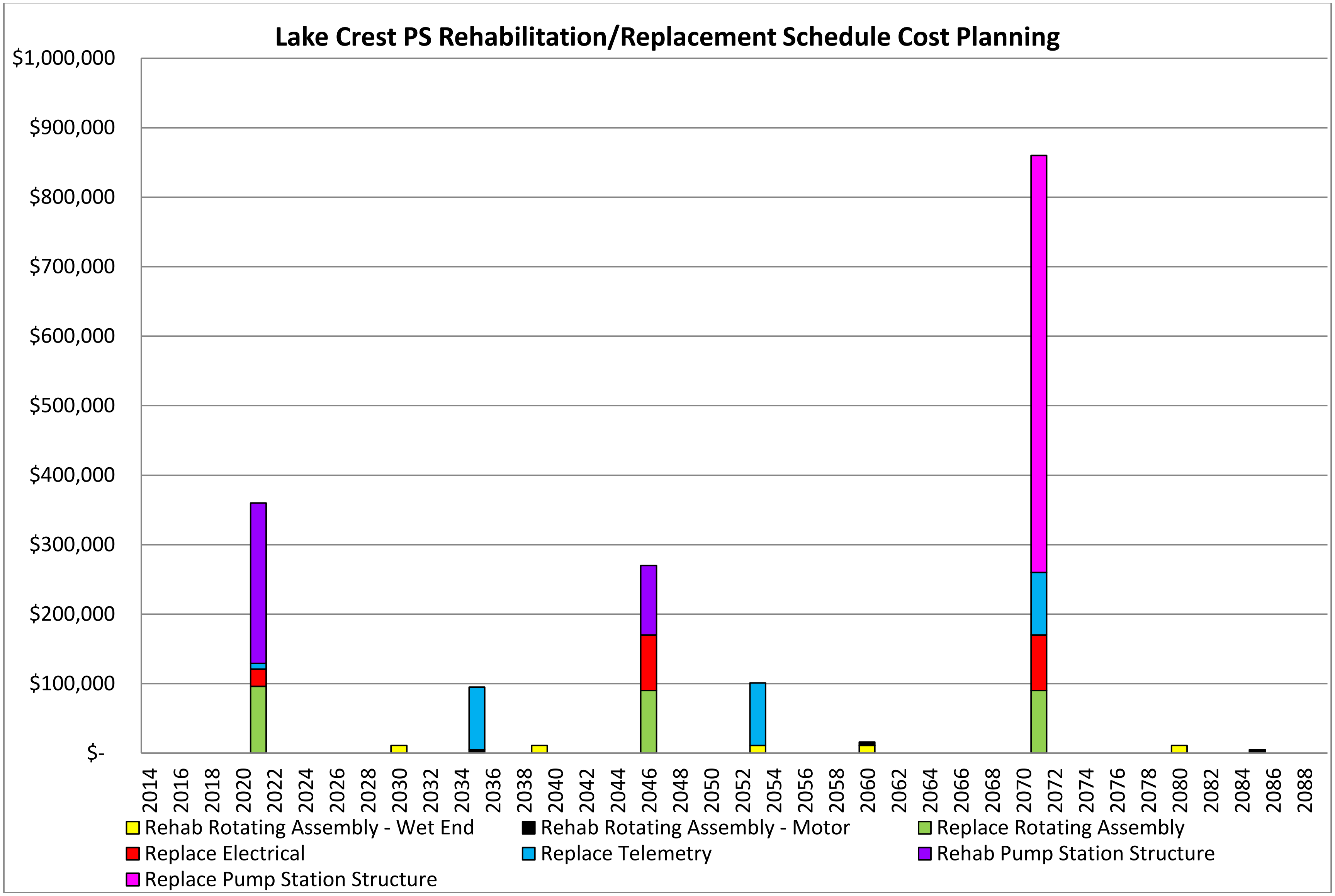
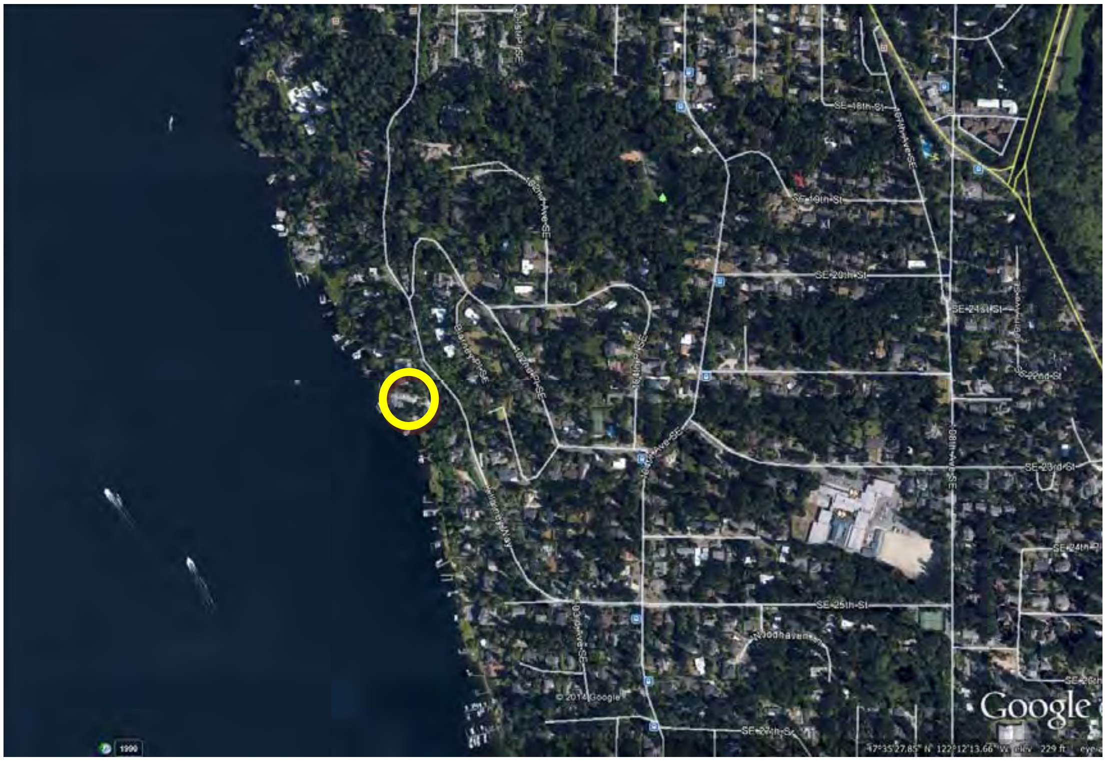


Figure 13-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 14
KILLARNEY



14.1 Killarney Pump Station General Description

Date of Visit	May 21st, 2014
City of Bellevue Asset No.	187613
Address	2177 Killarney Way SE
Station configuration	Wet well/Dry pit
Original Construction	1966
Major Rehabilitation/Upgrade	1996
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	230/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	250 – 310 gpm

14.1.1 Summary of Findings

Killarney pump station is located adjacent to a private residence near a steep driveway and the lake. The station receives flow from Flush 7 and discharges to the lake line. There are a few electrical code issues at this station such as inadequate clearance and isolation of the intrinsically safe relay wiring. The service entrance cabinet adjacent to the site is also rusting near the bottom. There are two Paco pumps at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech).

Table 14-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 14-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
K-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$181,000
	Electrical clearance between power and control panel and pump does not meet code	Provide adequate clearance		
	Intrinsically safe relay wiring does not have required clearance of barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
K-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$213,000
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

14.2 Site

14.2.1 Site Description

Vehicle access to site	Steep driveway, switch back pavement driveway, parking 20’ from station
Landscaping	Heavy cover – fir trees
Site lighting	None
Fencing/security	None
Public accessibility to site	Within unmarked/unimproved public R.O.W

General observations/notes from field visit:

- Six steps down to station from parking

Steep driveway, switch back pavement driveway

Vehicle parking adjacent to station and home

Six steps down to station from parking

14.3 Station Facilities

14.3.1 Wet Well – Structure and Accessories

14.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”x13’-6”*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	(2) 8” above operating level
Lighting	Yes, dim lighting
Ventilation	Yes
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

14.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified interior appears to be in good condition with some delamination of the interior coating.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

Wet well access hatch

Interior of wet well

14.3.2 Dry Pit – Structure and Accessories

14.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and spiral staircase
Access fall protection	Yes, chain across one side of hatch
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x8’-6”x13’-6”*
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

14.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- No equipment access hatch

Lift assist access hatch and spiral staircase, chain fall protection on one side

Ceiling of dry pit, rail with no equipment access hatch

14.3.3 Wet Well Blower Vault – Structure and Accessories

14.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	Yes, chain on one side of hatch
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x4’x4’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

14.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

Wet well blower vault hatch, chain fall protection on one side

Interior of wet well blower vault

14.4 Mechanical

14.4.1 Pumps

Pump System Performance

The field test performance of the pumps at Killarney Pump Station measured a significantly lower flow (~280 gpm vs. 350 gpm) and lower head (~9.5 ft vs. 15.5 ft). Plotting the measured point against the original design point, it appears that the pump has experienced significant wear. Given the degradation in capacity, the City should confirm that the pumping capacity is not nearing the peak design flow.

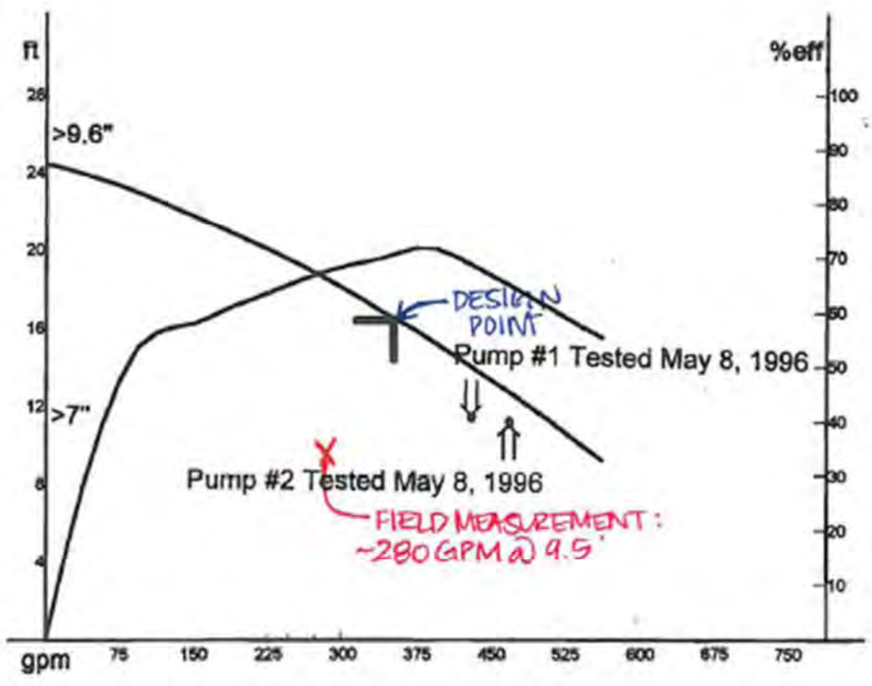
The following table documents the pump run hours and starts by month over the past year.

Table 14-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	58.5	952	62.13	950
May-13	52.59	528	50.69	521
Jun-13	57.39	495	54	499
Jul-13	48.15	501	64.32	505
Aug-13	50.36	482	57.62	482
Sep-13	49.68	468	44.31	466
Oct-13	49.14	430	47.01	432
Nov-13	56.93	417	46.1	419
Dec-13	72.2	533	49.79	530
Jan-14	52.14	527	48.48	525
Feb-14	49.55	554	50.27	555
Mar-14	84.23	630	63.23	656
Total	**680.86**	**6,517**	**637.95**	**6,540**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.9	0.7	1.7	0.7

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

TABLE 1 PUMP INVENTORY	
Manufacturer and Local Representative	PACO Pumps 3215 S. 116th Seattle, WA 98168 Phone: (206) 433-2600 FAX: (206) 433-0263
Description	4" Model 945-11 Vertical Non-Clog Centrifugal Pump (9.24-in. diameter impeller) 240 V, 3 HP, 3 phase 900 RPM, US Electric Motor
Design Point:	350 GPM at 15.5 feet TDH
Serial No's.:	Pump 1 (northeast): TK95A0056801A Pump 2 (southwest): TK95A0056801B
Performance Curve:	



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14.4.1.1 Pump 1 – City of Bellevue Asset No. 193863

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-77
Serial No.	TK95A0056801A
Horsepower	3
Voltage/phase	460/230/3 phase
Date of installation	1996
Design Conditions	350 gpm @ 15.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley chain hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump has experienced significant wear but the reliability is still acceptable.

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	3.4
Calculated pumping capacity	245 – 250 gpm
Total Dynamic head (feet)	10.5
Number of tests performed	2

General observations/notes from drawdown test:

- Pumping capacity appears to be significantly lower than the design flow, low flow and head may be a strong indication of wear

Duplex configuration, Pump 1 in foreground

Pump 1 showing signs of aging on exterior

Rag removal from Pump 1 was performed during evaluation visit

14.4.1.2 Pump 2 – City of Bellevue Asset No. 193874

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-77
Serial No.	TK95A0056801A
Horsepower	3
Voltage/phase	460/230/3 phase
Date of installation	1996
Design Conditions	350 gpm @ 15.5 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley chain hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump has experienced significant wear but the reliability is still acceptable.

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	3.4
Calculated pumping capacity	305 – 310 gpm
Total Dynamic head (feet)	8
Number of tests performed	2

General observations/notes from drawdown test:

- Pumping capacity appears to be significantly lower than the design flow, low flow and head may be a strong indication of wear

Duplex configuration, Pump 2 in background

Pump 2 showing signs of aging on exterior

14.4.2. Exposed Piping and Valves

14.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, horizontal axis of rotation

14.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve and ball check valve, vertical installation

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

Plug valve isolation for suction piping

Ball check valve vertical installation and plug valve on discharge piping

Ball check valve vertical installation on discharge piping

14.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

14.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in two locations of dry pit
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	Below grade box

General observations/notes from field visit:

- Backflow assembly below grade in meter box, no drain to daylight – does not meet code for installation

Backflow prevention assembly in below grade box

14.4.5 Ventilation

14.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	400 CFM @ 0.47” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

14.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	5’ AFF of dry pit
Fan type	Axial
Airflow rate	1300 CFM @ 0.72” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – Easily accessible

General observations/notes from field visit:

- Some rusting on pipe

Wet well supply fan located in wet well blower vault

Supply fan located 5 feet AFF in dry pit

14.5 Electrical

14.5.1 Electrical Service

14.5.1.1 Electrical Service Description

Voltage	230
Phases	3
Utility transformer	Unknown
Service meter location	Outside of service equipment cabinet

5.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway; housed in power cabinet

14.5.2 Backup Power

14.5.2.1 Backup Power Description

Type	Generator receptacle
Location	On wood post
Transfer switch type	Manual
Transfer switch location	Service entrance equipment cabinet

14.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is accessible from driveway; located in power cabinet

Utility service meter on outside of service equipment cabinet

Interior of service equipment cabinet

Generator receptacle on wood post

14.5.3 Site – Panelboard

14.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120/1 phase
Manufacturer	Square D
Model	D20B1

14.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

14.5.4 Site - Starters

14.5.4.1 Starters Description

Starters	(2) FVNR Starters

14.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Starters and circuit breakers are Westinghouse and appear to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Panelboard located in dry pit, appears to be in good condition

Starters located in dry pit, appears to be in good condition

Westinghouse circuit breakers appear to be in good condition

14.5.5 Site – Telemetry Control Panel

14.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376848
Location	Dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Hydroranger 100
Secondary Level Indication	High level float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In service equipment cabinet

14.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel located in dry pit, appears to be in good condition

Telephone network interface located in service equipment cabinet

14.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 14-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Electrical clearance between power and control panel and pump does not meet code	Potential safety issue	• Provide adequate clearance
Intrinsically safe relay wiring does not have required clearance of barriers	Intrinsically safe relay clearance does not meet code requirements	• Provide barrier
Paco pumps are obsolete and condition is deteriorating	Paco pumps will not be serviceable in near future	• Replace pumps and motors
Backflow assembly enclosure requires drain to daylight	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure
Wet well interior coating failing	May decrease integrity of wet well structure	• Re-coat interior of wet well
Standby power phase monitor is aging	Loss of power at site	• Replace standby power phase monitor
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

14.6.1 Project Recommendations

The deficiencies identified at this station were separated in two separate projects. The first project includes the various code issues identified at this site as well as the replacement of the pumps and motors. The timing of this recommended project is driven by the replacement of the Paco pumps which is critical to the operation of the station.

The second project includes recoating the wet well and replacing the standby power phase monitor and primary and backup level indicators. All of these components are estimated to reach its end of useful life within the 2023 to 2027 time frame so this project should be completed during this time.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 14-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
K-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$181,000
	Electrical clearance between power and control panel and pump does not meet code	Provide adequate clearance		
	Intrinsically safe relay wiring does not have required clearance of barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
K-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$213,000
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

14.6.2 Project Justification

The timing of the first recommended project is driven by the replacement of the Paco pumps due to its serviceability rating. The Paco pumps are no longer manufactured, making the pumps obsolete. Also, based on the drawdown tests, their capacity appears to have deteriorated. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

The second project is necessary to insure the structural integrity of the wet well is not compromised.

14.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 14-4 have been implemented in the timeline identified.

14.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 14-5 and 14-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 14-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 14-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 14-6 includes project estimated remaining useful life when the recommended projects provided in Table 14-4 are complete. Upon completion of the recommended projects the remaining useful life of the pump station and rotating assembly will increase significantly. The estimated remaining useful life of the electrical system and telemetry system will remain the same since the recommended projects only includes the rehabilitation and replacement of a few electrical and telemetry components.

Table 14-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

14.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 14-1 graphically represents the rehabilitation and replacement cost projections for the Killarney Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 14-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 14-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 14-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 14-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

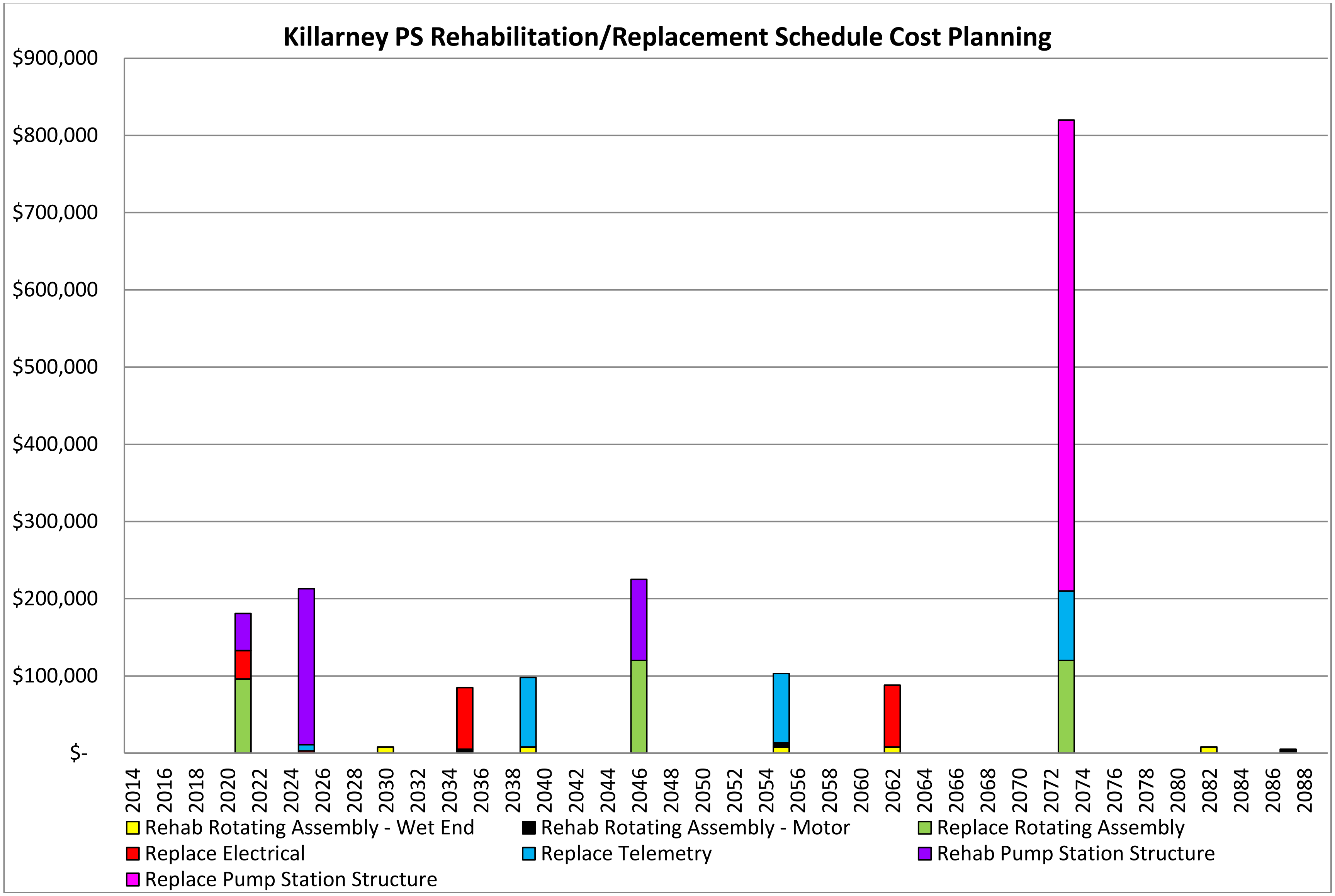
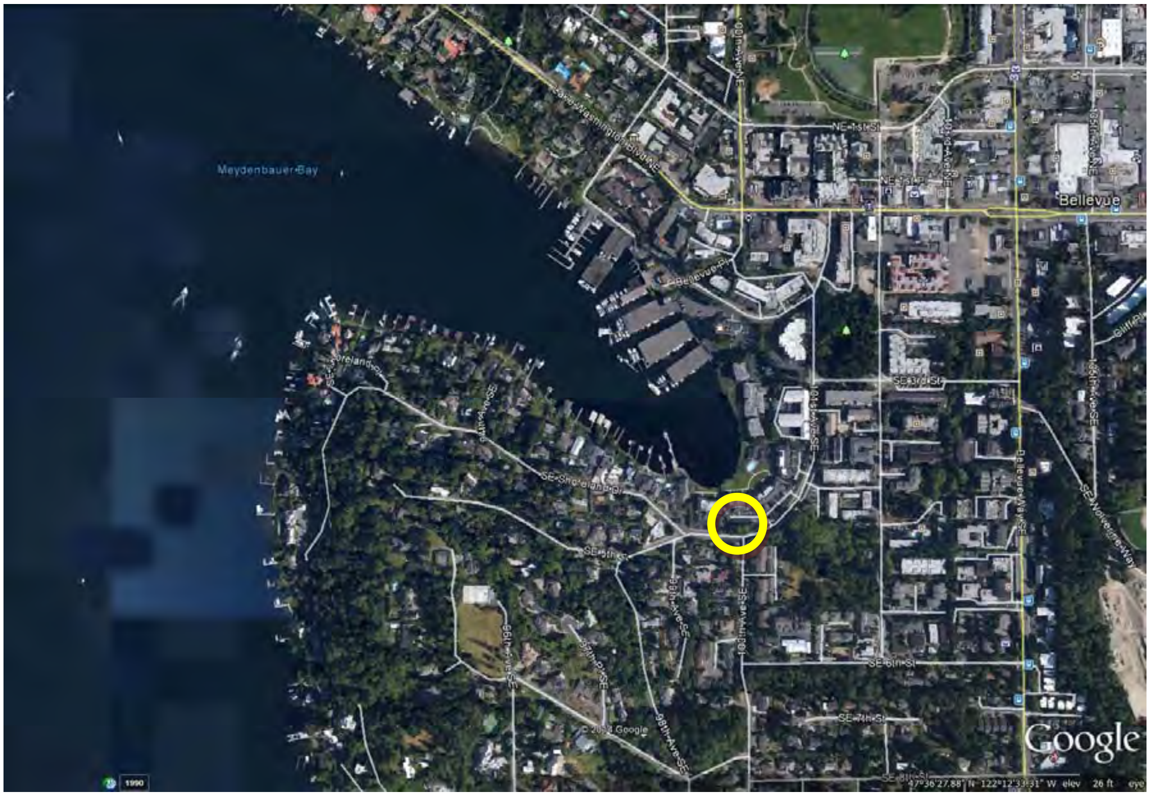


Figure 14-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 15
MEYDENBAUER



15.1 Meydenbauer Pump Station General Description

Date of Visit	May 21st, 2014
City of Bellevue Asset No.	187604
Address	9931 Shoreland Dr SE
Station configuration	Wet well/Dry pit
Original Construction	1961
Major Rehabilitation/Upgrade	1995
Number of Pumps	2
Pump Horsepower	10
Station Voltage/Phase	240/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	270 – 330 gpm

15.1.1 Summary of Findings

Meydenbauer pump station is located adjacent to a two-way street on 100th Ave SE in the sidewalk area. All of the vaults at this station are raised approximately 12” to 18” above the ground. This station receives flow from Flush 6 and discharges flow through a dedicated force main. Significant deficiencies at this station includes inadequate clearance of the intrinsically safe relay wiring and lower corrosion on the outdoor service cabinet.

Table 15-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 15-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
M-1	Gap between staircase and wall – safety issue	Add grating between wall and staircase	As soon as possible	N/A - maintenance
M-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$343,000
	Intrinsically safe relay wiring does not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Corrosion of service cabinet at base and City owned meter base	Repair		
	Wet well interior coating failing	Recoat interior of wet well		
	Utility power phase monitor and standby power phase monitor aging	Replace utility power phase monitor and standby power phase monitor		
	Primary and backup level indicators aging	Replace primary and backup level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

15.2 Site

15.2.1 Site Description

Vehicle access to site	Two-way street, parking adjacent to site
Landscaping	Paved space – prune bushes near site
Site lighting	None
Fencing/security	None
Public accessibility to site	Public access, adjacent to sidewalk along 100th Ave SE

General observations/notes from field visit:

- Curb ends adjacent to sidewalk – potential tripping hazard for public

Curb ends adjacent to sidewalk – potential tripping hazard for public

All vaults raised 12” – 18” above grade

Parking adjacent to station

15.3 Station Facilities

15.3.1 Wet Well – Structure and Accessories

15.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”x13’-6” deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	(2) 8”, above operating level
Lighting	Yes, dim lighting
Ventilation	Supply Fan
Ventilation continuous	Yes

*Based on Record Drawings, unable to confirm in field.

15.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified interior coating is failing.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

Interior of wet well

15.3.2 Dry Pit – Structure and Accessories

15.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and spiral staircase
Access fall protection	Yes, chain on one side
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x10’x13’-6” deep*
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

15.3.2.2 Dry Pit Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Gap between spiral staircase and wall, no rail on staircase by gap, potential fall/safety issue
- Grating on sump drain
- No equipment access hatch

Gap between spiral staircase and wall, no rail on staircase by gap

Grating on sump drain

Ceiling of dry pit, rail with no equipment access hatch

15.3.3 Wet Well Blower Vault – Structure and Accessories

15.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x5’x4’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

15.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Raised 18” off ground, step up 18” then step down onto ladder

Wet well blower vault hatch, chain fall protection on one side

Interior of wet well blower vault

5.4 Mechanical

5.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at the Meydenbauer Pump Station indicates that the facility is pumping at the intended design flow of 300 gpm with a slightly lower head (54 ft vs. 57 ft). Given the field test it appears the pumps are operating properly.

The following table documents the pump run hours and starts by month over the past year.

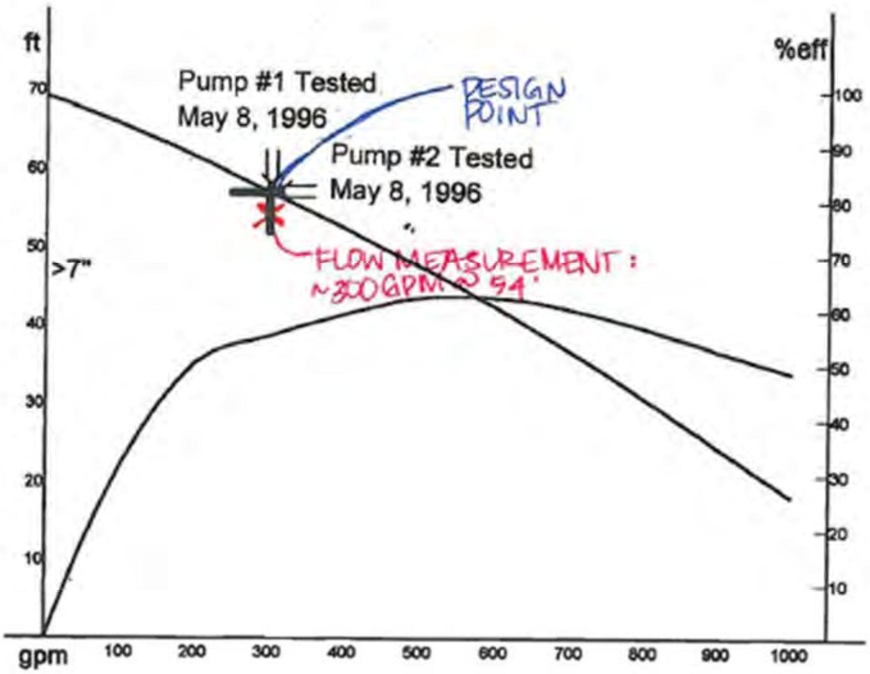
Table 15-1
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	58.5	952	62.13	950
May-13	56.52	961	60.29	960
Jun-13	55.85	930	56.99	930
Jul-13	59.83	963	56.9	964
Aug-13	60.38	944	62.25	947
Sep-13	60.24	918	63.16	917
Oct-13	53.54	904	63.81	907
Nov-13	55.45	872	61.65	876
Dec-13	58.58	926	67.64	928
Jan-14	55.66	898	62.36	900
Feb-14	53.03	845	60.7	842
Mar-14	61.23	998	69.83	1,000
Total	**688.81**	**11,111**	**747.71**	**11,121**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.9	1.3	2.0	1.3

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

TABLE 1 PUMP INVENTORY	
Manufacturer and Local Representative	PACO Pumps 3215 S. 116th Seattle, WA 98168 Phone: (206) 433-2600 FAX: (206) 433-0263
Description	4" Model 945-11 Vertical Non-Clog Centrifugal Pump (8.07-in. diameter impeller) 240 V, 10 HP, 3 phase 1750 RPM, US Electric Motor
Design Point:	300 GPM at 57 feet TDH
Serial No's.:	Pump 1 (north): TK950056901A Pump 2 (south): TK950056901B

Performance Curve:



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15.4.1.1 Pump 1 – City of Bellevue Asset No. 193842

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-ZZ
Serial No.	TK95A0056901
Horsepower	10
Voltage/phase	460/230/3 phase
Date of installation	1995
Design Conditions	300 gpm @ 57 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	52
Calculated pumping capacity	270 – 285 gpm
Total Dynamic head (feet)	54.5
Number of tests performed	2

General observations/notes from drawdown test:

- The pump appears to be operating very close to the intended design pumping capacity

Pump 1 showing signs of aging on exterior

15.4.1.2 Pump 2 – City of Bellevue Asset No. 193843

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-ZZ
Serial No.	TK95A0056903
Horsepower	10
Voltage/phase	460/230/3 phase
Date of installation	1995
Design Conditions	300 gpm @ 57 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, trolley hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	52
Calculated pumping capacity	270 – 335 gpm
Total Dynamic head (feet)	53.5
Number of tests performed	2

General observations/notes from drawdown test:

- The pump appears to be operating very close to the intended design pumping capacity

Pump 2 showing signs of aging on exterior

15.4.2. Exposed Piping and Valves

15.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, horizontal axis of rotation

15.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Ball check valve and plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Ball check valve, vertical installation

Plug valve isolation for suction piping, horizontal installation - ideal

Ball check valve vertical installation on discharge piping

Plug valve vertical installation on discharge piping

15.4.3 Other Station Piping

Bypass piping	No
Pig launching	Yes, blind flange on wye – must go through plug valve
Air release valves	No
Force main isolation	8” plug valve inside dry pit

15.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in two locations in dry pit
Backflow prevention assembly	Zurn reduced pressure backflow device
Enclosure/Freeze protection	Two stacked water boxes/Heat tape

General observations/notes from field visit:

- 12” above grade

8” plug valve for force main isolation
inside dry pit

Backflow prevention assembly in two
stacked water boxes, 12” above grade

Backflow prevention assembly in
water boxes

15.4.5 Ventilation

15.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	400 CFM @ 0.47” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

15.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	5’ AFF in dry pit
Fan type	Axial
Airflow rate	1300 CFM @ 0.4” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

Wet well supply fan located in wet well blower vault

Supply fan located 5 feet AFF in dry pit

15.5 Electrical

15.5.1 Electrical Service

15.5.1.1 Electrical Service Description

Voltage	240
Phases	
Utility transformer	Unknown
Service meter location	Outside service cabinet

15.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Circuit breaker appears to be in good condition, repair corroding service cabinet and meter base

Criticality Rating 3 – Station cannot operate without electrical service

Serviceability Rating 1 – Standard parts; accessible from street located in power cabinet

General observations/notes from field visit:

- Service cabinet paint is chipping near bottom, conduit corroding near grade

15.5.2 Backup Power

15.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Outside of service cabinet
Transfer switch type	Manual
Transfer switch location	Service cabinet

15.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is accessible from street in power cabinet

Service cabinet paint is chipping near bottom, conduit corroding near grade

Generator receptacle located on outside service cabinet

Transfer switch located in service cabinet

15.5.3 Site – Panelboard

15.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120/1 phase
Manufacturer	Square D 100A
Model	D20B1 EZ

15.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Square D panelboard appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Good quality equipment; easily accessible in dry pit

15.5.4 Site - Starters

15.5.4.1 Starters Description

Starters	(2) FVNR Starters

15.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Cutler Hammer starters and Westinghouse circuit breakers appear to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard equipment; equipment is in dry pit

Panelboard located in dry pit

Starters located in dry pit, appears to be in good condition

15.5.5 Site – Telemetry Control Panel

15.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376821
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In service cabinet

15.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel with operator interface located in dry pit, appears to be in good condition

Telephone network interface located in service cabinet

15.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 15-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Gap between staircase and wall	Potential fall and safety issue	• Add grating between wall and staircase
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Intrinsically safe relay wiring does not have required clearance or barriers	Does not meet code requirements	• Provide barrier
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps, motors and motor drivers
Corrosion of service cabinet at base and City owned meter base	Loss of power at site	• Repair
Wet well interior coating failing	May decrease integrity of wet well structure	• Re-coat interior of wet well
Utility power phase monitor and standby power phase monitor aging	Loss of power at site	• Replace utility power phase monitor and standby power phase monitor
Primary and backup level indicators aging	Loss of control at site	• Replace primary and backup level indicators

15.6.1 Project Recommendations

Due to the simplicity of project M-1, it is recommended to be done when the operations and maintenance make their next routine visit to this station. The second project includes the remaining deficiencies identified at this station including the replacement of the Paco pumps. The timing of the recommended project is driven by the replacement of the Paco pumps which is critical to the operation of the station.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 15-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
M-1	Gap between staircase and wall – safety issue	Add grating between wall and staircase	As soon as possible	N/A - maintenance
M-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$343,000
	Intrinsically safe relay wiring does not have required clearance or barriers	Provide barrier		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Corrosion of service cabinet at base and City owned meter base	Repair		
	Wet well interior coating failing	Recoat interior of wet well		
	Utility power phase monitor and standby power phase monitor aging	Replace utility power phase monitor and standby power phase monitor		
	Primary and backup level indicators aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

15.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the Paco pumps due to its serviceability rating The consequence of failure of either of these components will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pumps are no longer manufactured, making the pumps obsolete. Also, based on the drawdown tests, their capacity appears to have deteriorated. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

15.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 15-4 have been implemented in the timeline identified.

15.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 15-5 and 15-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 15-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 15-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	2	1	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 15-6 includes project estimated remaining useful life when the recommended projects provided in Table 15-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups will increase significantly. The telemetry system asset group will have the same estimated remaining life following completion of the recommended projects since significant telemetry equipment including the telemetry control panel will not be rehabilitated or replaced.

Table 15-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

15.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 15-1 graphically represents the rehabilitation and replacement cost projections for the Meydenbauer Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 15-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 15-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 15-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 15-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

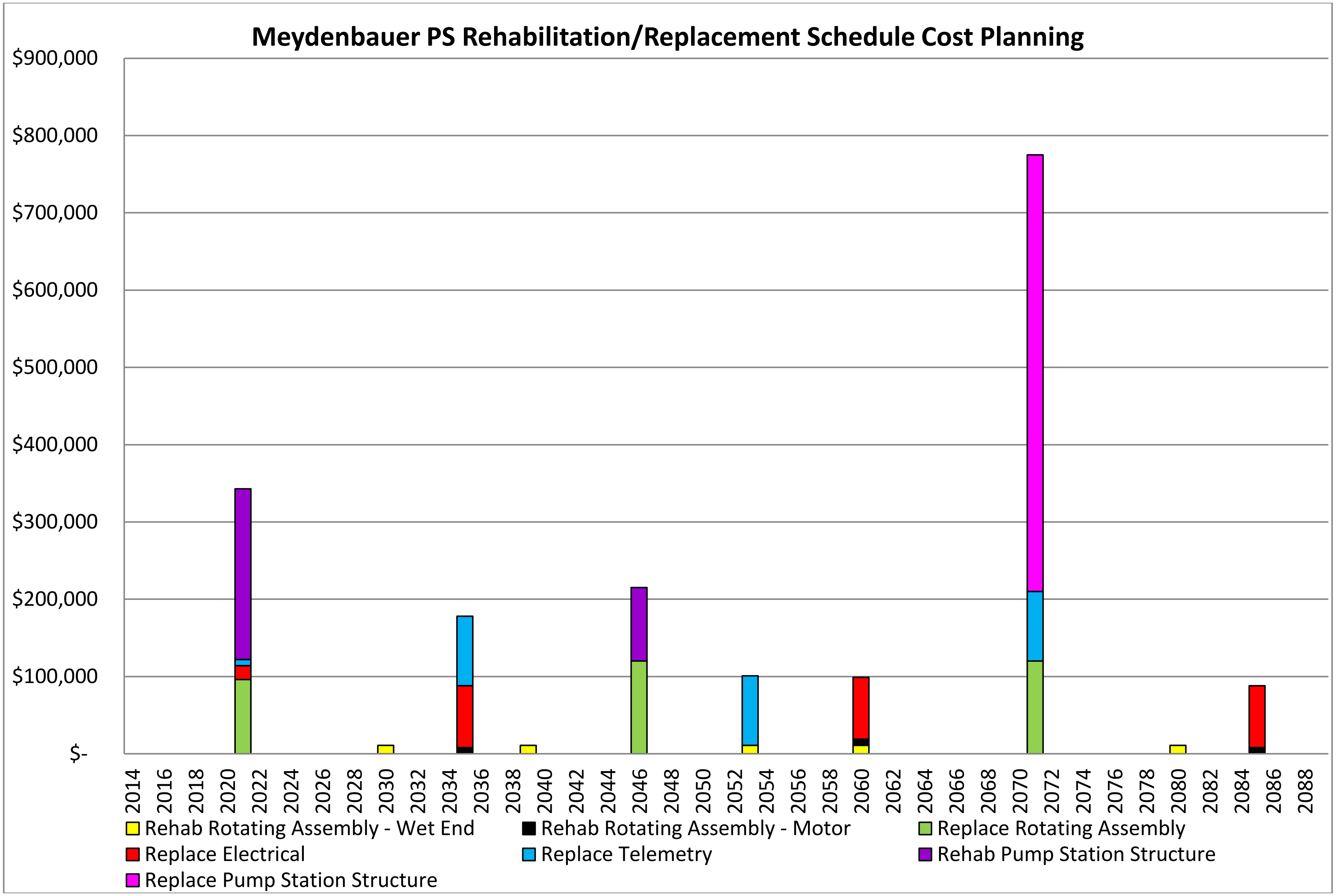
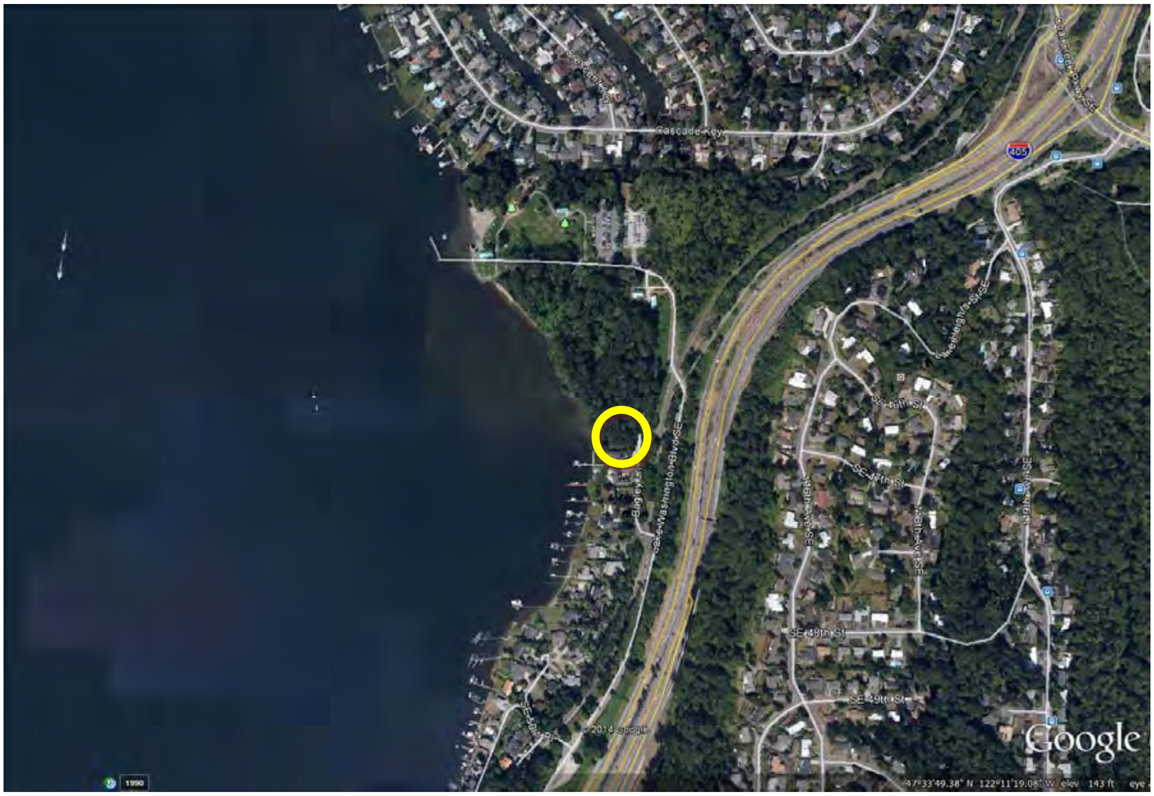


Figure 15-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 16
BAGLEY



16.1 Bagley Pump Station General Description

Date of Visit	May 21st, 2014
City of Bellevue Asset No.	187626
Address	4400 Lake Washington Blvd SE
Station configuration	Wet well/Dry pit
Original Construction	1968
Major Rehabilitation/Upgrade	1996
Number of Pumps	2
Pump Horsepower	5
Station Voltage/Phase	240/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	175 – 185 gpm

16.1.1 Summary of Findings

Bagley pump station is located in a large grassy area and is adjacent to the lake and Newcastle Beach Park. This station receives flow from Flush 8 and Pleasure Point pump station and discharges flow through a dedicated force main. This station has reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the stations level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. With a dedicated force main it is possible to increase the capacity at this station but the downstream capacity should be considered as well.

Table 16-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 16-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
B-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$154,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Intrinsically safe relay wiring does not have required clearance or barrier	Provide barrier		
	Corrosion on back of service cabinet	Repair		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
B-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$210,000
	Primary and backup level indicators aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

16.2 Site

16.2.1 Site Description

Vehicle access to site	Gravel driveway from paved park entrance, parking 100’ away from station
Landscaping	A lot of grass, City mows area and takes care of driveway
Site lighting	None
Fencing/security	None
Public accessibility to site	Minimal public access

General observations/notes from field visit:

- Somewhat steep, narrow ramp down from parking to station

Parking adjacent to station on gravel driveway

Narrow paved path to station

A lot of grass surrounding station, City mows area

16.3 Station Facilities

16.3.1 Wet Well – Structure and Accessories

16.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12’x8’-6”x13’-6” deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8”, above operating level
Lighting	None
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

16.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified some delamination of interior coating.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Manhole lid and top portion of wet well

Interior of wet well

16.3.2 Dry Pit – Structure and Accessories

16.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Access hatch and spiral staircase
Access fall protection	Yes, chain on one side of hatch
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x10’x13’-6” deep*
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

16.3.2.2 Dry Pit Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

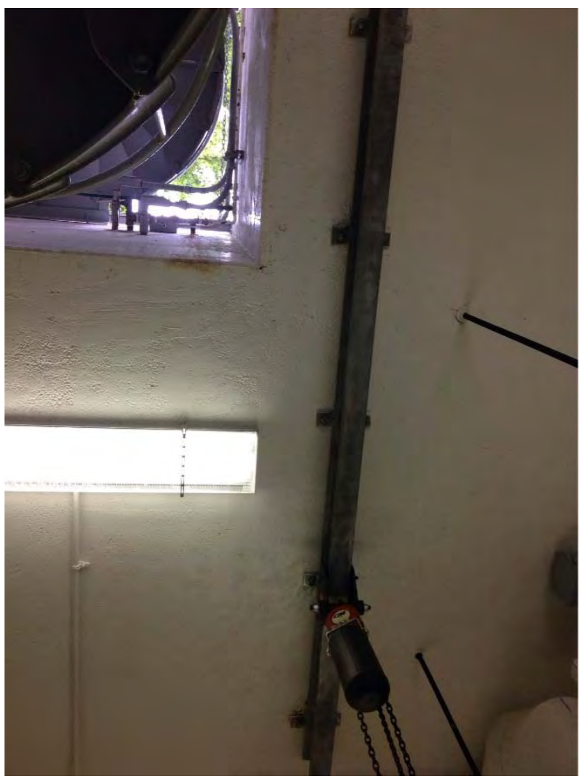
Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- No equipment access hatch
- Spiral stair case hand rail starts from beginning of treads down

Lift assist hatch and chain fall protection on one side

Spiral staircase rail begins at top of staircase



Ceiling of dry pit, no equipment access hatch

16.3.3 Wet Well Blower Vault – Structure and Accessories

16.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	Yes, chain on one side of hatch
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x4’x4’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

16.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

Wet well blower vault hatch, chain fall protection on one side

16.3.4 Odor Control Fan Vault – Structure and Accessories

16.3.4.1 Odor Control Fan Vault General Description

Area	Current Classification	Rationale
Odor Control Fan Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5’x5’-6”x5’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

16.3.4.2 Odor Control Fan Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

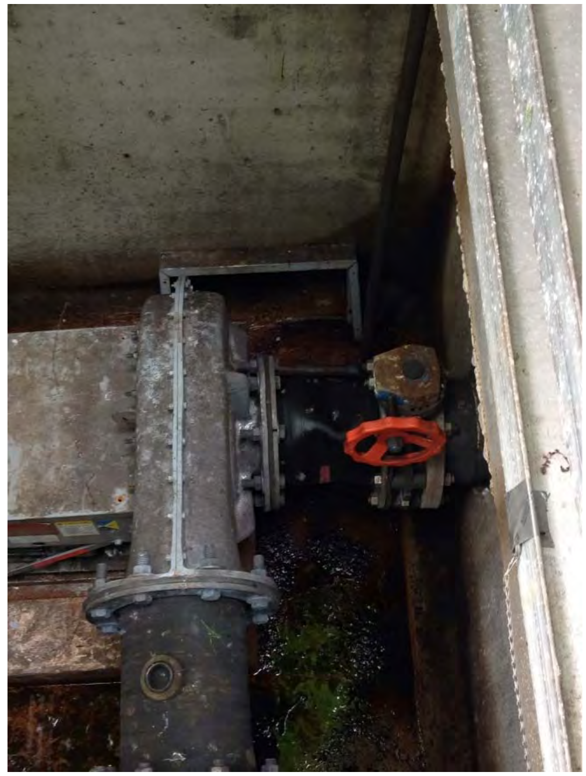
Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Flexible piping “sucked in”, rigid and stuck in that position even when wet well lid opened
- Some rusting and water in vault

Interior of odor control fan vault, some rusting and water in vault



Piping imploded near red hand-wheel, stuck in rigid position even when wet well lid opened

16.4 Mechanical

16.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at the Bagley Pump Station indicates that the facility is pumping at just over one half of the intended design pumping capacity (~180 gpm vs. 300 gpm). Given that this point generally falls along the designated impeller curve, it is likely that the current head condition is greater than the anticipated design and/or original installation. Additionally, the location of the measured operating point, and even the design operating point, is far to the left of the curve. Operating at this end of the curve has the potential to experience a number of hydraulic problems, largely surrounding low velocities through the pump that may contribute to ragging and recirculation. Given the degradation in capacity, the City should confirm that the pumping capacity is not nearing the peak design flow.

The following table documents the pump run hours and starts by month over the past year.

Table 16-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	44.91	1,257	44.38	1,254
May-13	46.53	1,347	46.35	1,346
Jun-13	43.82	1,330	42.25	1,330
Jul-13	42.59	1,331	41.41	1,331
Aug-13	39.56	1,242	38.81	1,250
Sep-13	35.19	1,074	34.93	1,085
Oct-13	37.56	1,138	37.44	1,139
Nov-13	37.93	1,115	39.5	1,112
Dec-13	39.91	1,172	39.86	1,172
Jan-14	41.05	1,099	39.62	1,100
Feb-14	39.66	1,048	37.64	1,052
Mar-14	45.86	1,260	43.94	1,264
Total	**494.57**	**14,413**	**486.13**	**14,435**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.4	1.6	1.3	1.6

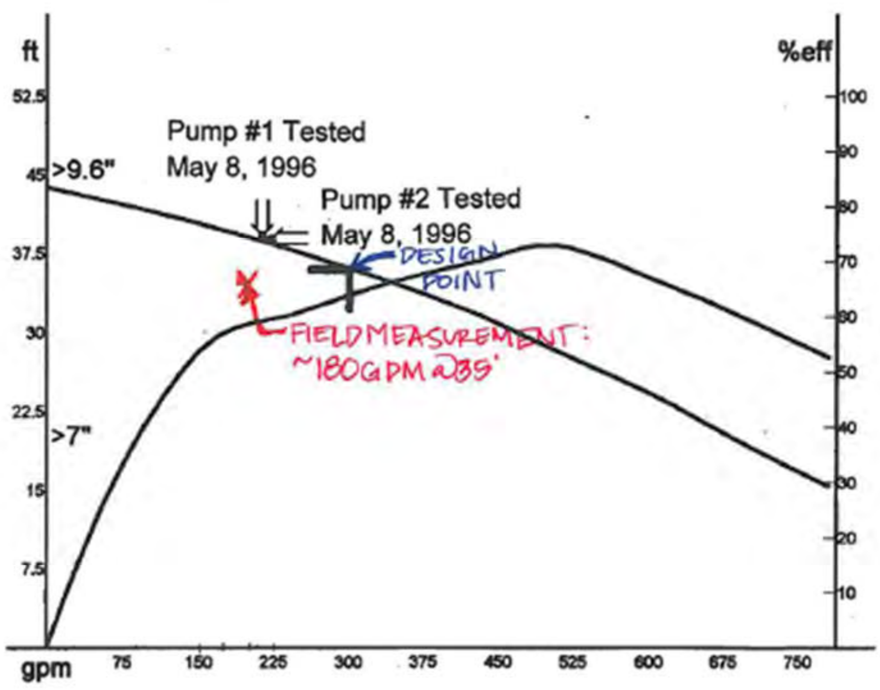
The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

TABLE 1

PUMP INVENTORY

Manufacturer and Local Representative	PACO Pumps 3215 S. 116th Seattle, WA 98168 Phone: (206) 433-2600 FAX: (206) 433-0263
Description	4" Model 945-11 Vertical Non-Clog Centrifugal Pump (9.45-inch diameter impeller) 240 V, 5 HP, 3 phase 1150 RPM, US Electric Motor
Design Point:	300 GPM at 36 feet TDH
Serial No's.:	Pump 1 (west): TK95A0056701B Pump 2 (east): TK95A0056701A

Performance Curve:



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16.4.1.1 Pump 1 – City of Bellevue Asset No. 193868

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-ZZ
Serial No.	TK95A0056701B
Horsepower	5
Voltage/phase	460/230/3 phase
Date of installation	1996
Design Conditions	300 gpm @ 36 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Quiet pump under operation
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	25
Calculated pumping capacity	175 – 180 gpm
Total Dynamic head (feet)	35
Number of tests performed	2

General observations/notes from drawdown test:

- Pump is operating at about two-thirds of intended design pumping capacity

Duplex configuration, pump #1 in foreground

Pump #1 showing signs of aging on exterior

16.4.1.2 Pump 2 – City of Bellevue Asset No. 193869

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-49511-X46D0Y-ZZ
Serial No.	TK95A0056701A
Horsepower	5
Voltage/phase	460/230/3 phase
Date of installation	1996
Design Conditions	300 gpm @ 36 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer’s representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Quiet pump under operation
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	25
Calculated pumping capacity	185 gpm
Total Dynamic head (feet)	35
Number of tests performed	2

General observations/notes from drawdown test:

- Pump is operating at about two-thirds of intended design pumping capacity

Duplex configuration, pump #1 on the right

Pump #2 showing signs of aging on exterior

16.4.2. Exposed Piping and Valves

16.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, vertical axis of orientation – not ideal

16.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve and ball check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats up – ideal
- Ball check valve vertical installation

Plug valve isolation for suction piping, vertical axis of orientation – not ideal

Ball check valve, vertical orientation

Ball check valve and plug valve on discharge piping

16.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

16.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in two locations in dry pit
Backflow prevention assembly	Zurn reduced pressure backflow device
Enclosure/Freeze protection	Underground meter box/Heat tape

General observations/notes from field visit:

- Backflow assembly in below grade meter box, no drain to daylight – does not meet code for installation

Backflow prevention assembly in below grade box

16.4.5 Ventilation

16.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	400 CFM @ 0.48” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical, failure would not significantly affect station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

16.4.5.2 Wet Well Ventilation (Exhaust Fan)

Location	Odor control fan vault
Fan type	Centrifugal?
Airflow rate	400 CFM @ 12” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical, failure would not significantly affect station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

16.4.5.3 Dry Pit Ventilation (Supply Fan)

Location	5’ AFF in dry pit
Fan type	Axial
Airflow rate	1300 CFM @ 0.52” SP

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical, failure would not significantly affect station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

Wet well supply fan located in wet well blower vault

Wet well exhaust fan located in odor control fan vault

Supply fan located 5 feet AFF in dry pit

16.5 Electrical

16.5.1 Electrical Service

16.5.1.1 Electrical Service Description

Voltage	240
Phases	3
Utility transformer	Pad mounted
Service meter location	On side of service cabinet

16.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; equipment is in driveway and easily accessed

16.5.2 Backup Power

16.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	On side of service cabinet
Transfer switch type	Manual
Transfer switch location	In service cabinet

16.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is in driveway and easily accessed

General observations/notes from field visit:

- Some paint chipping/rusting near bottom of service cabinet

Generator receptacle and service meter located on service cabinet


Interior of service cabinet including manual transfer switch


Some paint chipping/rusting near bottom of service cabinet

16.5.3 Site – Panelboard

16.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	120/240/1 phase
Manufacturer	Square D
Model	D20B1

16.5.3.2 Panelboard Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition but with some surface rust

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

16.5.4 Site - Starters

16.5.4.1 Starters Description

Starters	(2) FVNR Starters

16.5.4.2 Starters Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Panelboard located in dry pit, appears to be in good condition with some surface rust

Starters located in dry pit, appears to be in good condition

16.5.5 Site – Telemetry Control Panel

16.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376887
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In service cabinet

16.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel with operator interface located in dry pit, appears to be in good condition

Telephone network interface in service cabinet

16.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 16-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reason for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Intrinsically safe relay wiring does not have required clearance or barrier	Does not meet code requirement	• Provide barrier
Corrosion on back of service cabinet	Loss of power at site	• Repair service cabinet
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps and motors
Backflow assembly enclosure requires drain to daylight	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure
Wet well interior coating failing	May decrease integrity of wet well structure	• Re-coat interior of wet well
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

16.6.1 Project Recommendations

The deficiencies identified were separated into two separate projects. The timing of the first recommended project should be complete between 2015 and 2018 since the station has reported loss of pump redundancy. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. With a dedicated force main it is possible to increase the capacity at this station but the downstream capacity should be considered as well.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 16-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
B-1	Reported loss of pump redundancy	Investigate reason for loss of pump redundancy	2015-2018	$154,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Intrinsically safe relay wiring does not have required clearance or barrier	Provide barrier		
	Corrosion on back of service cabinet	Repair service cabinet		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps and motors		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
B-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$210,000
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

16.6.2 Project Justification

The timing of the recommended projects is driven by the reported loss of redundancy at this station which does not meet regulatory requirements and the station does not meet the minimum level of service.

In addition to the loss of redundancy, the Paco pumps at this station are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump which is challenging since this station on occasion relies on both pumps to keep up with flows.

Continued deterioration of the wet well coating may decrease the structural integrity of the wet well. If proper coating of the wet well is not done within the recommended time frame (2023-2027), the remaining useful life of the wet well structure could decrease significantly causing the replacement of the station to occur at an accelerated time frame.

16.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 16-4 have been implemented in the timeline identified.

16.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 16-5 and 16-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 16-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 16-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	3	1	0	-	3	10-15
Electrical System	1	1	0	-	1	30-35
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 16-6 includes project estimated remaining useful life when the recommended projects provided in Table 16-4 are complete. Upon completion of the recommended projects the remaining useful life for most asset groups will increase significantly with the exception of the telemetry system. The estimated remaining useful life will remain the same since the recommended projects do not include the replacement of significant telemetry equipment including the telemetry control panel. Thus the condition and estimated remaining life for this asset group will remain unchanged.

Table 16-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

16.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 16-1 graphically represents the rehabilitation and replacement cost projections for the Bagley Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 16-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 16-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 16-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 16-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

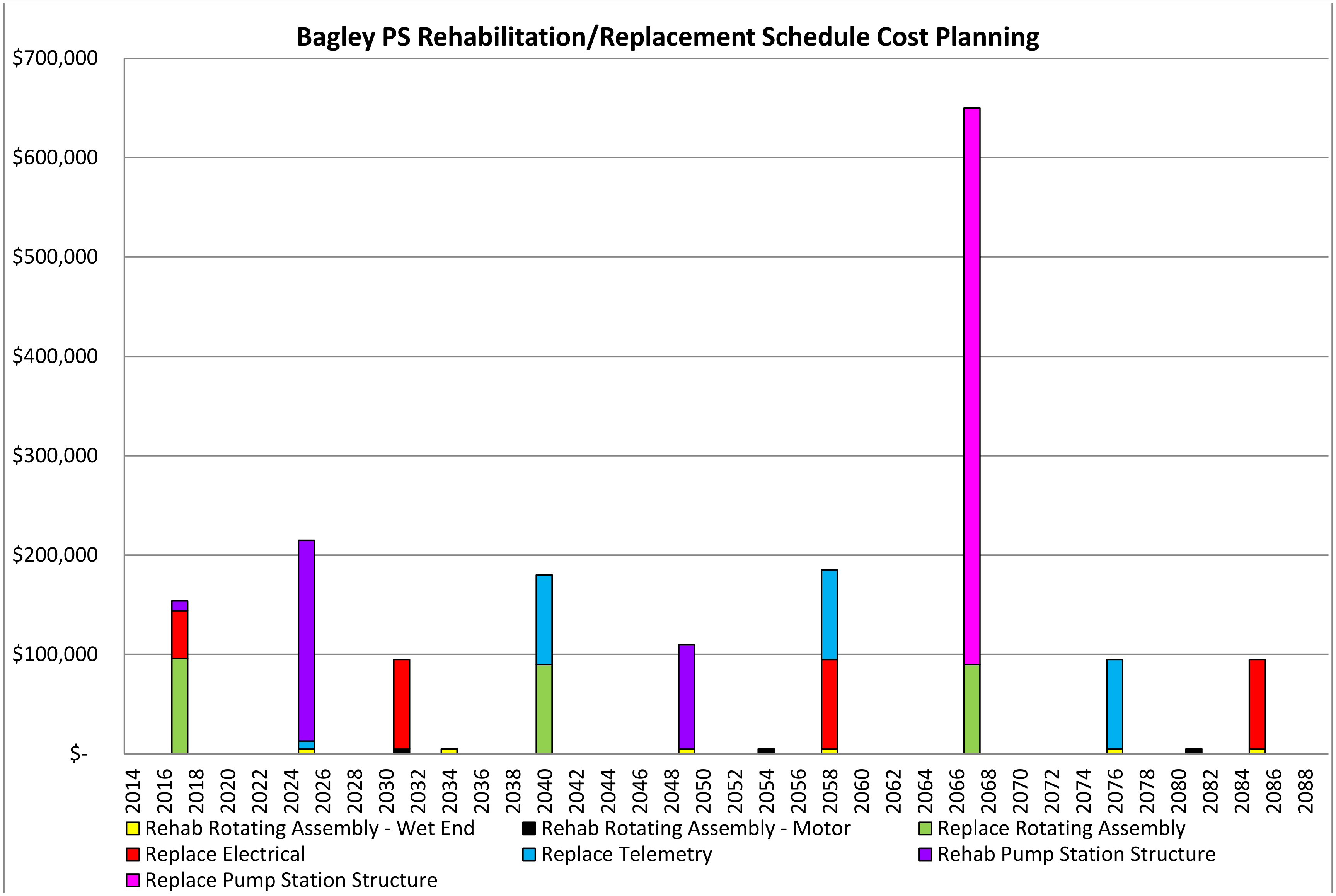
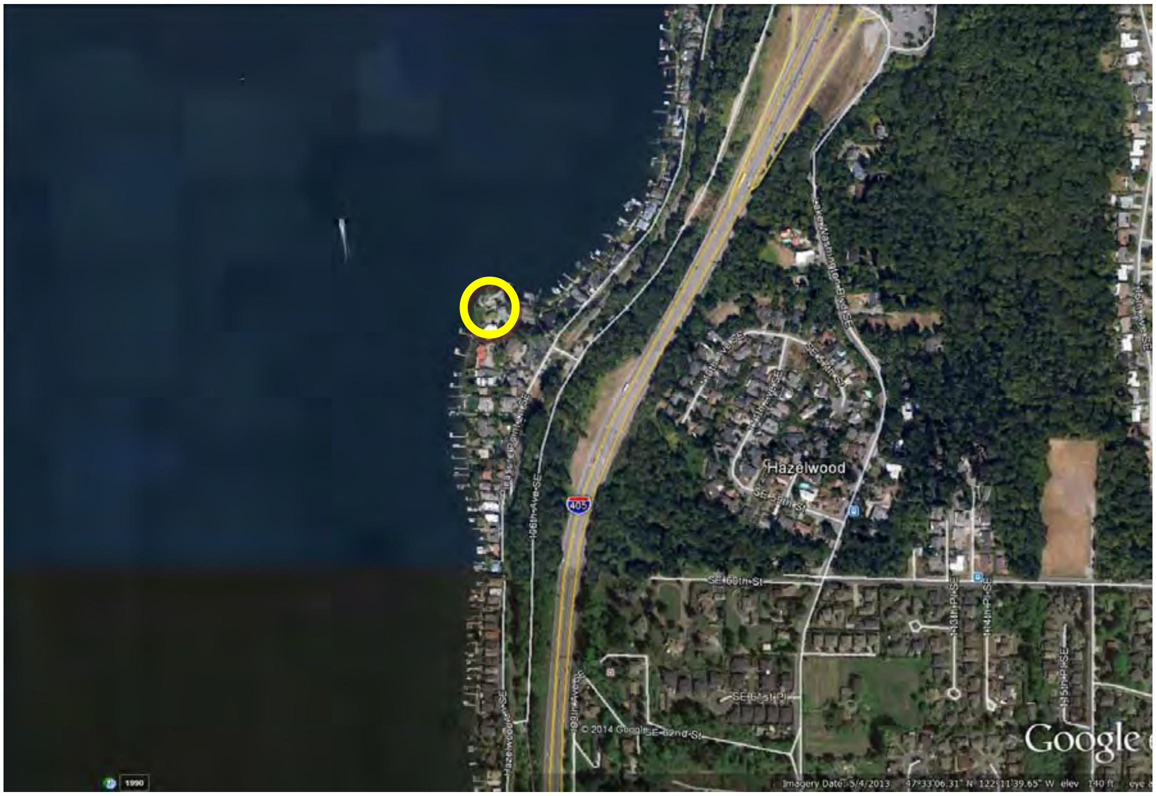


Figure 16-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 17
PLEASURE POINT



17.1 Pleasure Point Pump Station General Description

Date of Visit	May 28th, 2014
City of Bellevue Asset No.	187625
Address	5600 Pleasure Point Rd SE
Station configuration	Wet well/Dry pit
Original Construction	1965
Major Rehabilitation/Upgrade	1998
Number of Pumps	2
Pump Horsepower	1
Station Voltage/Phase	240/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	240 – 250 gpm

17.1.1 Summary of Findings

Pleasure Point pump station is located between two private residences surrounded by bushes and foliage maintained by others. The pump station receives flow from Flush 8 and discharges to the lake line. The station has reported loss of pump redundancy meaning on occasion both pumps operate simultaneously to keep up with incoming flows. The loss of pump redundancy reduces the stations level of service below industry standards and regulatory requirements. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

Table 17-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 17-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
PP-1	Reported loss of pump redundancy	Investigate reasoning for loss of pump redundancy	2015-2018	$150,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Service cabinet is corroded	Repair service cabinet		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
PP-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$210,000
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and back up level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

17.2 Site

17.2.1 Site Description

Vehicle access to site	Paved one lane path, dead end, parking adjacent to station
Landscaping	None, taken care of by others
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access to site, adjacent to resident garages

Parking adjacent to station at dead end

A lot of shrubs surrounding station, maintained by others

17.3 Station Facilities

17.3.1 Wet Well – Structure and Accessories

17.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	12'x8'-6"x13'-6" deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8", above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

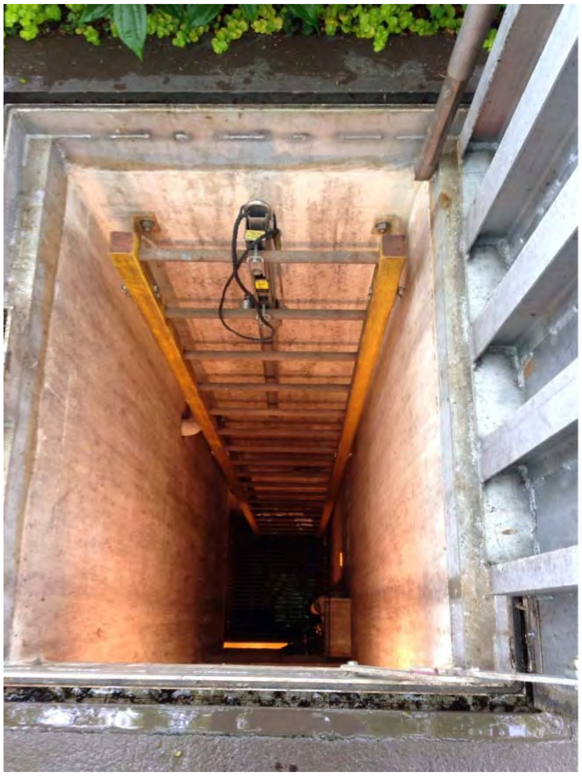
17.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified interior coating showing signs of degradation.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping



Interior of wet well, showing signs of degradation

17.3.2 Dry Pit – Structure and Accessories

17.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder to first level, spiral staircase down to bottom level
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12’x10’x17’ deep + 8’-6” first level
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

17.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Some coating failing near bottom/floor of dry pit
- Top or first level added to station when grade was raised for surrounding development
- Narrow access around dry pit hatch
- Grating on sump drain
- No equipment access hatch

Lift assist hatch and post to access ladder to first level

Ladder to first level landing, spiral stair case down to bottom level

Grating on sump drain, note some coating failing near bottom of wall

Narrow access around dry pit hatch

17.3.3 Wet Well Blower Vault – Structure and Accessories

17.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5'x5'x5' deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

17.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Vault floor is damp

Interior of wet well blower vault

17.4 Mechanical

17.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at the Pleasure Point Pump Station indicates that the facility is pumping at almost double the design flow (~245 gpm vs. 125 gpm) and half the pressure head (~5 ft vs. 11 ft). Assuming the accuracies of the measurements are reasonable and based on the pumping system head comparison in the following figure, it is possible that the design system head condition was overestimated relative to the current situation. Additionally, falling so far below the pump design curve, it seems that pump wear may be prevalent. Given that the pumps are successfully operating and the conveyed flow is greater than the original design point, there are no concerns over this installation.

The following table documents the pump run hours and starts by month over the past year.

Table 17-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	33.61	300	33.73	297
May-13	32.92	320	31.49	326
Jun-13	35.55	297	33.55	301
Jul-13	44.1	313	43.09	309
Aug-13	46.52	327	56.07	314
Sep-13	32.04	318	31.78	320
Oct-13	28.68	343	26.18	341
Nov-13	29.78	340	28.98	344
Dec-13	30.61	341	28.61	348
Jan-14	27.5	316	26.76	327
Feb-14	29.02	297	27.06	295
Mar-14	25.74	326	26.32	320
Total	**396.07**	**3,838**	**393.62**	**3,842**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.1	0.4	1.1	0.4

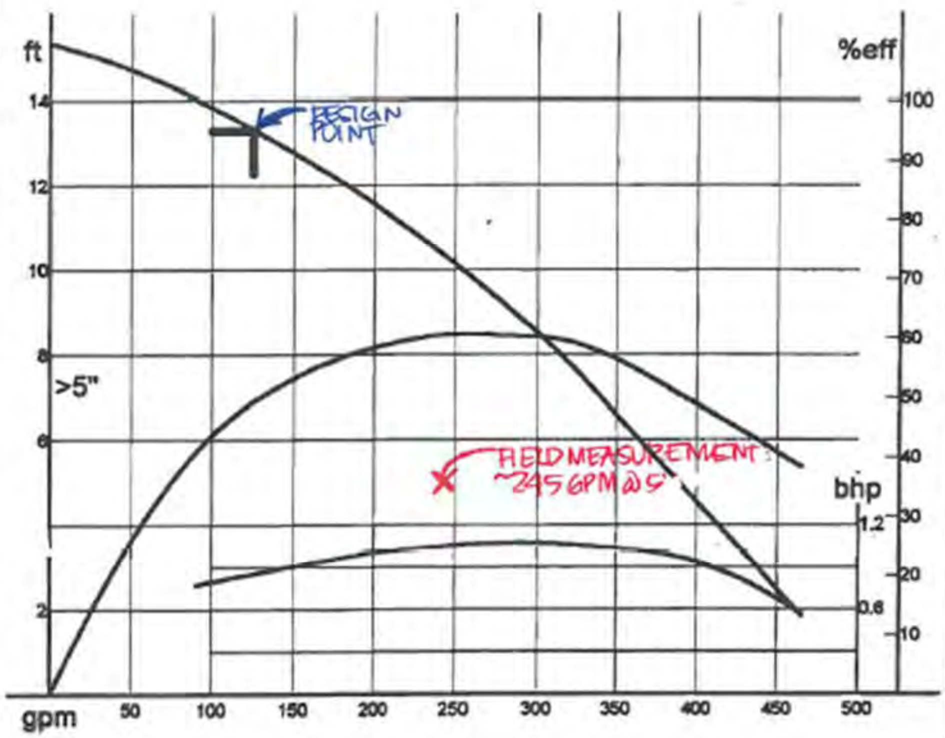
The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

TABLE 1

PUMP INVENTORY

Manufacturer and Local Representative	PACO Pumps 3215 S. 116th Street Seattle, WA 98168 Phone: (206) 433-2600 FAX: (206) 433-0263
Description	4" Model 470-11 Vertical Non-Clog Centrifugal Pump (5.97- inch diameter impeller) 240 V, 1.5 HP, 3 phase 1,150 RPM, US Electric Motor (TEFC)
Design Point:	125 GPM at 11.9 feet TDH
Serial No's.:	Pump 1 (northeast): 96A0192301B Pump 2 (southwest): 96A0192301A

Performance Curve:



17.4.1.1 Pump 1 – City of Bellevue Asset No. 193772

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-47011-X46D0Y-ZZ
Serial No.	96A001923018B
Horsepower	1.5
Voltage/phase	240/3
Date of installation	1998
Design Conditions	125 gpm @ 12 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 1 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Quiet under operation
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 1 Drawdown Test

Static head (feet)	3.8
Calculated pumping capacity	245
Total Dynamic head (feet)	5
Number of tests performed	2

General observations/notes from drawdown test:

- Pump appears to be operating near end of pump curve, cavitation could be a potential concern

Duplex configuration, pump 1 on the right

Pump 1 showing signs of aging on exterior

17.4.1.2 Pump 2 – City of Bellevue Asset No. 193870

Pump style	Vertical, centrifugal non-clog
Make	Paco Pumps
Model	52-NCF-47011-X46D0Y-ZZ
Serial No.	96A001923018B
Horsepower	1.5
Voltage/phase	240/3
Date of installation	1998
Design Conditions	125 gpm @ 12 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Trolley/hoist and rail

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 4 – Pump 2 is critical to the function of the station and not redundant, as both pumps have been reported as running simultaneously

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Quiet under operation
- Hoisting rail is not marked with load capacity, as required by code
- Reported loss of pump redundancy

Pump 2 Drawdown Test

Static head (feet)	3.8
Calculated pumping capacity	250 gpm
Total Dynamic head (feet)	5
Number of tests performed	2

General observations/notes from drawdown test:

- Pump appears to be operating near end of pump curve, cavitation could be a potential concern

Duplex configuration, pump 2 on the left

Pump 2 showing signs of aging on exterior

17.4.2. Exposed Piping and Valves

17.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, horizontal axis of rotation - ideal

17.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Ball check valve and plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

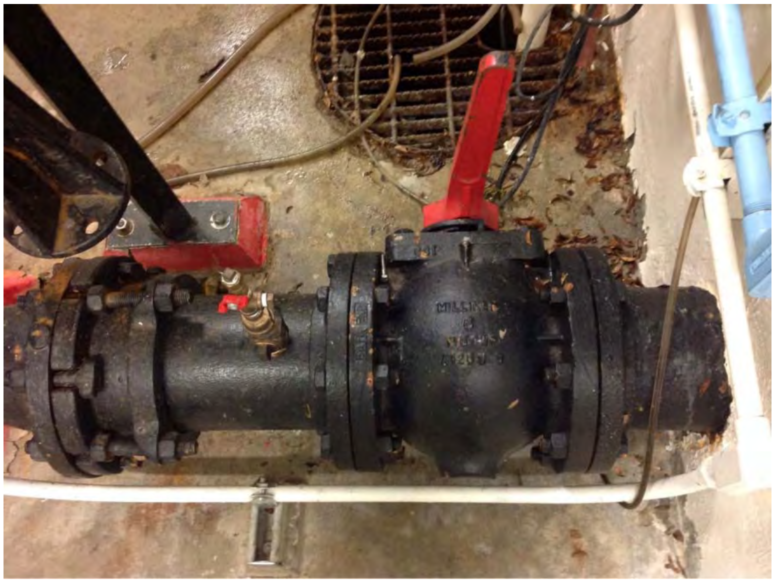
Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Ball check valve slams when pump shuts down, vertical installation



Plug valve isolation for suction piping, horizontal axis of orientation - ideal

Ball check valve vertical installation and plug valve on discharge piping

17.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

17.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in two locations in dry pit
Backflow prevention assembly size & type	Reduced pressure backflow device
Enclosure/Freeze protection	12” above floor of air intake underground vault/Heat tape

General observations/notes from field visit:

- Backflow assembly located below grade, no drain to daylight – does not meet code for installation

Backflow prevention assembly in
underground air intake vault

17.4.5 Ventilation

17.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	685 CFM @ 1" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

17.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	5' AFF in dry pit
Fan type	Axial
Airflow rate	1450 CFM @ 0.66" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed

Wet well supply fan located in wet well blower vault

Supply fan located 5 feet AFF in dry pit

17.5 Electrical

17.5.1 Electrical Service

17.5.1.1 Electrical Service Description

Voltage	240
Phases	3
Utility transformer	Overhead, 2 transformers
Service meter location	On side of service cabinet

17.5.1.2 Electrical Service Findings

Condition	1	**2**	3	4	5
Criticality	1	2	**3**	4	
Serviceability	1	**2**	3	4	

Condition Rating 2 – Circuit breaker and meter appear to be in good shape; power cabinet needs repair

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 2 – Standard parts; accessible from driveway though meter base in bushes

17.5.2 Backup Power

17.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Post mounted above in the driveway
Transfer switch type	Manual
Transfer switch location	Service cabinet

17.5.2.2 Backup Power Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is accessible from driveway in power cabinet

General observations/notes from field visit:

- Rusty bolts on generator receptacle

Manual transfer switch located in
service cabinet

17.5.3 Site – Panelboard

17.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120/1 phase
Manufacturer	Siemens
Model	S1A18BL 050 CTS

17.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Siemens panelboard appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

17.5.4 Site - Starters

17.5.4.1 Starters Description

Starters	230 VAC, (2) FVNR Starters

17.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Square D starters and Westinghouse circuit breakers appears to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Panelboard located in dry pit, appears to be in good condition

Square D starters appear to be in good condition

Westinghouse circuit breakers appear to be in good condition

17.5.5 Site – Telemetry Control Panel

17.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376884
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In service cabinet

17.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

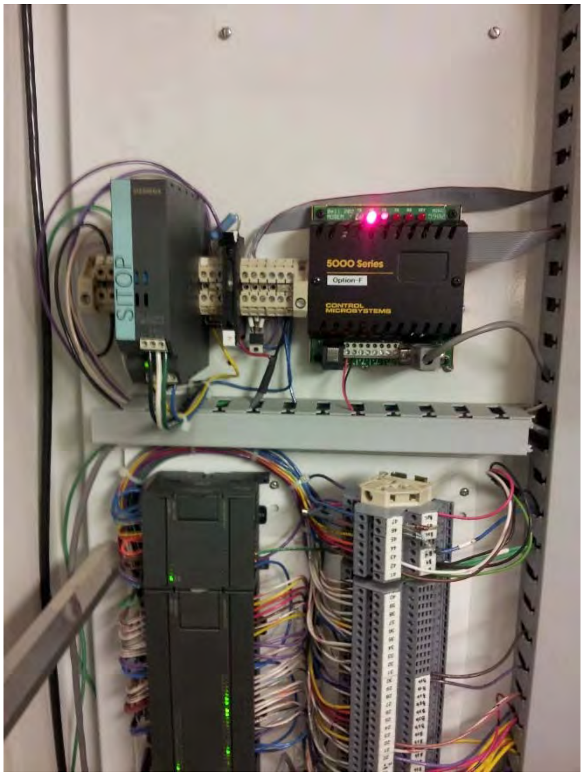
Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- High level float timers in power and control panel, difficult to serve



Telephone modem in telemetry control panel

Telephone network interface located in service cabinet

17.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 17-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Reported loss of pump redundancy	Reduces the station's level of service below industry standards and regulatory requirements	• Investigate reasoning for loss of pump redundancy
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Service cabinet is corroded	Loss of power at site	• Repair service cabinet
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace pumps, motors and motor drivers
Backflow assembly enclosure requires drain to daylight	Does not meet code requirement	• Install device above grade in an enclosure
Wet well interior coating failing	May decrease integrity of wet well structure	• Re-coat interior of wet well
Standby power phase monitor is aging	Loss of power at site	• Replace standby power phase monitor
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

17.6.1 Project Recommendations

The recommended improvements were grouped into two projects

The first recommended project addresses deficiencies associated with the reported loss of pump redundancy. This includes replacing the Paco pumps and repairing the service cabinet that is corroded. The timing of this project is driven by the reported loss of pump redundancy at the station which speeds the projects up to the first time frame from 2015 to 2018. Since this station has a loss of redundancy there is a concern that the station does not have sufficient capacity for incoming flows. However, since this station discharges to the lake line, there is a concern that the station is recirculating back to itself due to insufficient downstream capacity meaning an increase in station capacity would not address the loss of redundancy.

The second recommended project includes all other deficiencies identified at this station. This includes recoating the interior of the wet well and replacing the standby power phase monitor as well as the primary and backup level indicators. The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 17-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost[(1)(2)(3)]
PP-1	Reported loss of pump redundancy	Investigate reasoning for loss of pump redundancy	2015-2018	$150,000
	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan		
	Service cabinet is corroded	Repair service cabinet		
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		
PP-2	Wet well interior coating failing	Recoat interior of wet well	2023-2027	$210,000
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and back up level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%)
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

17.6.2 Project Justification

The timing of the recommended projects is driven by the reported loss of redundancy at this station which does not meet regulatory requirements and the station does not meet the minimum level of service.

In addition to the loss of redundancy, the Paco pumps at this station are no longer manufactured, making the pumps obsolete. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump which is challenging since this station on occasion relies on both pumps to keep up with flows.

The second project is recommended due to the continued wear on equipment over time and the potential decrease in integrity of the wet well structure.

17.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 17-4 have been implemented in the timeline identified.

17.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 17-5 and 17-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 17-5 includes the current estimated remaining useful life prior to implementation of the capital improvement projects.

Table 17-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	2	1	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	5	0	-	5	0-5

Table 17-6 includes project estimated remaining useful life when the recommended projects provided in Table 17-4 are complete. Upon completion of the recommended projects the remaining useful life for most asset groups will increase significantly with the exception of the telemetry system. The estimated remaining useful life will remain the same since the recommended projects do not include the replacement of significant telemetry equipment including the telemetry control panel. Thus the condition and estimated remaining life for this asset group will remain unchanged.

Table 17-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	0	0	-	1	15-20
Telemetry System	1	0	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

17.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 17-1 graphically represents the rehabilitation and replacement cost projections for the Pleasure Point Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 17-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 17-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 17-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 17-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

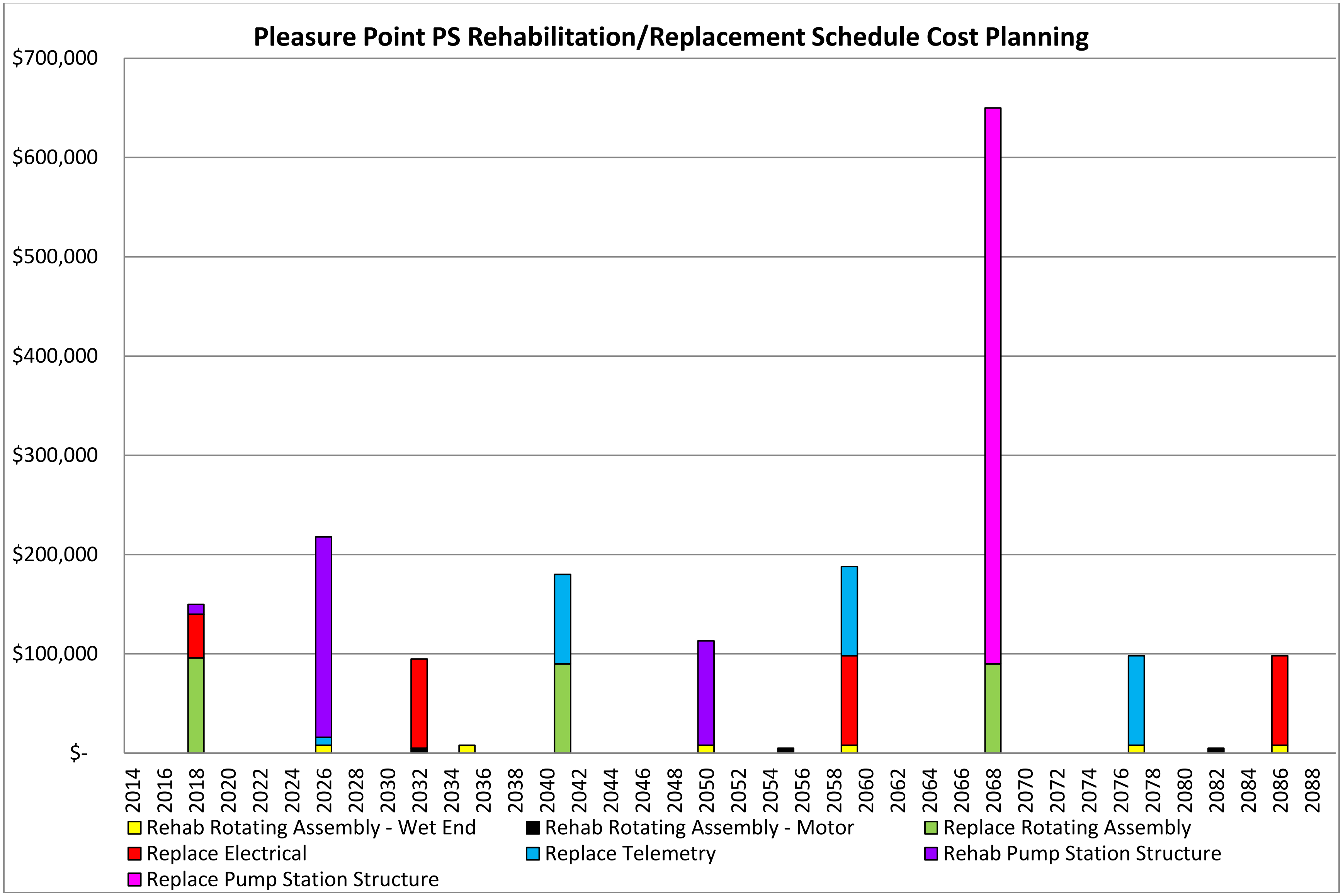
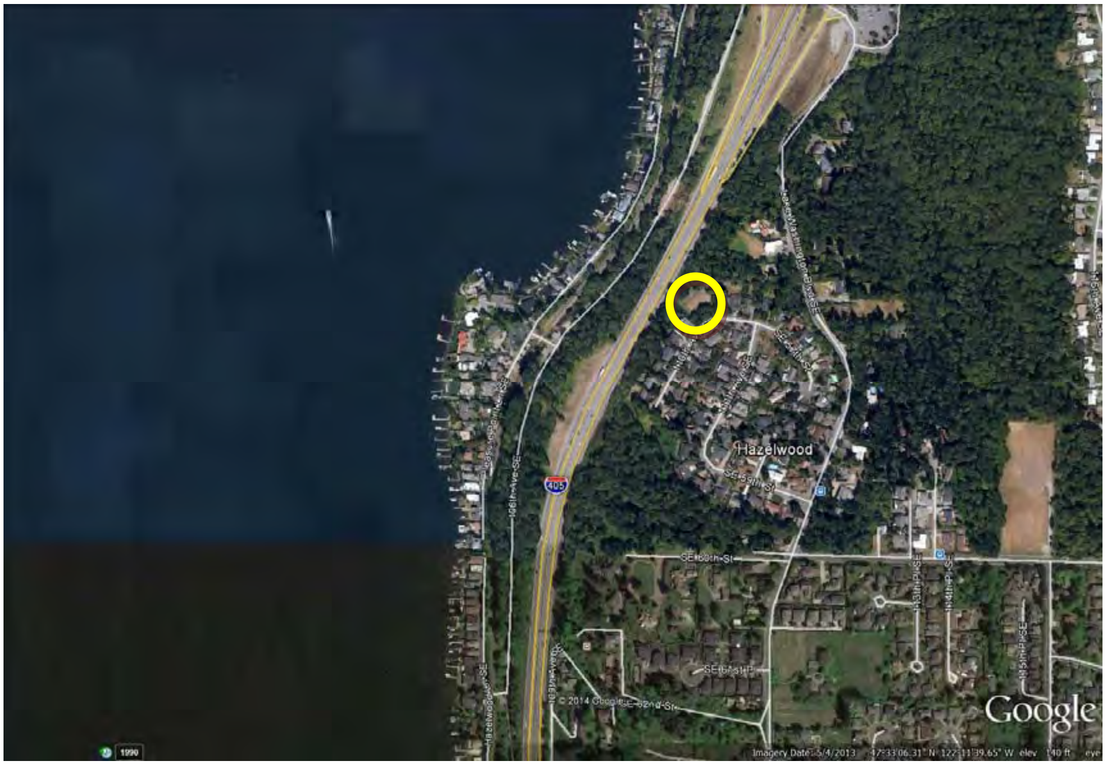


Figure 17-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 18
KIMBERLEE PARK



18.1 Kimberlee Park Pump Station General Description

Date of Visit	May 28th, 2014
City of Bellevue Asset No.	187589
Address	11001 SE 56th SE
Station configuration	Wet well/Dry pit
Original Construction	1993
Major Rehabilitation/Upgrade	2007 – does not include pump upgrade
Number of Pumps	2
Pump Horsepower	40
Station Voltage/Phase	480/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	395 – 405 gpm

18.1.1 Summary of Findings

Kimberlee Park pump station is a formerly owned Coal Creek station. It is located adjacent to the I-405 and Kimberlee Park with two access points through Kimberlee Park or the paved driveway with a secured gate. This pump station does not receive flow from other pump stations and discharges to a gravity line. One deficiency identified at this site is an undersized transformer and main disconnect which is not properly sized to run both pumps. Another deficiency identified at this site is the difficult access to the lower level via the ladder. The ladder is not centered and the grating beam limits your ability to step down on the ladder rungs, this introduces a potential fall and safety hazard.

Table 18-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 18-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
KP-1	Concrete spalled in dry pit top corner	Patch to prevent further deterioration	As Soon As Possible	N/A - Maintenance
KP-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2023-2027	$289,000
	Main disconnect is not properly sized to run both pumps	Increase main disconnect to 200 A service to properly run both pumps		
	Utility transformer is undersized	Coordinate with utility to upsize transformer		
	Access to lower level via ladder – safety issue	Replace grating with common 2-leaf grating hatch, relocate ladder to center		
	Cornell pumps and motors are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

18.2 Site

18.2.1 Site Description

Vehicle access to site	Narrow access paved one lane road (gated), also park above Kimberlee Park and walk down trail to station, parking distance 0 or 100 yards
Landscaping	None, homeowners association takes care of mowing, etc
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access, adjacent to public park

General observations/notes from field visit:

- Big grease problem reported – none identified in field
- Moss growth on asphalt concrete – slippery
- Gate to access road locked

Paved one lane road access, gated

Moss growth on asphalt concrete

General site layout, more moss growth on asphalt concrete and a lot of vegetation maintained by others

18.3 Station Facilities

18.3.1 Wet Well – Structure and Accessories

18.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	12'x6' with two 6' risers on top
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	10", above operating level*
Lighting	None
Ventilation	None
Ventilation continuous	N/A

*Based on Record Drawings, unable to confirm in field.

18.3.1.2 Wet Well Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	1	**2**	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Back-up wet well baffled structure
- Overflow connected wet wells

Interior of wet well including connected
overflow wet well

Interior of overflow wet well

18.3.2 Dry Pit – Structure and Accessories

18.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	7'-9"x9'-9"x10' deep top floor, 8'-6" deep bottom floor
Lighting	Yes, adequate
Ventilation	Supply and exhaust fan
Ventilation continuous	No

18.3.2.2 Dry Pit Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

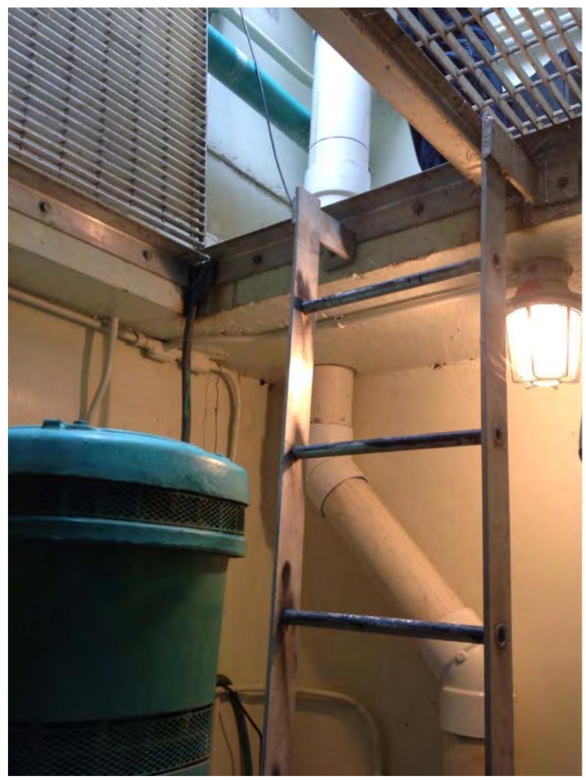
General observations/notes from field visit:

- Concrete spalled in top corner – reinforcing exposed and rusted. Should be patched to prevent further deterioration.
- Some rusting and delamination near access and at seam near bottom of the first floor
- Access to lower level via ladder – safety issue – recommend replacing grating w/ common 2-leaf grating hatch, relocated ladder to center

Interior of first floor of dry pit

Some rusting near bottom of first floor seam

Concrete spalled in top corner – reinforcing exposed and rusted



Access to lower level via ladder – safety issue

18.3.3 Above Grade Blower Vents – Structure and Accessories

18.3.3.1 Above Grade Blower Vents General Description

Construction materials	Metal
Access description	Screw driver sealed
General dimensions	2’x3’-4”x2’ high
Lighting	None
Ventilation	None
Ventilation continuous	N/A

18.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Above grade blower vents appear to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- A lot of cobwebs/branches inside

Interior of above grade exhaust fan vents, a lot of cobwebs, some branches inside

Interior of above grade supply fan vents, a lot of cobwebs, some branches inside

18.4 Mechanical

18.4.1 Pumps

Pump System Performance

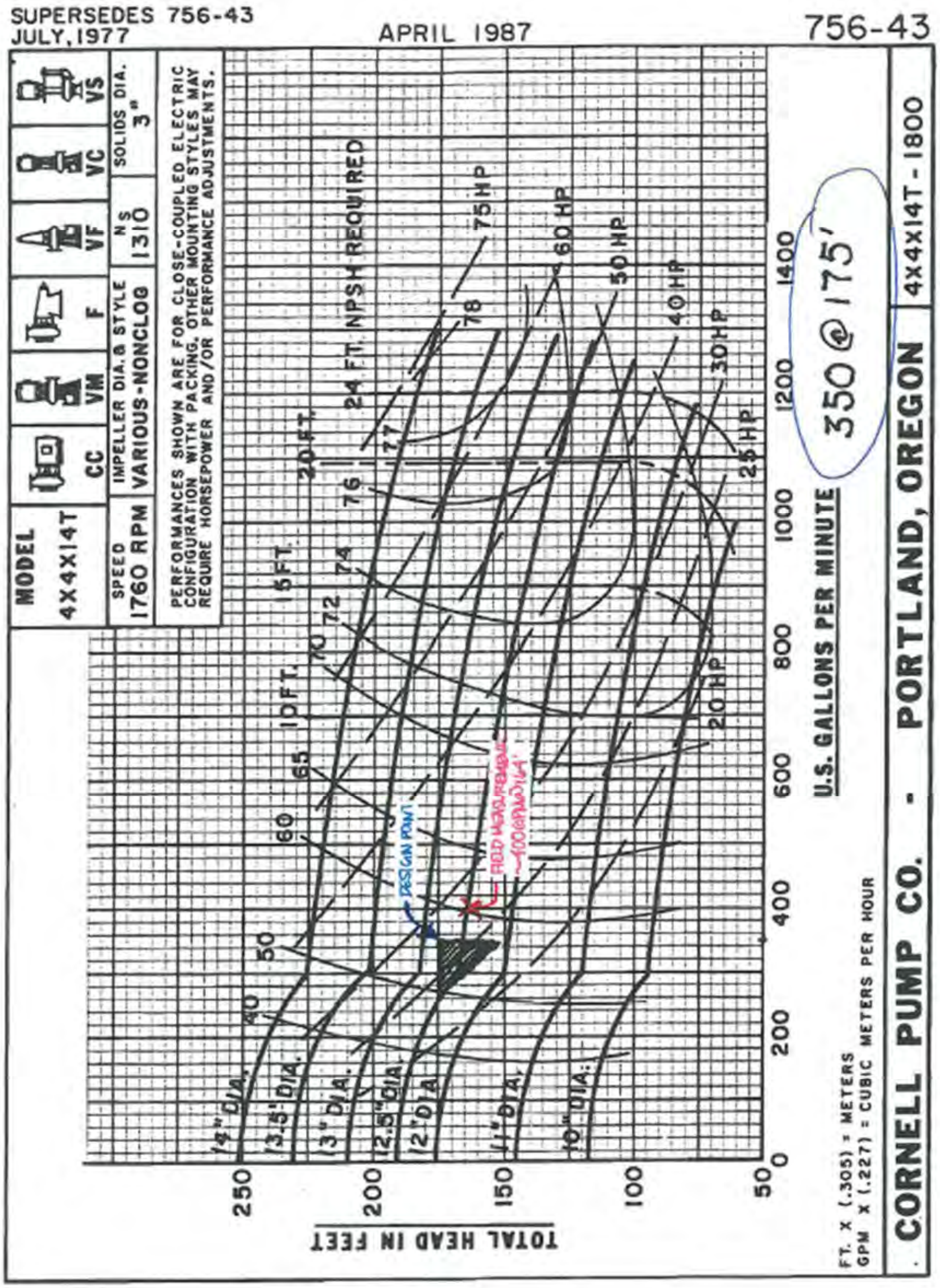
The field tested performance of the pumps at the Kimberlee Park Pump Station measured a slightly higher flow (~400 gpm vs. 350 gpm) and lower head (164 ft vs. 175 ft) than the design flow. Assuming the accuracies of the measurements are reasonable and based on the pumping system head comparison in the following figure, it is possible that the design system head condition was overestimated relative to the current situation. Given the measured flow and head, it appears to be in reasonable alignment with the original design point.

The following table documents the pump run hours and starts by month over the past year.

Table 18-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	4.78	154	4.64	148
May-13	5.21	168	5.13	171
Jun-13	4.72	150	4.39	150
Jul-13	4.77	145	4.27	145
Aug-13	4.73	158	4.57	151
Sep-13	4.81	151	4.54	151
Oct-13	4.98	163	4.85	163
Nov-13	5.25	161	4.78	157
Dec-13	5.19	162	4.7	156
Jan-14	5.05	150	4.76	149
Feb-14	4.87	137	4.43	135
Mar-14	5.38	162	4.63	160
Total	**59.74**	**1,861**	**55.69**	**1,836**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.2	0.2	0.2	0.2

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.



SUPERSEDES 756-43
JULY, 1977
APRIL 1987
756-43
MODEL
4X4X14T
CC
VM
F
VF
VC
VS
SPEED
1760 RPM
IMPELLER DIA. & STYLE
VARIOUS-NONCLOG
N S
1310
SOLIDS DIA.
3"
PERFORMANCES SHOWN ARE FOR CLOSE-COUPLED ELECTRIC CONFIGURATION WITH PACKING. OTHER MOUNTING STYLES MAY REQUIRE HORSEPOWER AND/OR PERFORMANCE ADJUSTMENTS.
24 FT. NPSH REQUIRED
20 FT.
15 FT.
10 FT.
75 HP
60 HP
50 HP
40 HP
30 HP
25 HP
20 HP
14" DIA.
13.5" DIA.
13" DIA.
12.5" DIA.
12" DIA.
11" DIA.
10" DIA.
TOTAL HEAD IN FEET
U.S. GALLONS PER MINUTE
DESIGN POINT
FIELD MEASUREMENT ~400GPM@164'
350 @ 175'
FT. X (.305) = METERS
GPM X (.227) = CUBIC METERS PER HOUR
CORNELL PUMP CO. - PORTLAND, OREGON
4X4X14T-1800

18.4.1.1 Pump 1 – City of Bellevue Asset No. 193765

Pump style	Vertical
Make	Cornell Pumps
Model	4414T-VC18DB
Serial No.	77720
Horsepower	40
Voltage/phase	460/230/3 phase
Date of installation	1993
Design Conditions	350 gpm @ 175 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Crane, straight up

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition with some degradation but the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Parts are available but the pump is somewhat difficult to access

General observations/notes from field visit:

- Mirrored pumps – opposite rotation

Pump 1 Drawdown Test

Static head (feet)	153
Calculated pumping capacity	400 – 405 gpm
Total Dynamic head (feet)	163.5
Number of tests performed	2

General observations/notes from drawdown test:

- The measured flow and head appears to be in reasonable alignment with the original design point.

Pump 1 showing signs of aging on exterior

Pump and motor #1

18.4.1.2 Pump 2 – City of Bellevue Asset No. 193768

Pump style	Vertical
Make	Cornell Pumps
Model	4414T-VC18DB
Serial No.	77720
Horsepower	40
Voltage/phase	460/230/3 phase
Date of installation	1993
Design Conditions	350gpm @ 175 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Crane, straight up

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Parts are available but the pump is somewhat difficult to access

General observations/notes from field visit:

- Mirrored pumps – opposite rotation

Pump 2 Drawdown Test

Static head (feet)	153
Calculated pumping capacity	395 – 405 gpm
Total Dynamic head (feet)	163.5
Number of tests performed	2

General observations/notes from drawdown test:

- The measured flow and head appears to be in reasonable alignment with the original design point.

Pump 2 showing signs of aging on exterior

18.4.2. Exposed Piping and Valves

18.4.2.1 Suction Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, vertical axis of rotation – not ideal. Should be addressed upon replacement of rotating assembly.

18.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Swing check valve w/ outside weight lever and spring and plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats to pump, vertical axis of rotation – not ideal. Should be addressed upon replacement of rotating assembly.
- Swing check valve slams upon shut down

Plug valve isolation for suction piping, vertical axis of orientation – not ideal

Plug valve isolation for discharge piping, vertical axis of orientation – not ideal

Swing check valve on discharge piping, with outside weight level and spring

18.4.3 Other Station Piping

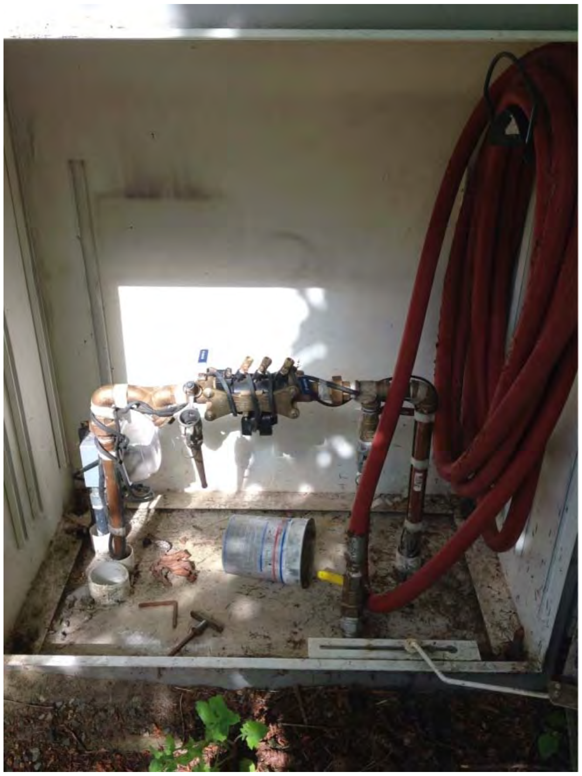
Bypass piping	No
Pig launching	Yes
Air release valves	No
Force main isolation	Isolation valve in access road, 20’ from station

General observations/notes from field visit:

- Pig launching possible
- Force main drain to wet well 4” plug valve

18.4.4 Washdown Water

Supply	Domestic/Metered
Access	Top floor of dry pit
Backflow prevention assembly	Wilkins reduced pressure backflow device
Enclosure/Freeze protection	Stainless steel above ground enclosure/Insulated



Backflow prevention assembly in above grade stainless steel insulated enclosure

Isolation valve in access road aproximately 20 feet from station

18.4.5 Ventilation

18.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Above grade, secure enclosure
Fan type	Centrifugal
Airflow rate	225 CFM @ 0.3” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Both supply and exhaust fans at this facility – on/off confusing

18.4.5.2 Wet Well Ventilation (Exhaust Fan)

Location	Above grade, secure enclosure
Fan type	Centrifugal
Airflow rate	400 CFM @ 0.5” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

Wet well supply fan located in above grade enclosure

Wet well exhaust fan located in above grade enclosure

18.4.5.3 Dry Pit Ventilation (Exhaust Fan)

Location	In dry pit
Fan type	Centrifugal
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access

General observations/notes from field visit:

- Configuration different from other stations

Exhaust fan located on first floor in dry pit

18.5 Electrical

18.5.1 Electrical Service

18.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Underground vault
Service meter location	Outdoor rack

18.5.1.2 Electrical Service Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible down walkway equipment on outdoor rack

18.5.2 Backup Power

18.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Adjacent to road
Transfer switch type	Manual
Transfer switch location	In dry pit

18.5.2.2 Backup Power Findings

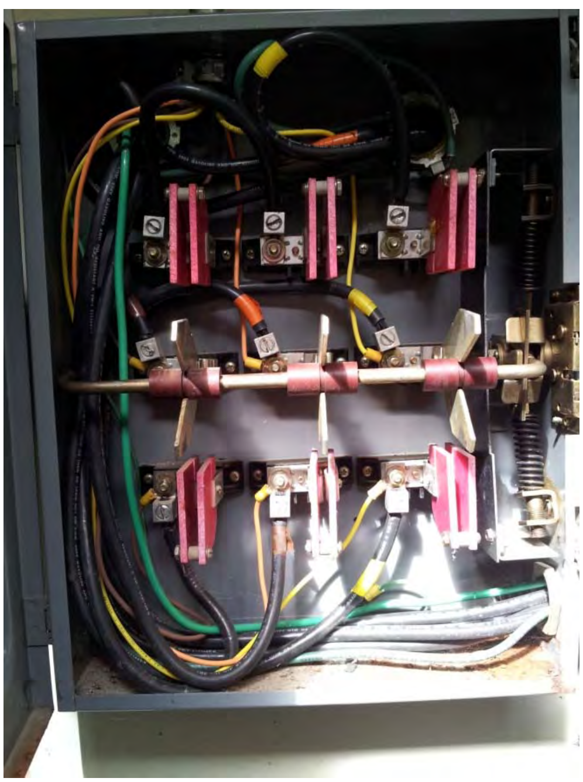
Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Service meter located on outdoor rack adjacent to station



Manual transfer switch located in dry pit

18.5.3 Site – Panelboard

18.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120
Manufacturer	Square D Load Center
Model	Unknown

18.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Load center is low quality but appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

18.5.4 Site - Starters

18.5.4.1 Starters Description

Starters	(2) FVNR Starters

18.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Starters and circuit breakers are GE & Furnas, appears to be in good condition

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Square D Panelboard located in dry pit on
left side

Starters located in dry pit, appears to be
in good condition

18.5.5 Site – Telemetry Control Panel

18.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376805
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/SCADANET Network Module
Telephone Network Interface	Outdoor telephone pedestal

18.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Power and control panel layout in dry pit

Telephone network interface located in outdoor telephone pedestal adjacent to station

Telemetry control panel located in dry pit, appears to be in good condition

18.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 18-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Concrete spalled in dry pit top corner	May decrease integrity of dry pit structure	• Patch to prevent further deterioration
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Main disconnect is not properly sized to run both pumps	Pumps cannot run simultaneously if necessary	• Increase main disconnect to 200 A service to properly run both pumps
Utility transformer is undersized	Loss of power at site	• Coordinate with utility to upsize transformer
Access to lower level via ladder – safety issue	Fall and safety hazard	• Replace grating with common 2-leaf grating hatch, relocate ladder to center
Cornell pumps and motors are degrading based on perceived age	Loss of service at site	• Replace pumps, motors and motor drivers
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box
No interior wet well coating	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

18.6.1 Project Recommendations

Due to the simplicity of project KP-1, it is recommended to be done when the operations and maintenance make their next routine visit to this station. Per discussion with the City, since this station receives very low flows and there is a backup wet well, all other deficiencies were lumped together during the time frame when the rotating assembly will need to be replace. This timeline is from 2023 to 2027. The pumps that are currently installed at the station are oversized and upon replacement should be properly sized for the station's needs.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 18-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
KP-1	Concrete spalled in dry pit top corner	Patch to prevent further deterioration	As Soon As Possible	N/A - Maintenance
KP-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2023-2027	$289,000
	Main disconnect is not properly sized to run both pumps	Increase main disconnect to 200 A service to properly run both pumps		
	Utility transformer is undersized	Coordinate with utility to upsize transformer		
	Access to lower level via ladder – safety issue	Replace grating with common 2-leaf grating hatch, relocate ladder to center		
	Cornell pumps and motors are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

18.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the rotating assembly. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

18.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 18-4 have been implemented in the timeline identified.

18.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 18-5 and 18-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 18-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 18-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	2	1	0	-	2	10-15

Table 18-6 includes project estimated remaining useful life when the recommended projects provided in Table 18-4 are complete. Upon completion of the recommended projects the remaining useful life of most asset groups will increase significantly with the exception of the electrical and telemetry system. The estimated remaining useful life will remain the same since the recommended projects do not include the replacement of significant electrical and or telemetry equipment.

Table 18-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

18.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 18-1 graphically represents the rehabilitation and replacement cost projections for the Kimberlee Park Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 18-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 18-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 18-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 18-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

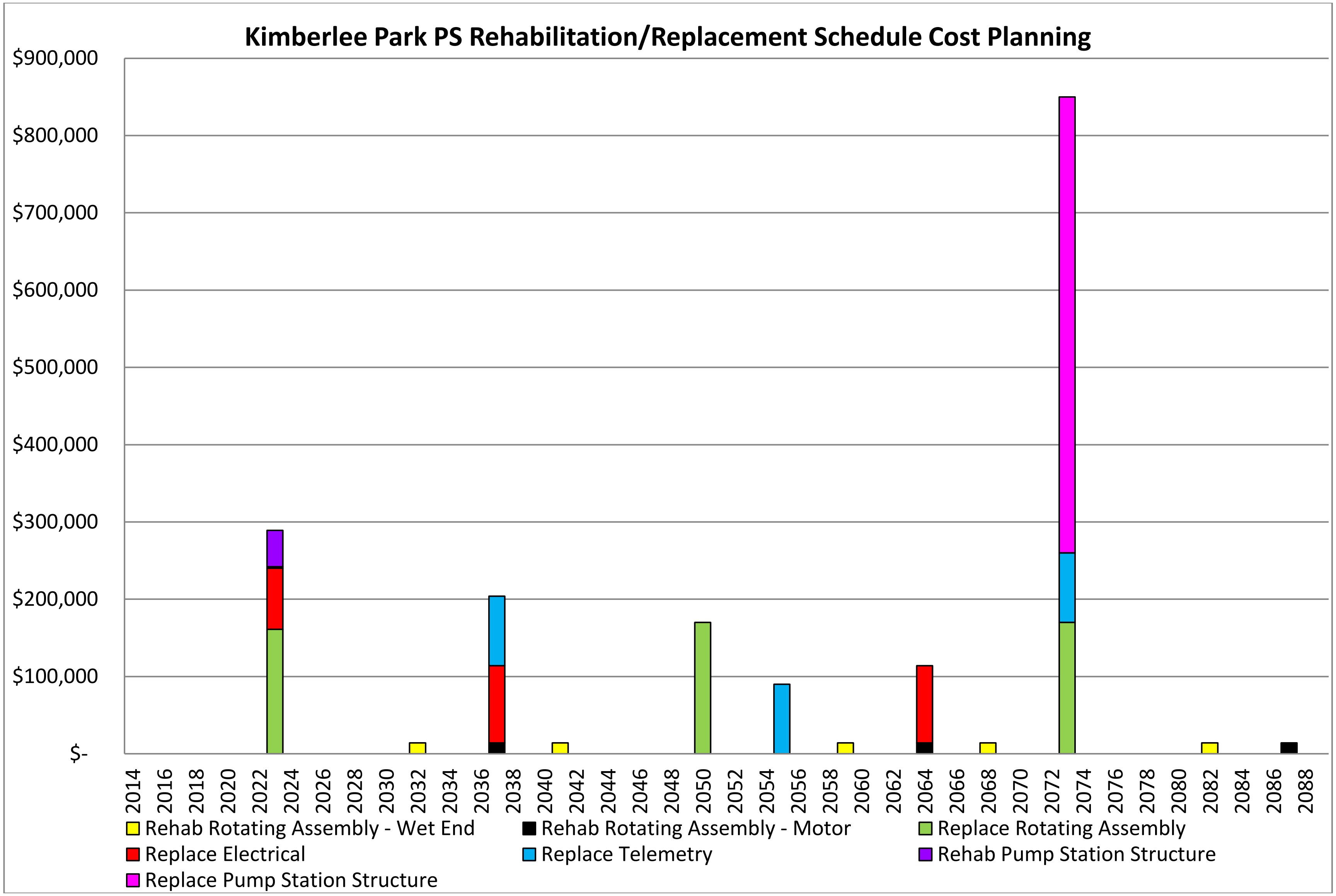
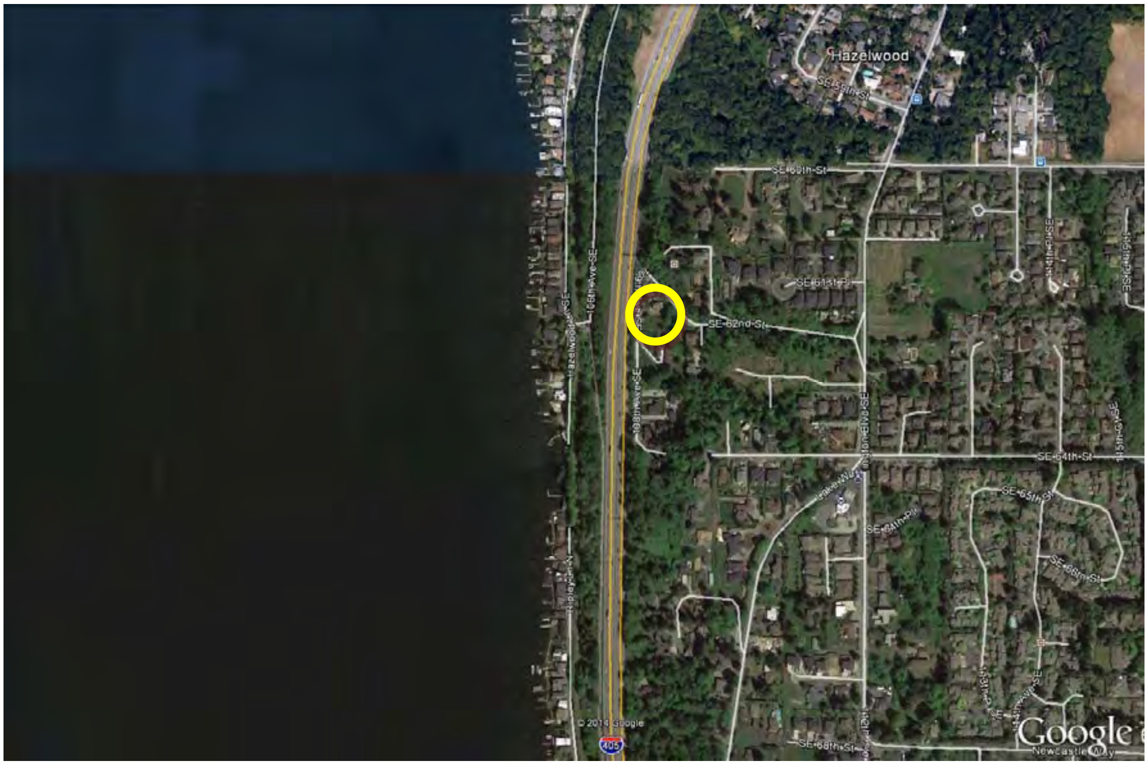


Figure 18-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 19
SOUTH RIDGE



19.1 South Ridge Pump Station General Description

Date of Visit	May 28th, 2014
City of Bellevue Asset No.	187575
Address	6216 108th Ave SE
Station configuration	Submersible
Original Construction	1993
Major Rehabilitation/Upgrade	2009, pumps replaced
Number of Pumps	2
Pump Horsepower	7.5
Station Voltage/Phase	480/3 Phase
Standby Power	Onsite generator in underground vault
Field-measured Station Firm Capacity	15 – 25 gpm

19.1.1 Summary of Findings

South Ridge pump station is a former Coal Creek Station located adjacent to the I-405. This pump station does not receive flow from other stations and discharges flow to a gravity line. A significant deficiency observed during the site visit includes the exposed wiring of the generator receptacle which is a hazard. The main control cabinet is located on a deck area that is 2’-3’ above grade which creates a potential fall/safety hazard.

Table 19-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 19-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
SR-1	Main control cabinet is up 2'-3'	Install railing	2020-2025	$123,000
	Submersible pumps and motors degrading based on perceived age	Replace submersible pumps, motors and motor drivers		
	Generator receptacle wiring is exposed and hazardous	Mount generator receptacle for clearance of conductors		
	Primary and backup level indicators aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

19.2 Site

19.2.1 Site Description

Vehicle access to site	Narrow one lane paved road, parking adjacent to station on side of road
Landscaping	Gravel with weeds
Site lighting	Yes, photo cell and switch
Fencing/security	Coated chain link fence with padlock, shrubs on one side of fence
Public accessibility to site	No access

General observations/notes from field visit:

- Main control cabinet up 2’-3’, no railing – potential safety issue
- Davit base for pump hoisting approximately 4” above grade, tripping hazard next to wet well
- Wet well hatch opening is too large to accommodate fall protection

Main control cabinet up 2’ – 3’, no railing – potential safety issue

Station layout, green davit base for pump hoisting approximately 4” above grade, tripping hazard next to wet well

19.3 Station Facilities

19.3.1 Wet Well – Structure and Accessories

19.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder down to platform grating
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	6' inside diameter*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	8", above operating level*
Lighting	Yes, dim lighting
Ventilation	Supply and Exhaust Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

19.3.1.2 Wet Well Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	1	**2**	3	4	

Condition Rating 1 – Interior coating appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Some grating from the wet well stored outside
- Back up wet well/holding tank located adjacent to station within gated area, approximately 8' inside diameter

Interior of wet well

Some grating outside adjacent to power and control panel platform

Interior of holding tank adjacent to wet well

19.3.2 Control Building – Structure and Accessories

19.3.2.1 Control Building General Description

Construction materials	Shed, timber with metal roof
Access description	Step up to platform area
Access fall protection	No
Access locked	No
Access intrusion alarm	No
General dimensions	14’x7’x2’ above grade*
Lighting	Yes

*Based on Record Drawings, unable to confirm in field.

19.3.2.2 Control Building Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Control building/shelter appears to be in good condition.

Criticality Rating 3 – Critical but redundant, the shelter is provided over the control panel/electrical equipment located in NEMA rated cabinets for outdoor weather

Serviceability Rating 1 – The control building is easily accessed and parts are readily available

Timber shed with metal roof on platform providing cover for power and control equipment

19.3.3 Above Grade Wet Well Blower Vent Enclosures – Structure and Accessories

19.3.3.1 Above Grade Wet Well Blower Vent Enclosures General Description

Construction materials	Galvanized steel enclosure
Access description	Screw driver sealed
General dimensions	2’x3’x2’ high
Lighting	None
Ventilation	None
Ventilation continuous	N/A

19.3.3.2 Above Grade Wet Well Blower Vent Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Above grade blower vents appear to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Two blower vent enclosures one houses supply fan and the other houses the exhaust fan for the wet well

Above grade steel enclosure for exhaust fan

Interior of exhaust fan above grade steel enclosure

Above grade steel enclosure for supply fan

Interior of supply fan above grade steel enclosure

19.4 Mechanical

19.4.1 Pumps

Pump System Performance

The field measured performance of the pumps at South Ridge Pump Station only captured flow rates, as operating pressures were not available. The measured flow is significantly lower than the design flow (~19 gpm vs. 84 gpm). This decrease in flow could be caused by two potential conditions:

- The pump pressure has increased from 125 ft to 180 ft potentially indicating a partial blockage of the pipe
- The pressure has not increased significantly and it is likely that the reduced flow is due to significant wear of the pumps.

Regardless of the reason, further investigation should be performed to determine the root cause of the decrease in measured flow. ***Recommendation:*** *City staff should collect operating pressure information to help determine the necessary course of action at this facility*.

The following table documents the pump run hours and starts by month over the past year.

Table 19-2
Summary of Pump Run Hours and Starts

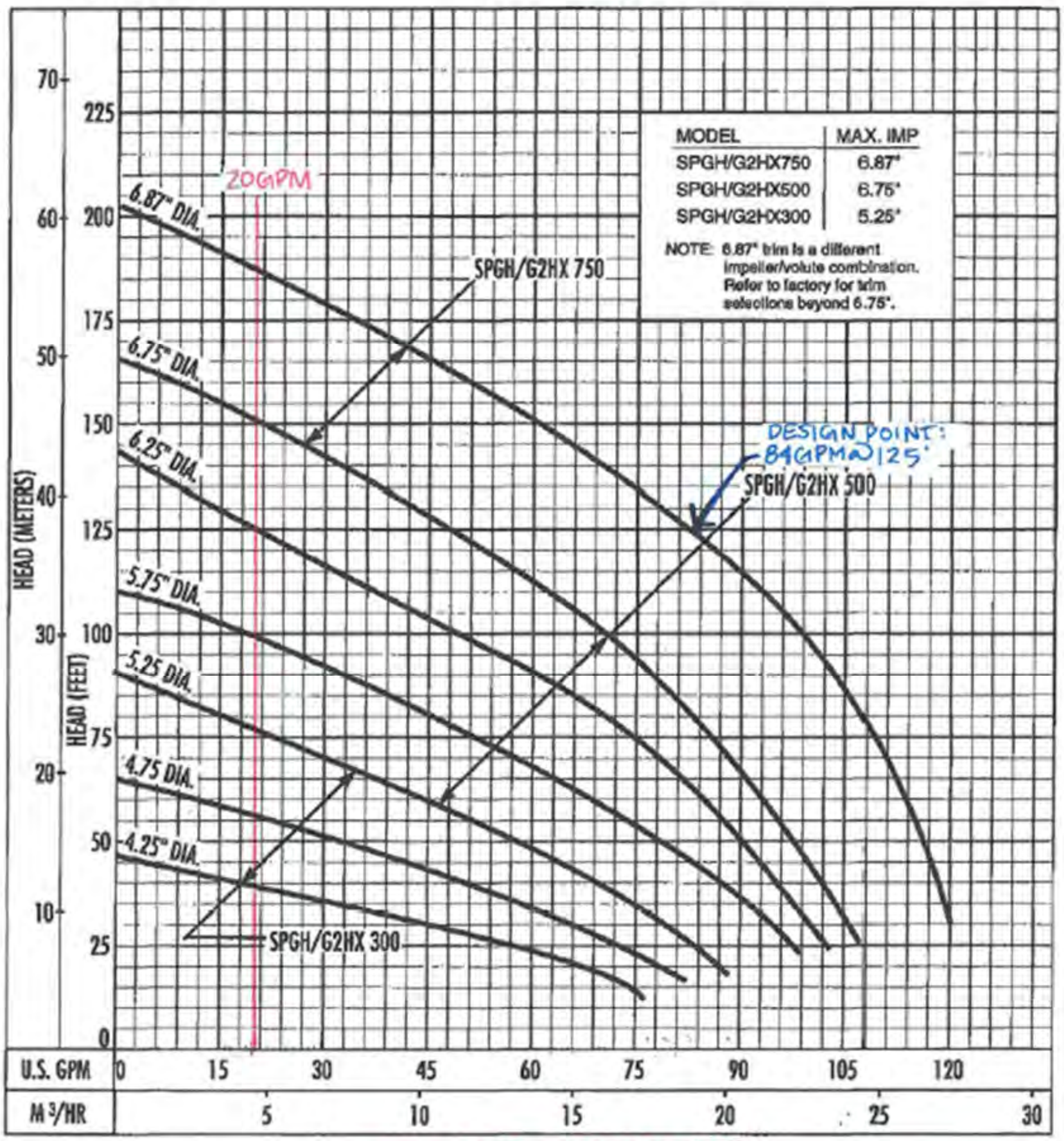
Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	74.24	189	91.72	189
May-13	101.98	282	93.52	222
Jun-13	157.97	274	90.22	338
Jul-13	74.04	280	95.15	279
Aug-13	73.56	273	104.54	275
Sep-13	90.81	183	78.21	506
Oct-13	21.82	106	113.34	574
Nov-13	53.97	352	97.39	339
Dec-13	62.7	396	104.06	343
Jan-14	61.68	218	93.63	192
Feb-14	58.14	180	93.47	179
Mar-14	78.74	249	133.67	251
Total	**909.65**	**2,982**	**1,188.92**	**3,687**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	2.5	0.3	3.3	0.4

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Section **GRINDER** Page **109**
Dated **SEPTEMBER 1993**

Performance Curve — SPGH/G2HX

RPM: **3500** Discharge: **2"**



Operating point must fall within curve.

FIELD MEASUREMENT: ~20GPM, NO PRESSURE MEASURED

Conditions of Service:

GPM: _____ TDH: _____

AURORA PUMP — A UNIT OF GENERAL SIGNAL

HYDROMATIC™ PUMPS

19.4.1.1 Pump 1 – City of Bellevue Asset No. 193766

Pump style	Submersible
Make	Hydromatic*
Model	HPGHX750FD*
Serial No.	G80608*
Horsepower	7.5
Voltage/phase	460/3
Date of installation	2009
Design Conditions	84 gpm @ 125 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	2-rail system

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but as a 7 year old grinder pump, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

General observations/notes from field visit:

- No fall protection when pulling equipment, hatch too big to accommodate

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	15 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- The measured flow is significantly lower than the design point, further investigation should be done to determine the reasoning behind this drastic change in flow.

Submersible station, unable to observe pumps

19.4.1.2 Pump 2 – City of Bellevue Asset No. 193769

Pump style	Submersible
Make	Hydromatic*
Model	HPGHX750FD*
Serial No.	G80608*
Horsepower	7.5
Voltage/phase	460/3
Date of installation	2009
Design Conditions	84 gpm @ 125 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	2-rail system

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but as a 7 year old grinder pump, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

General observations/notes from field visit:

- No fall protection when pulling equipment, hatch too big to accommodate

Pump 2 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	20 – 25 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- The measured flow is significantly lower than the design point, further investigation should be done to determine the reasoning behind this drastic change in flow.

Submersible station, unable to observe pumps

19.4.2 Exposed Piping and Valves

19.4.2.1 Discharge Piping/Valve(s) Description

Size	3”
Material	PVC and galvanized
Valve Type(s)	Gate valve and ball check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Gate valve before ball check valve, ball check valve before common discharge piping

19.4.3 Other Station Piping

Bypass piping	Yes
Pig launching	Yes
Air release valves	No
Force main isolation	

General observations/notes from field visit:

- Same clean out-type port u/s of force main isolation valve

19.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in backflow preventer enclosure
Backflow prevention assembly	Zurn reduced pressure backflow device
Enclosure/Freeze protection	Painted steel enclosure/Heat tape

Backflow prevention assembly in above grade stainless steel enclosure

Backflow prevention assembly with heat tape and hose bibb for wash down located in enclosure

Gateway valve and ball check valve located in wet well, PVC and galvanized discharge piping

19.4.5 Ventilation

19.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Above grade galvanized steel enclosure
Fan type	Centrifugal
Airflow rate	225 CFM @ 0.3” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

19.4.5.2 Wet Well Ventilation (Exhaust Fan)

Location	Above grade galvanized steel enclosure
Fan type	Centrifugal
Airflow rate	400 CFM @ 0.5” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Located behind submersible cable termination enclosure

Wet well supply fan located in above grade steel enclosure

Wet well exhaust fan located in above grade enclosure

19.5 Electrical

19.5.1 Electrical Service

19.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Unknown
Service meter location	Outside of power and control panel

19.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused disconnect appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway

19.5.2 Backup Power

19.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Mounted thru outside of power and control panel
Transfer switch type	Manual
Transfer switch location	In power and control panel

19.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Transfer switch appears to be in good condition; generator receptacle needs to be reinstalled on back box to provide protection of conductors

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; generator receptacle is too closely installed in power and control panel

General observations/notes from field visit:

- Generator receptacle needs to be mounted for clearance of conductors

Service meter located on side of power and control panel

Generator receptacle mounted thru outside of power and control panel

Generator receptacle needs to be mounted for clearance of conductors

Generator receptacle needs to be mounted for clearance of conductors, alternate view

19.5.3 Site – Panelboard

19.5.3.1 Panelboard Description

Location	Power and control panel
Voltage/Phase	240/120/1 phase
Manufacturer	Cutler Hammer
Model	Unknown

19.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Cutler Hammer panel appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel

19.5.4 Site - Starters

19.5.4.1 Starters Description

Starters	(2) FVNR Starters

5.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Both the Furnas starter and replacement Siemens starter appear to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Power and control panel outdoor enclosure located on platform

Starters located in power and control panel outdoor enclosure, appears to be in good condition

Panelboard located in power and control panel outdoor enclosure, appears to be in good condition

19.5.5 Site – Telemetry Control Panel

19.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376773
Location	On platform
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In power and control panel enclosure

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in outdoor panel under roof

19.5.6 Site – Submersible Cable Termination Block

19.5.6.1 Submersible Cable Termination Block Description

Location	Adjacent to wet well in above grade enclosure
Material	Unknown

19.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Large fairly new termination cabinet appears to be in good condition

Criticality Rating 3 – Critical but redundant, transmits power from the starters to the pump cords but if one cord or termination fails the other pair will still operate

Serviceability Rating 1 – Standard parts; close to gate

Power and control panel outdoor
enclosure located on platform

Telephone network interface located in
power and control panel enclosure

Submersible cable termination
enclosure adjacent to wet well in above
grade enclosure, fairly new appears to
be in good condition

19.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 19-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Main control cabinet is up 2’-3’	Potential fall and safety hazard	• Install railing
Submersible pumps and motors degrading based on perceived age	Loss of service at site	• Replace submersible pumps, motors and motor drivers
Generator receptacle wiring is exposed and hazardous	Wiring is exposed and hazardous	• Mount generator receptacle for clearance of conductors
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

19.6.1 Project Recommendations

Due to the ease of access at this site and its low impact on the public and private residents, the deficiencies were lumped into one project. The timing of the recommended project is driven by the generator receptacle since it is a safety hazard.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 19-4
Summary of Project Improvement Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
SR-1	Main control cabinet is up 2'-3'	Install railing	2020-2025	$123,000
	Submersible pumps and motors degrading based on perceived age	Replace submersible pumps, motors and motor drivers		
	Generator receptacle wiring is exposed and hazardous	Mount generator receptacle for clearance of conductors		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

19.6.2 Project Justification

If the generator receptacle wiring issue is not addressed, personnel working near the receptacle and panel could be exposed to a safety hazard. The submersible pump are nearing the end of their useful life based on perceived age. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

19.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 19-4 have been implemented in the timeline identified.

19.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 19-5 and 19-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 19-5 includes the current estimated remaining useful life

Table 19-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	2	1	0	-	2	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 19-6 includes project estimated remaining useful life when the recommended projects provided in Table 19-4 are complete. Upon completion of the recommended projects the remaining useful life for the rotating assembly. The estimated remaining useful life for the pump station, electrical and telemetry system will remain the same since the recommended project does not include significant rehabilitation or replacement of most of the components within these asset groups.

Table 19-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

19.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 19-1 graphically represents the rehabilitation and replacement cost projections for the South Ridge Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from

Section 4, Long Term Resource Planning. Table 19-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 19-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 19-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 19-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

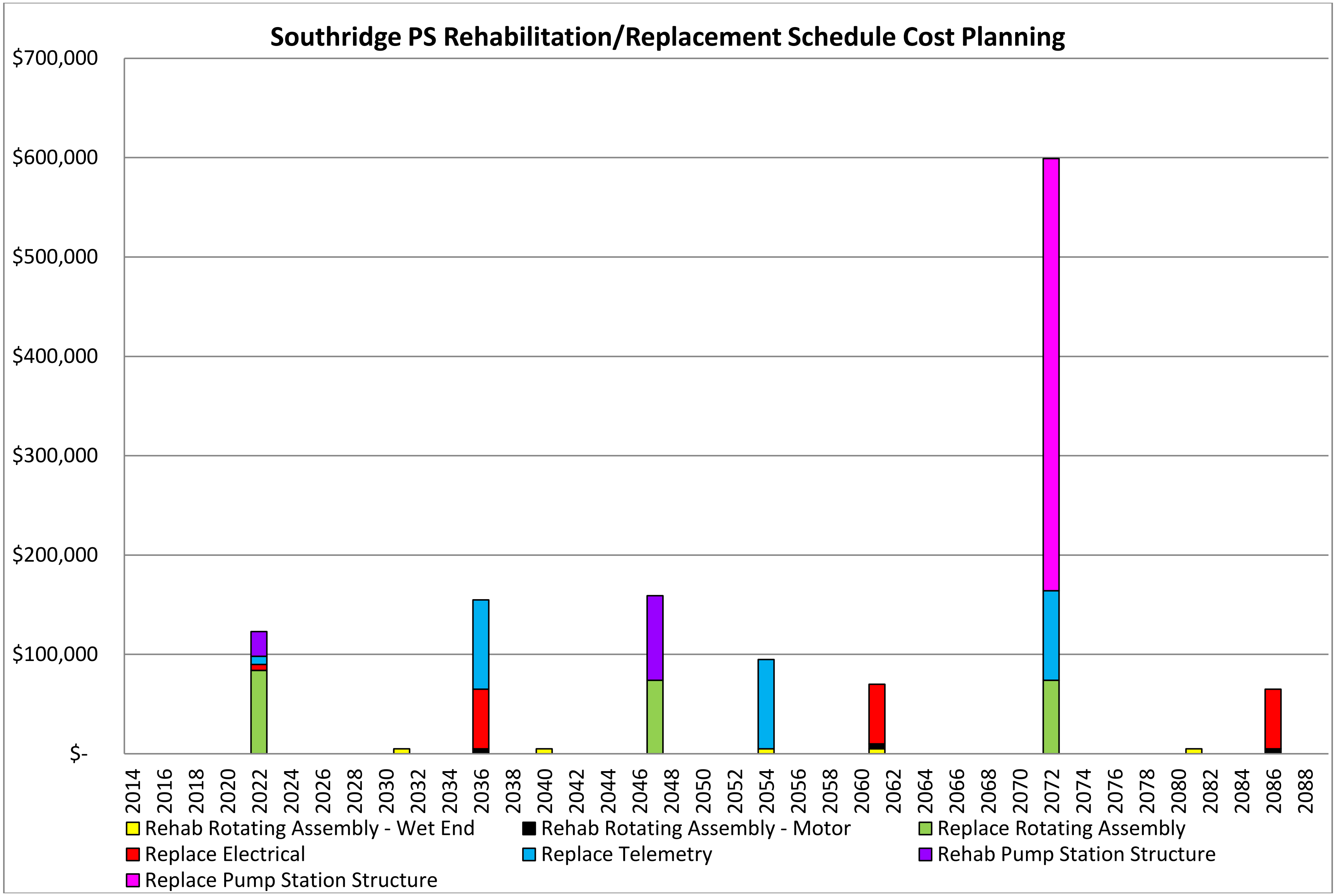
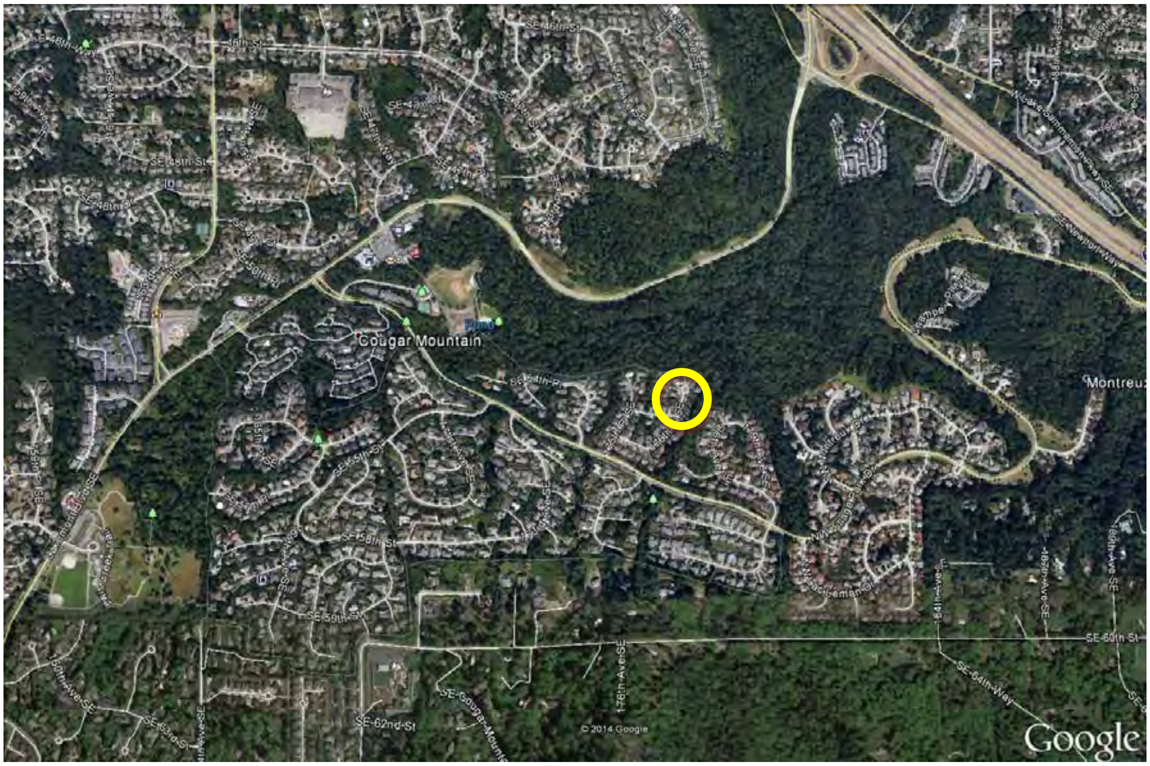


Figure 19-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 20
LAKEMONT



20.1 Lakemont Pump Station General Description

Date of Visit	May 28th, 2014
City of Bellevue Asset No.	187619
Address	5392 176th Pl SE
Station configuration	Submersible
Original Construction	1994
Major Rehabilitation/Upgrade	None
Number of Pumps	2
Pump Horsepower	25
Station Voltage/Phase	480/3 Phase
Standby Power	Onsite generator in underground vault
Field-measured Station Firm Capacity	260 – 315 gpm

20.1.1 Summary of Findings

Lakemont pump station is located between two homes at the end of the cul de-sac on 176th Pl SE. This pump station does not receive flow from other stations and discharges to a gravity line. There were a few deficiencies observed at this site including potential pump seating issues. In addition to this deficiency, the intrinsic and non – intrinsic wiring are not properly isolated in the power and control panel which does not meet code requirements. The dry pit/generator vault has a continuous water leakage near the power and control panel and there is some water damage on the surrounding equipment. The check valve located in the check valve vault was leaking and there was stagnant raw sewage and water in the vault.

Table 20-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 20-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
L-1	Intrinsic and non-intrinsic wiring mixed in power and control panel	Provide barrier/isolation	2018-2022	$333,000
	Leaks near power and control panel where water is continuously dripping	Seal-up leaks		
	Utility power phase monitor – browned and cracked plastic housing	Replace and change out to Standard Diversified Electronics Model		
	Potential seating issue with Essco submersible pumps	Replace pumps, motors and motor drivers		
	Dry transformer runs hot	Replace dry transformer		
	Service entrance disconnect equipment and meter base showing signs of aging	Replace service entrance disconnect and meter base		
	Some delamination of PVC liner	Rehab interior		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

20.2 Site

20.2.1 Site Description

Vehicle access to site	Removable bollards at end of street, parking 20' from site
Landscaping	Gravel, shrubs around
Site lighting	None
Fencing/security	None, Arborvitae around three sides, 10' high
Public accessibility to site	Full access

General observations/notes from field visit:

- Hatches several inches above grade – potential tripping hazard

Hatches several inches above grade – potential tripping hazard

Parking adjacent to station, station behind Arborvitae

20.3 Station Facilities

20.3.1 Wet Well – Structure and Accessories

20.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, PVC liner
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	8' inside diameter
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	(2) 8", above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

20.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified there is some delamination of the PVC liner.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

Wet well hatch and ladder

Interior of wet well

20.3.2 Dry Pit/Generator Vault – Structure and Accessories

20.3.2.1 Dry Pit/Generator Vault General Description

Area	Current Classification	Rationale
Dry Pit/Generator Vault	Unclassified	-

Construction materials	Concrete, sound proof panels
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	18’x8’
Lighting	Yes
Ventilation	Exhaust Fan
Ventilation continuous	No

20.3.2.2 Dry Pit/Generator Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit/generator vault appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit/generator vault is easily accessed and parts are readily available

General observations/notes from field visit:

- Water cooled generator

Interior of dry pit/generator vault with sound proof panels

Generator located in vault

20.3.3 Wet Well Blower Vault – Structure and Accessories

20.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x4’x5’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

20.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Flooding evident

Interior of wet well blower vault,
flooding evident

20.3.4 Check Valve and Isolation Valve Vault – Structure and Accessories

20.3.4.1 Check Valve and Isolation Valve Vault General Description

Area	Current Classification	Rationale
Check Valve and Isolation Valve Vault	Class 1, Division 2	NFPA 820, table 4.2, row 31a

Construction materials	Concrete
Access description	30”x30” Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inside diameter
Lighting	None
Ventilation	None
Ventilation continuous	N/A

20.3.4.2 Check Valve and Isolation Valve Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Interior of vault appears to be in good condition, but flooding is evident and there is raw sewage in the vault due to the leaking check valve.

Criticality Rating 4 – Station could not operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- Flooding evident
- Check valve leaking, raw sewage in vault

Isolation and check valve vault, flooding evident, check valve leaking upon site visit

20.4 Mechanical

20.4.1 Pumps

Pump System Performance

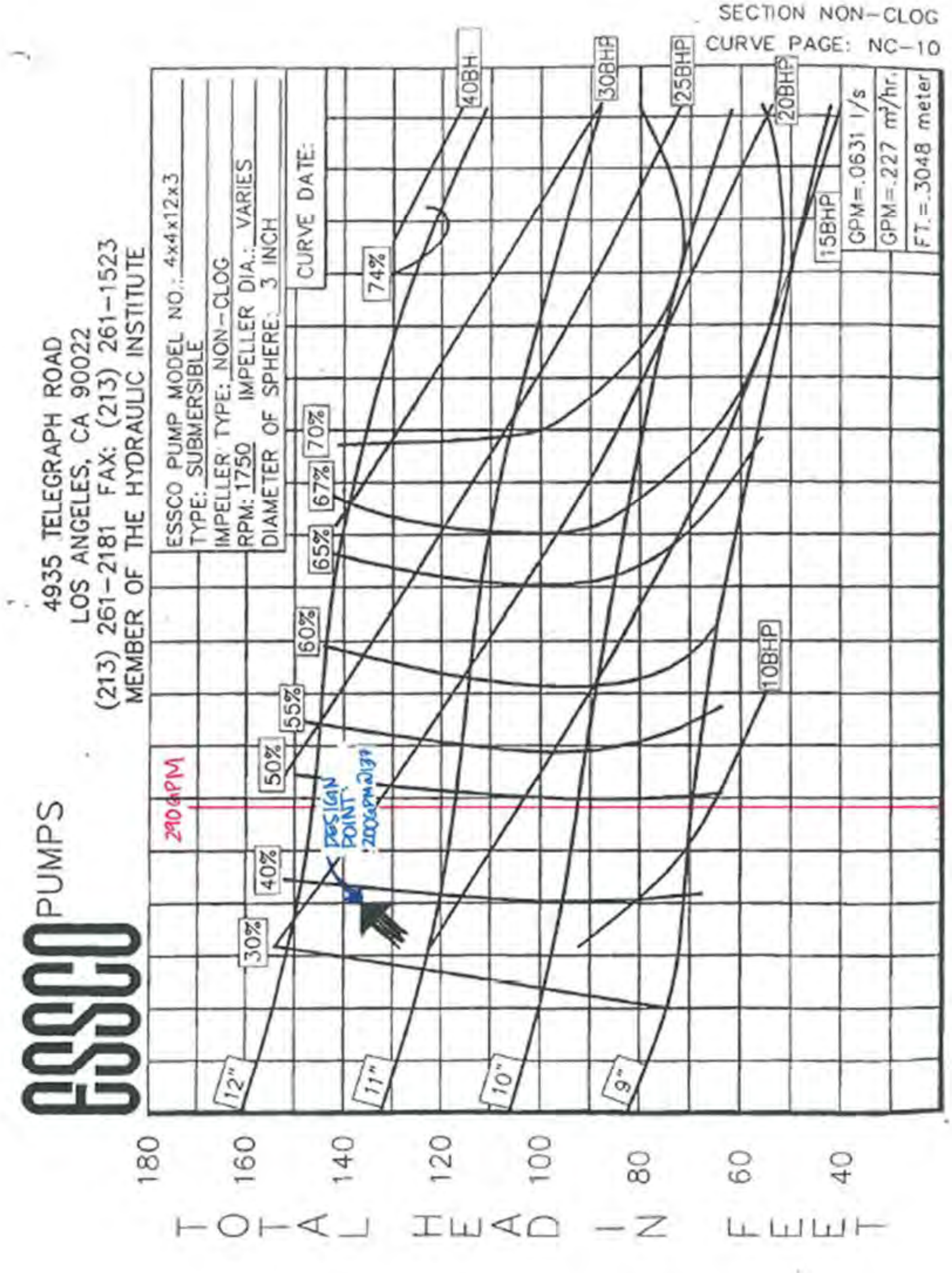
The field measured performance of the pumps at Lakemont Pump Station only captured flow rates, as operating pressures were not available. Without the pressure information, little can be understood regarding the operation of the pumps. The measured flow was higher than the design flow (~290 gpm vs. 200 gpm), which may indicate that the current head condition is lower than the original design condition. However, it was evident during the site visit that the one of the pumps was not seating properly against the base discharge elbow and was subsequently recirculating flow in the wet well (turbulent water conditions). This is a reportedly an ongoing problem that reduces the effective pumping capacity.

The following table documents the pump run hours and starts by month over the past year.

Table 20-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	13.23	319	18.31	319
May-13	12.83	312	18.83	313
Jun-13	13.72	340	18.08	305
Jul-13	12.47	311	15.3	308
Aug-13	19.95	473	7.31	137
Sep-13	27.54	658	0	0
Oct-13	26.69	638	0	0
Nov-13	23.34	464	0.02	2
Dec-13	17.75	352	20.28	353
Jan-14	19.94	357	19.31	357
Feb-14	12.98	238	27.01	444
Mar-14	2.78	77	36.1	714
Total	**203.22**	**4,539**	**180.55**	**3,252**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.6	0.5	0.5	0.4

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.


ESSCO PUMPS
4935 TELEGRAPH ROAD
LOS ANGELES, CA 90022
(213) 261-2181 FAX: (213) 261-1523
MEMBER OF THE HYDRAULIC INSTITUTE
ESSCO PUMP MODEL NO.: 4x4x12x3
TYPE: SUBMERSIBLE
IMPELLER TYPE: NON-CLOG
RPM: 1750 IMPELLER DIA.: VARIES
DIAMETER OF SPHERE: 3 INCH
CURVE DATE:
SECTION NON-CLOG
CURVE PAGE: NC-10
GPM=.0631 l/s
GPM=.227 m³/hr.
FT.=.3048 meter
12"
11"
10"
9"
30%
40%
50%
55%
60%
65%
67%
70%
74%
40BHP
30BHP
25BHP
20BHP
15BHP
10BHP
290GPM
DESIGN POINT: 200GPM@137'
TOTAL HEAD IN FEET
180
160
140
120
100
80
60
40
100
200
300
400
500
600
700
800
900
1000
US GPM
FIELD MEASUREMENT: ~290 GPM
NO PRESSURE MEASURED

20.4.1.1 Pump 1 – City of Bellevue Asset No. 193818

Pump style	Submersible
Make	Essco*
Model	4x4x12x3*
Serial No.	93232-1*
Horsepower	25
Voltage/phase	460/3
Date of installation	1993
Design Conditions	200 gpm @ 137 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	2-rail submersible system

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 4 – A lot of noise and recirculation during operation, pump may not be seating

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

General observations/notes from field visit:

- A lot of rattling during operation – potential vibration issues
- Extremely turbulent wet well – pump may not be seating – had to replace base elbows due to abrasion

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	260 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Measured flow is significantly higher than design flow

Submersible station, unable to observe pumps

20.4.1.2 Pump 2 – City of Bellevue Asset No. 193816

Pump style	Submersible
Make	Essco*
Model	4x4x12x3*
Serial No.	93232-1*
Horsepower	25
Voltage/phase	460/3
Date of installation	1993
Design Conditions	200 gpm @ 137 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	2-rail submersible system

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 4 – A lot of noise during operation, pump may not be seating

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

General observations/notes from field visit:

- A lot of rattling during operation – potential vibration issues
- Extremely turbulent wet well – pump may not be seating – had to replace base elbows due to abrasion

Pump 2 Drawdown Test

Static head (feet)	Unknown
Calculated pumping capacity	315 gpm
Total Dynamic head (feet)	Unknown
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Measured flow is significantly higher than design flow

Submersible station, unable to observe pumps

20.4.2 Exposed Piping and Valves

20.4.2.1 Discharge Piping/Valve(s) Description

Size	6”
Material	DI
Valve Type(s)	Plug valve and swing check valve with outside lever and spring

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Swing check valve with outside lever and spring do not open very far, it is also leaking
- Plug valve vertical axis of rotation – not ideal
- Some rusting on piping and valves

20.4.3 Other Station Piping

Bypass piping	Yes
Pig launching	Yes
Air release valves	No
Force main isolation	None known

20.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose bibb in underground generator vault, freeze-less yard hydrant near wet well
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	Above grade enclosure/Heat tape

Plug valve and swing check valve with outside level and spring located in isolation and check valve vault, some rusting evident

Freeze-less yard hydrant near wet well

Backflow prevention assembly in above grade enclosure

20.4.5 Ventilation

20.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	878 CFM @ 1" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

20.4.5.2 Dry Pit/Generator Vault Ventilation (Exhaust Fan)

Location	Ceiling/corner of generator vault/dry pit
Fan type	Belt driven axial
Airflow rate	3200 CFM @ 10" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The exhaust fan can be difficult to access since it is located in the ceiling/corner of the dry pit/generator vault

General observations/notes from field visit:

- Two speed exhaust fan

Wet well fan located in wet well blower vault

20.5 Electrical

20.5.1 Electrical Service

20.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Pad mounted
Service meter location	On service entrance equipment rack

20.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base appears to be in good condition; service disconnect is aging

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 2 – Standard parts; accessible, but must disassemble fence to replace

20.5.2 Backup Power

20.5.2.1 Backup Power Description

City of Bellevue Asset No.	193741
Type	Standby Generator (diesel)
Location	Underground generator vault
Manufacturer	Cummins
Model	80 DGDA
Serial No.	I930520443
Age	Approx. 26 years
Electrical Capacity (KW)	80 KW
Fuel Storage	160 gal
Cooling	Water (Domestic water supply)
Transfer switch type	Auto
Transfer switch location	In generator vault

20.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 3 – Standard parts; generator located in vault; service is more difficult

Service entrance equipment rack including generator receptacle located behind arborvitae adjacent to site

Service meter located on service entrance equipment rack

Standby generator located in dry pit/generator vault

20.5.3 Site – Panelboard

20.5.3.1 Panelboard Description

Location	In dry pit/generator vault
Voltage/Phase	240/120/1 phase
Manufacturer	SQ D
Model	NQOD20L100

20.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Panel is rusting on surface due to moisture; transformer is running hot

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; located in dry pit/generator vault

20.5.4 Site - Starters

20.5.4.1 Starters Description

Starters	(2) FVNR Starters

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Original starters and circuit breakers are Eaton Cutler Hammer, appears to be in good shape but aging

Criticality Rating 3 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit/generator vault

Panelboard located in dry pit/generator vault, some surface rust

Starter/control panel with operator interface located under tarp in dry pit/generator vault

Original starters and circuit breakers are Eaton Cutler Hammer, appear to be in good shape but aging

20.5.5 Site – Telemetry Control Panel

20.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376863
Location	Under tarp in dry pit/generator vault
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In box in dry pit/generator vault

20.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit/generator vault

General observations/notes from field visit:

- Some corrosion on top of power and control panel, tarp above needs to be sealed

20.5.6 Site - Submersible Cable Termination Enclosure

20.5.6.1 Submersible Cable Termination Enclosure Description

Location	Above grade explosion proof box
Material	Unknown

20.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Good quality equipment enclosures and appears to be in good condition

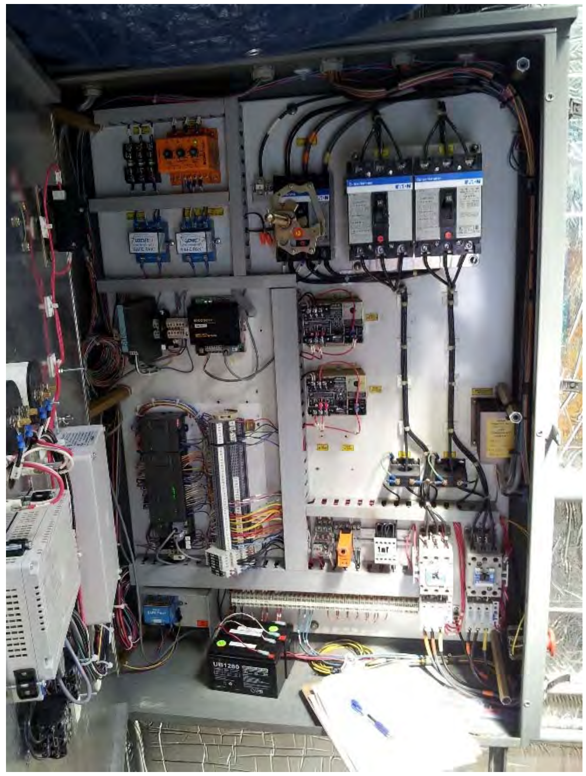
Criticality Rating 3 – Critical but redundant, transmits power from the starters to the pump cords but if one cord or termination fails the other pair will still operate

Serviceability Rating 1 – Low to the ground but otherwise fully accessible

General observations/notes from field visit:

- Terminal block spilled in – no terminals

Starter/control panel with operator interface located under tarp in dry pit/generator vault



Interior of telemetry control panel, appears to be in good condition

Submersible cable termination enclosure in above grade explosion proof box

Terminal block spilled in – no terminals

20.6 Station rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 20-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Intrinsic and non-intrinsic wiring mixed in power and control panel	Does not meet code requirements	• Provide Barrier
Leaks near power and control panel where water is continuously dripping	Degradation of power and control panel structure	• Seal-up leak
Utility power phase monitor – browned and cracked plastic housing	Loss of power at site	• Replace utility power phase monitor and change to Standard Diversified Electronics model
Potential seating issue with Essco submersible pumps	Loss of service at site	• Replace pumps, motors and motor drivers
Dry transformer runs hot	Loss of power at site	• Replace dry transformer
Service entrance disconnect equipment and meter base showing signs of aging	Loss of power at site	• Replace service entrance disconnect equipment and meter base
Some delamination of PVC liner	May decrease integrity of wet well structure	• Rehab PVC liner

20.6.1 Project Recommendations

Due to the location of the Lakemont pump station and its impact to adjacent private residences, it is recommended that a single project be completed to address all deficiencies identified and avoid returning for a second project soon after. The timing of the recommended project is driven by the replacement of the submersible pumps.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit/generator vault, wet well blower vault and check valve/isolation valve vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 20-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
L-1	Intrinsic and non-intrinsic wiring mixed in power and control panel	Provide barrier/isolation	2018-2022	$333,000
	Leaks near power and control panel where water is continuously dripping	Seal-up leaks		
	Utility power phase monitor – browned and cracked plastic housing	Replace and change out to Standard Diversified Electronics model		
	Potential seating issue with Essco submersible pumps	Replace pumps, motors and motor drivers		
	Dry transformer runs hot	Replace dry transformer		
	Service entrance disconnect equipment and meter base showing signs of aging	Replace service entrance disconnect and meter base		
	Some delamination of PVC liner	Rehab interior		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

20.6.2 Project Justification

The timing of the project is driven by the replacement of the pumps, motors and motor drivers since there is a potential seating issue. The consequence of failure of these components will reduce the level of service to the station below industry standards and regulatory requirements.

20.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 20-4 have been implemented in the timeline identified.

20.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 20-5 and 20-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 20-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 20-5
Current Estimated Remaining Useful Life

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	3	1	0	-	3	5-10

Table 20-6 includes project estimated remaining useful life when the recommended projects provided in Table 20-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups with the exception of the telemetry system will increase significantly. The estimated remaining life for the telemetry system will remain the same since the recommended projects do not include the replacement or rehabilitation of a majority of the telemetry system components.

Table 20-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	0	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

20.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 20-1 graphically represents the rehabilitation and replacement cost projections for the Lakemont Pump Station over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 20-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 20-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 20-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low				High
Pump Station	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	$10,000	$15,000	$20,000	$25,000	$30,000
	Ancillary components	$5,000	$10,000	$15,000	$20,000	$25,000
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 20-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

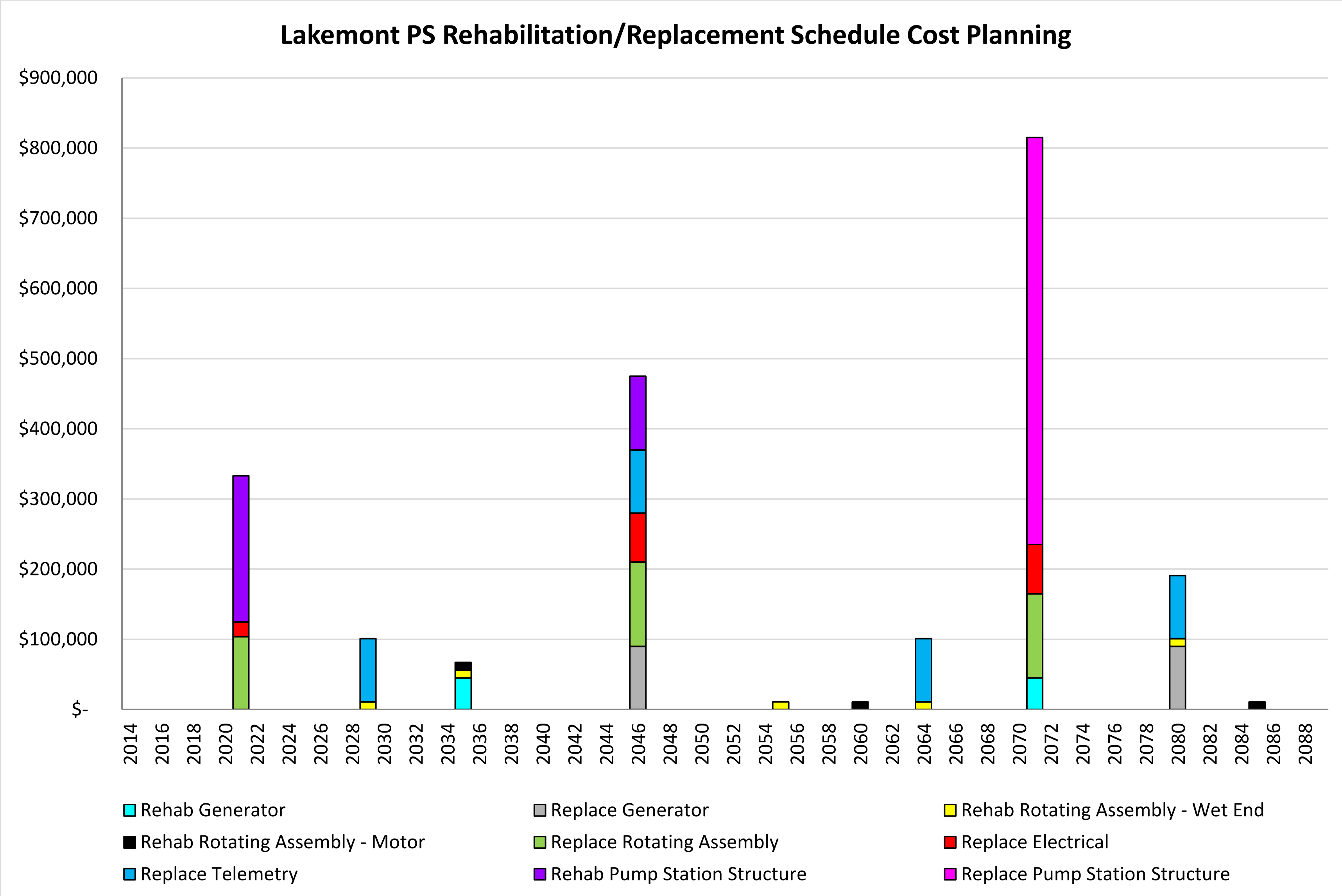
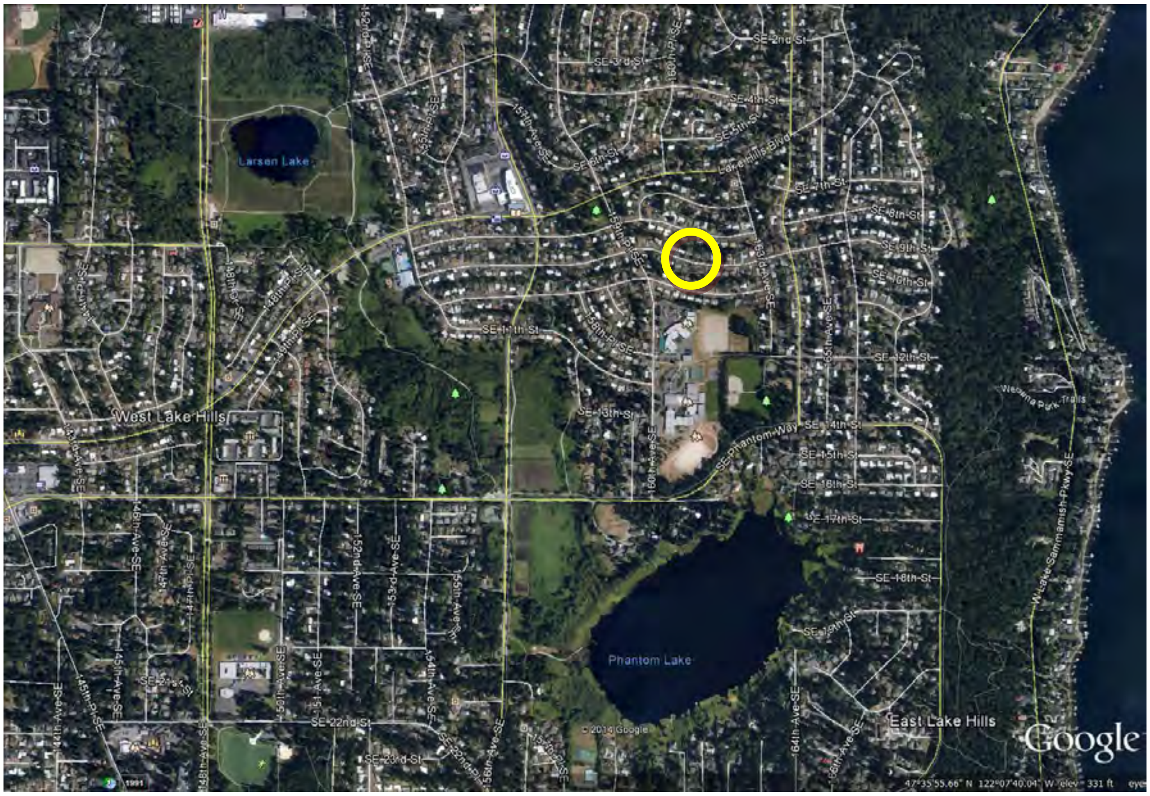


Figure 20-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 21
STATION 4



21.1 Station 4 General Description

Date of Visit	June 16th, 2014
City of Bellevue Asset No.	187617
Address	16035 SE 9th St
Station configuration	Wet well/Dry pit
Original Construction	1956
Major Rehabilitation/Upgrade	1991
Number of Pumps	2
Pump Horsepower	15
Station Voltage/Phase	480/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	370 – 400 gpm

21.1.1 Summary of Findings

Station 4 is adjacent to a home on 9th Ave in the yard area, the wet well access is in the roadway. This station does not receive flows from other stations and discharges to a gravity line. A major deficiency at this site is the corroded beam support in the dry pit that supports the grating on the mid-level.

Table 21-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 21-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S4-1	Beam seat connection is deteriorating and has significant corrosion	Replace beam seat connection	2015-2018	$12,000
	Portion of 6" cast iron pipe rusting near the rusted beam seat connection	Re-coat rusted portion of pipe		
S4-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2020-2025	$172,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	City owned meter base aging	Replace City owned meter base		
	Service entrance disconnect equipment and standby power phase monitor	Replace service entrance disconnect and standby power phase monitor		
	Telephone network interface termination box and backup level indicator aging	Replace telephone network interface termination box and backup level indicator		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

21.2 Site

21.2.1 Site Description

Vehicle access to site	Adjacent to SE 9th St
Landscaping	Rhododendron bushes surrounding 3 sides
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access to site, adjacent to home and road

Station adjacent to home on 9th Ave, Rhododendron bushes surrounding 3 sides

21.3 Station Facilities

21.3.1 Wet Well – Structure and Accessories

21.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	No
Access intrusion alarm	No
General dimensions	6’ inside diameter
Ladder/grating platform	Ladder and grating
Sewer invert(s)	12”, above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

21.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Wet well manhole lid in street adjacent to station

Wet well manhole lid and ladder, access adjacent to station in roadway

Interior of wet well

21.3.2 Dry Pit – Structure and Accessories

21.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete with steel grating at mid-level
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	7'-10"x5'-9"x17' deep, grating half way down
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

21.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition, but support bracket for midlevel grating requires further inspection and condition rating reassessment.

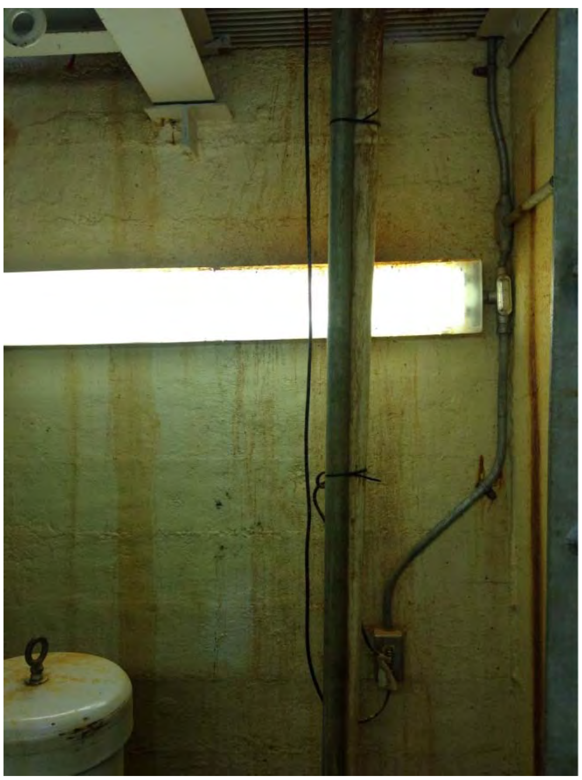
Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Tight space, somewhat challenging access for maintenance
- Discoloration on end wall – some from groundwater seepage, some from an old waterline leak
- Support bracket for mid-level grating platform appears to be significantly corroded, potential failure point. Further investigation of the structural integrity should be completed by the structural consultant.
- Supplemental evaluation done by CG Engineering, see Appendix B for summary of structural findings.

Ladder used to access pump level, somewhat challenging access for maintenance



Discoloration on end wall – some from groundwater seepage, some from an old waterline leak

Support bracket for mid level grating platform appears to be significantly corroded, potential failure point

21.3.3 Wet Well Blower Vault – Structure and Accessories

21.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	
Lighting	None
Ventilation	None
Ventilation continuous	N/A

21.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

Interior of wet well blower vault, vault is damp but appears to be in good condition

21.4 Mechanical

21.4.1 Pumps

Pump System Performance

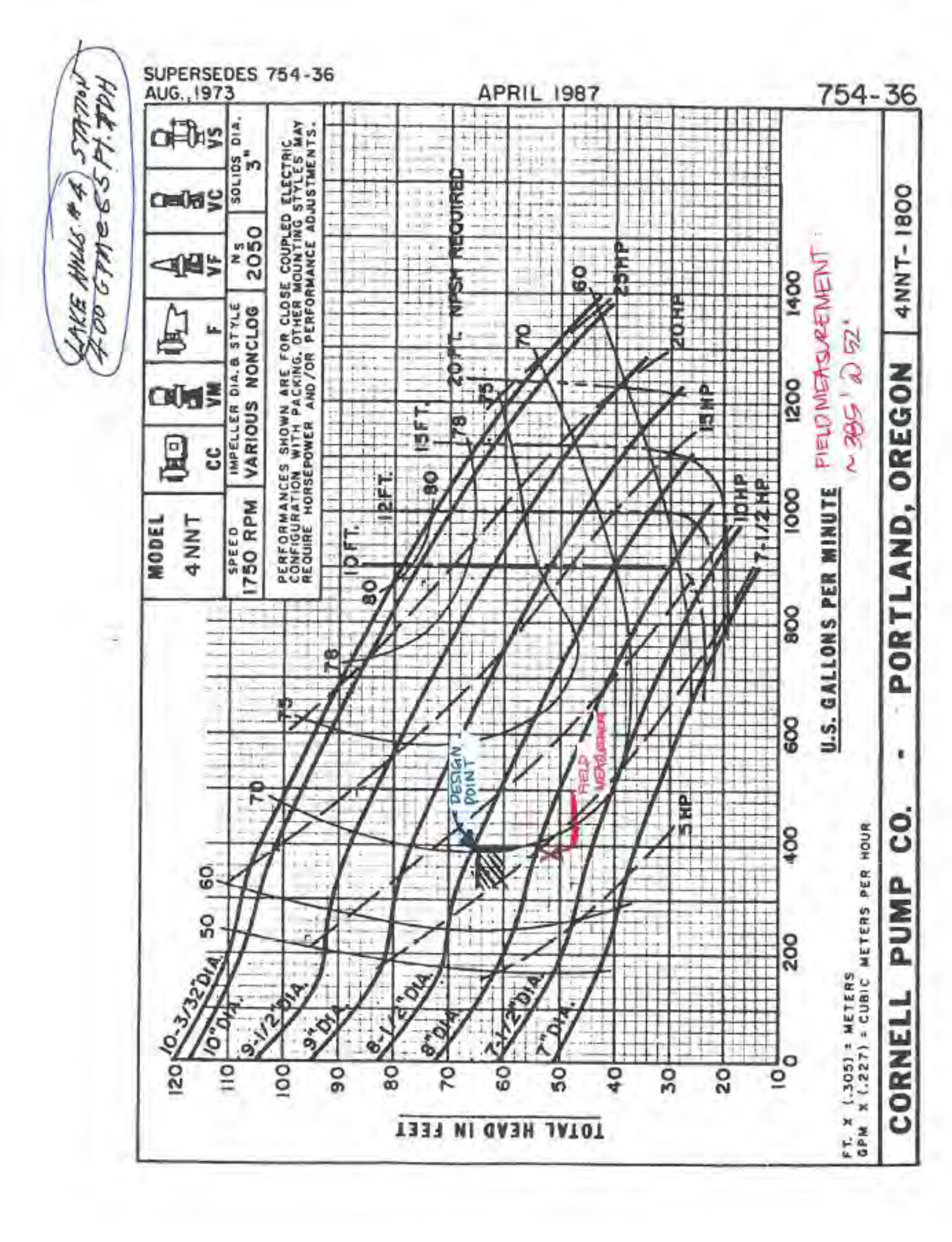
The field tested performance of Station 4 indicate that the flow is slightly lower than the design rate (~385 gpm vs. 400 gpm) and the pressure head is also slightly lower than the design rate (52 ft. vs. 65 ft). The measured flow and head appear to be in reasonable alignment with the original design point although it is measured below the curve which may indicate some wear.

The following table documents the pump run hours and starts by month over the past year.

Table 21-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	61.51	2,251	63.03	2,255
May-13	46.28	1,801	46.55	1,789
Jun-13	41.5	1,661	42.96	1,667
Jul-13	38.38	1,569	39.07	1,569
Aug-13	36.41	1,461	35.99	1,460
Sep-13	43.28	1,672	45.05	1,669
Oct-13	45.47	1,753	46.24	1,753
Nov-13	49.77	1,884	50.64	1,883
Dec-13	47.09	1,832	47.67	1,832
Jan-14	56.74	2,073	57.11	2,073
Feb-14	63.65	2,177	64.54	2,177
Mar-14	104.86	2,842	102.28	2,851
Total	**634.94**	**22,976**	**641.13**	**22,978**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.7	2.6	1.8	2.6

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.


SUPERSEDES 754-36
AUG., 1973
APRIL 1987
754-36
MODEL
4NNT
CC
VM
F
VF
VC
VS
SPEED
1750 RPM
IMPELLER DIA. & STYLE
VARIOUS NONCLOG
NS
2050
SOLIDS DIA.
3"
PERFORMANCES SHOWN ARE FOR CLOSE COUPLED ELECTRIC CONFIGURATION WITH PACKING. OTHER MOUNTING STYLES MAY REQUIRE HORSEPOWER AND/OR PERFORMANCE ADJUSTMENTS.
TOTAL HEAD IN FEET
U.S. GALLONS PER MINUTE
10-3/32"DIA.
10"DIA.
9-1/2"DIA.
9"DIA.
8-1/2"DIA.
8"DIA.
7-1/2"DIA.
7"DIA.
10 FT.
12 FT.
15 FT.
20 FT. NPSH REQUIRED
5HP
7-1/2 HP
10HP
15HP
20HP
25HP
DESIGN POINT
FIELD MEASUREMENT
FIELD MEASUREMENT ~ 395' @ 52'
LAKE HILLS #4 STATION
400 GPM @ 65 FT. TDH
FT. X (.305) = METERS
GPM X (.227) = CUBIC METERS PER HOUR
CORNELL PUMP CO. - PORTLAND, OREGON
4NNT-1800

21.4.1.1 Pump 1 – City of Bellevue Asset No. 193846

Pump style	Vertical mount, VM close-coupled centrifugal
Make	Cornell Pumps
Model	4NNT15-4LH
Serial No.	68116
Horsepower	15
Voltage/phase	460/230/3 phase
Date of installation	1991
Design Conditions	400 gpm @ 65 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Chain fall w/ picking eye above pump, only sufficient for inspecting wet end, not full removal

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition with some degradation and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 1 – Parts are available and the component is easily accessed

General observations/notes from field visit:

- Picking eye is attached to above platform – corrosion issue noted in dry pit section
- Trolley/rail is not marked with load capacity

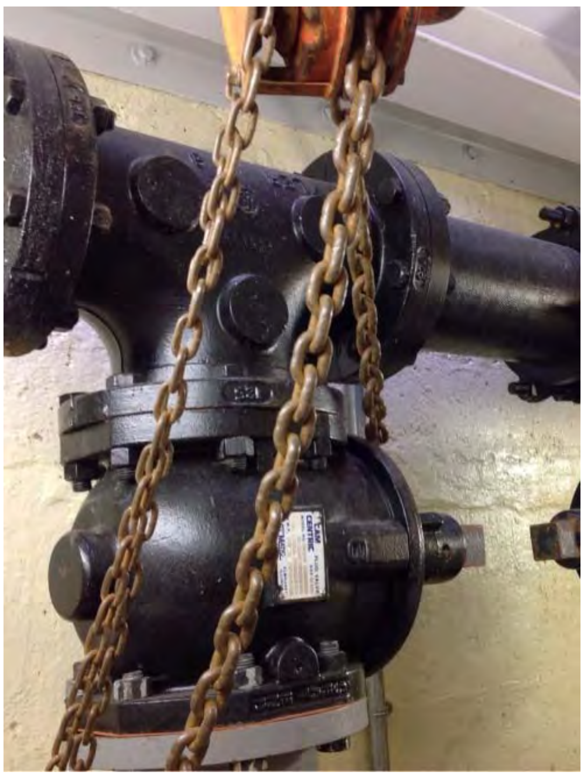
Pump 1 Drawdown Test

Static head (feet)	34
Calculated pumping capacity	370 – 380 gpm
Total Dynamic head (feet)	52
Number of tests performed	2

General observations/notes from drawdown test:

- Appears to be in reasonable alignment with the original design point with some potential wear since it measured below the original curve

Duplex station configuration, pump 1 on left



Picking eye is attached to above platform – corrosion issue on mid level grating platform

Pump and motor #1, showing signs of aging on exterior

21.4.1.2 Pump 2 – City of Bellevue Asset No. 193847

Pump style	Vertical mount, VM close-coupled centrifugal
Make	Cornell Pumps
Model	4NNT15-4RH
Serial No.	68117
Horsepower	15
Voltage/phase	460/230/3 phase
Date of installation	1991
Design Conditions	400 gpm @ 65 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Chain fall w/ picking eye above pump, only sufficient for inspecting wet end, not full removal

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition with some degradation and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 1 – Parts are available and the component is easily accessed

General observations/notes from field visit:

- Picking eye is attached to above platform – corrosion issue noted in dry pit section
- Trolley/rail is not marked with load capacity

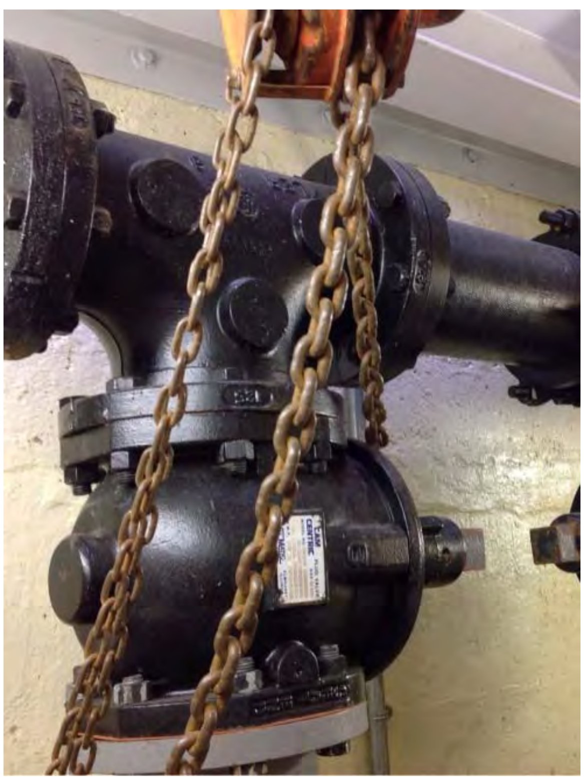
Pump 2 Drawdown Test

Static head (feet)	34
Calculated pumping capacity	390 – 400 gpm
Total Dynamic head (feet)	52.5
Number of tests performed	2

General observations/notes from drawdown test:

- Appears to be in reasonable alignment with the original design point with some potential wear since it measured below the original curve

Duplex station configuration, pump 2 on right



Picking eye is attached to above platform – corrosion issue on mid level grating platform

Pump and motor #2, showing signs of aging on exterior

21.4.2. Exposed Piping and Valves

21.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seats toward pump, horizontal axis of rotation – ideal

21.4.2.2 Discharge Piping/Valve(s)

Size	6”
Material	Unknown
Valve Type(s)	Plug valve and ball check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

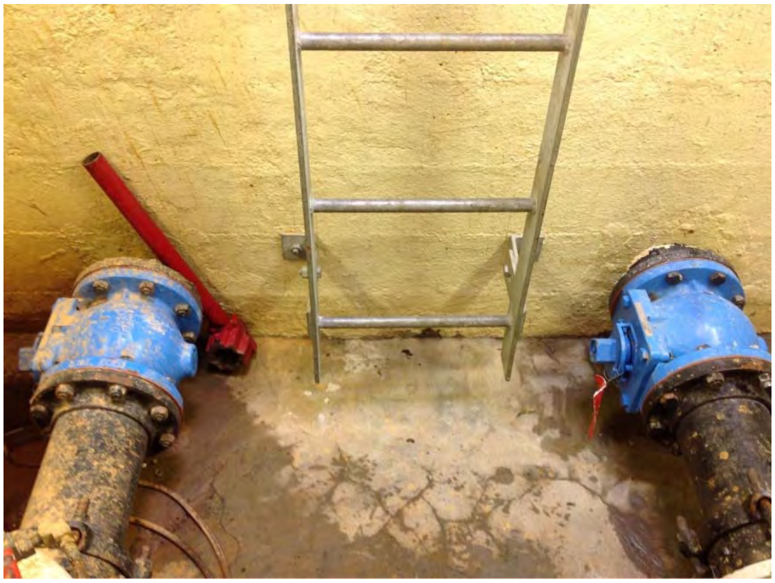
Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seat end is down toward pump, better for sealing flow but can accumulate debris behind plug and stop valve from working. Should be addressed upon replacement of rotating assembly.
- Ball check valve vertical installation



Plug valve on suction piping horizontal axis of rotation - ideal

Ball check valve vertical installation on discharge piping

Plug valve on discharge piping, seat end is down toward pump, better for sealing flow but can accumulate debris behind plug and stop valve from working

21.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	Discharge isolation valve outside station

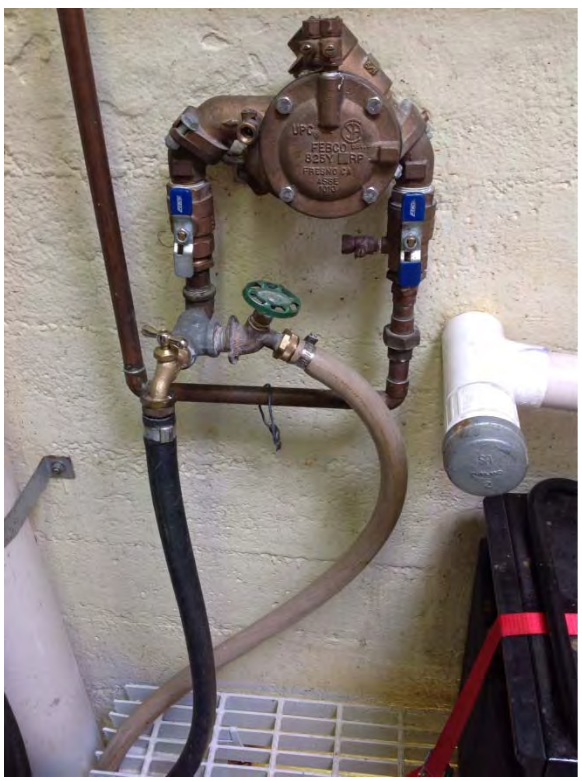
General observations/notes from field visit:

- Force main isolation valve is reportedly inoperable

21.4.4 Washdown Water

Supply	Domestic/Metered
Access	Service valve/connection on top level w/ hose to pump level
Backflow prevention assembly	Febco reduced pressure backflow device
Enclosure/Freeze protection	In upper level of dry pit/None

Service valve/connection on top level with hose to pump level



Backflow prevention assembly located in upper level of dry pit

21.4.5 Ventilation

21.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Belt driven axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating 1 – The supply fan is in good condition

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

21.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	Top of dry pit, upper level
Fan type	Axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located at the top of the dry pit

Wet well supply fan located in wet well blower vault

Dry pit supply fan located at ceiling at upper level

21.5 Electrical

21.5.1 Electrical Service

21.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Overhead on pole
Service meter location	Plywood pedestal

21.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base and fused disconnect appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from street

21.5.2 Backup Power

21.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	On galvanized unistrut stand
Transfer switch type	Manual
Transfer switch location	Dry pit wall

21.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Manual transfer switch and generator receptacle appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator receptacle accessible from the street

Electrical service meter and generator receptacle located between bushes

21.5.3 Site – Panelboard

21.5.3.1 Panelboard Description

Location	Upper dry pit wall
Voltage/Phase	120/240 VAC
Manufacturer	Siemens ITE
Model	CDP-7

21.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Siemens panel appears to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

21.5.4 Site - Starters

21.5.4.1 Starters Description

Starters	(2) FVNR Starters

21.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The Cutler Hammer starters are in good condition, but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard and starters located on upper level of dry pit

21.5.5 Site – Telemetry Control Panel

21.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376857
Location	Upper dry pit wall
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	On service pole

21.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry and control panel located on upper level of dry pit

21.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 21-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Beam seat connection is deteriorating and has significant corrosion	May decrease integrity of dry pit structure	• Replace beam seat connection
Portion of 6" cast iron pipe rusting near the rusted beam seat connection	May decrease integrity of pipe structure	• Re-coat rusted portion of pipe
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Pumps, motors and motor drivers are degrading based on perceived age	Loss of service at site	• Replace pumps, motors and motor driver
City owned meter base is aging	Loss of power at site	• Replace City owned meter base
Service entrance disconnect equipment and standby power phase monitor are aging	Loss of power at site	• Replace service entrance disconnect equipment and standby power phase monitor
Telephone network interface termination box and backup level indicator are aging	Loss of control at site	• Replace telephone network interface termination box and backup level indicator
No interior wet well coating	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

21.6.1 Project Recommendations

The deficiencies were separated into two projects since the structural improvements will not interrupt the operation of the station. The first project includes the replacement of the beam seat connection and re-coating of the rusted portion of the pipe. In addition CG Engineering recommends the water leak and humid/wet conditions in the dry pit should be rectified as soon as possible by the City maintenance staff. A detailed description of dry pit deficiencies and recommendations from CG Engineering is provided in Appendix B.

The timing of the second project was driven by the replacement of the rotating assembly and the City owned meter base, which is critical to the operation of the station. In addition to these recommendations all other deficiencies should be addressed within this project.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit and wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 21-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S4-1	Beam seat connection is deteriorating and has significant corrosion	Replace beam seat connection	2015-2018	$12,000
	Portion of 6” cast iron pipe rusting near the rusted beam seat connection	Re-coat rusted portion of pipe		
S4-2	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2020-2025	$172,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	City owned meter base aging	Replace City owned meter base		
	Service entrance disconnect equipment and standby power phase monitor	Replace service entrance disconnect and standby power phase monitor		
	Telephone network interface termination box and backup level indicator aging	Replace telephone network interface termination box and backup level indicator		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

21.6.2 Project Justification

The structural improvements should be complete to prevent additional corrosion and deterioration of the dry pit structure and piping.

The timing of the second recommended project is driven by the replacement of the rotating assembly and City owned meter base (due to its criticality and serviceability ratings). The consequence of failure of either of these components will reduce the level of service to the station below industry standards and regulatory requirements.

21.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 21-4 have been implemented in the timeline identified.

21.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 21-5 and 21-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 21-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 21-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	2	1	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	2	1	0	-	2	10-15

Table 21-6 includes project estimated remaining useful life when the recommended projects provided in Table 21-4 are complete. Upon completion of the recommended projects the remaining useful life for most asset groups with the exception of the telemetry system will increase significantly. The estimated remaining useful life will remain the same since the recommended projects do not include the replacement or rehabilitation of a majority of the telemetry equipment.

Table 21-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

21.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 21-1 graphically represents the rehabilitation and replacement cost projections for Station 4 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 21-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 21-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 21-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 12-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

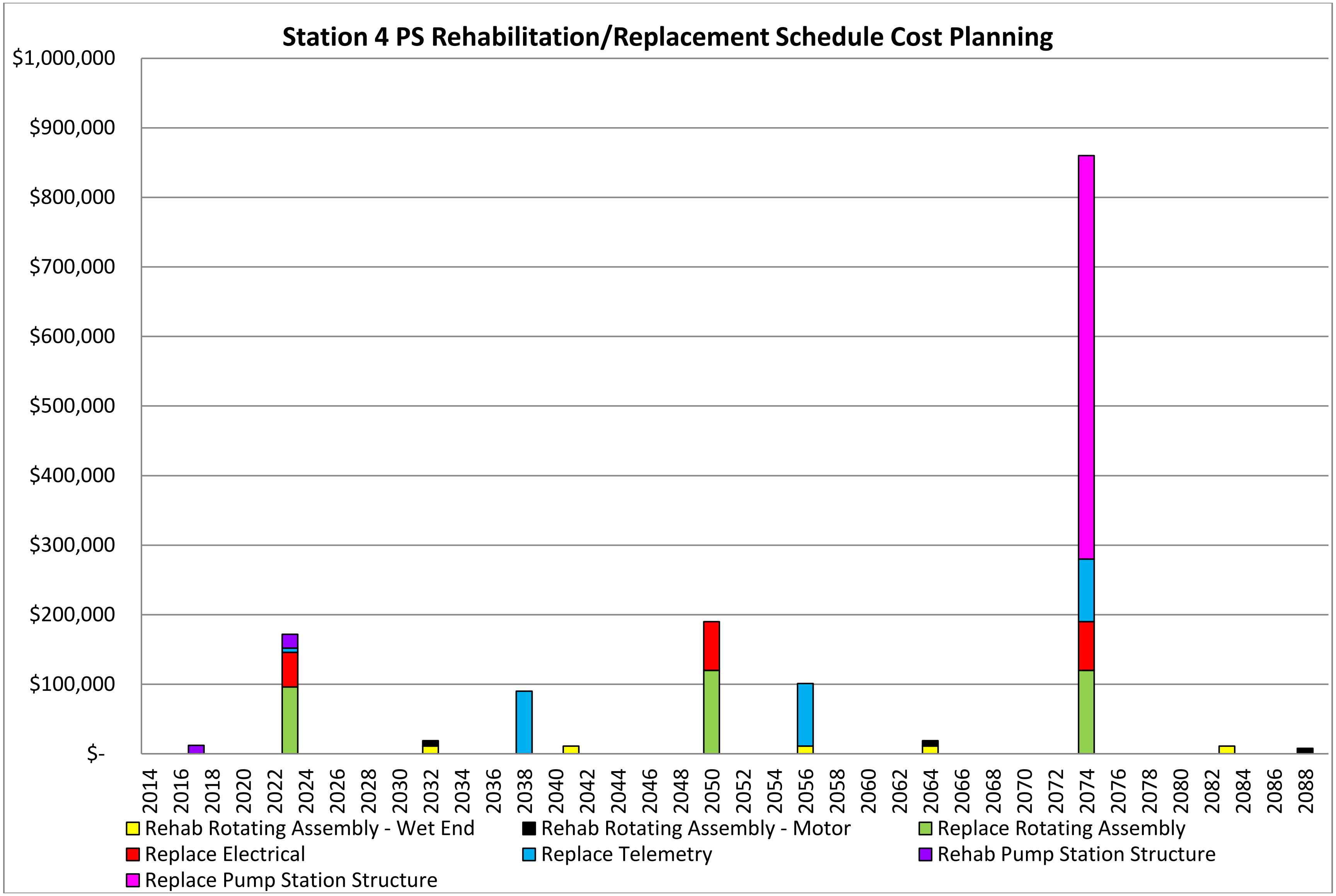
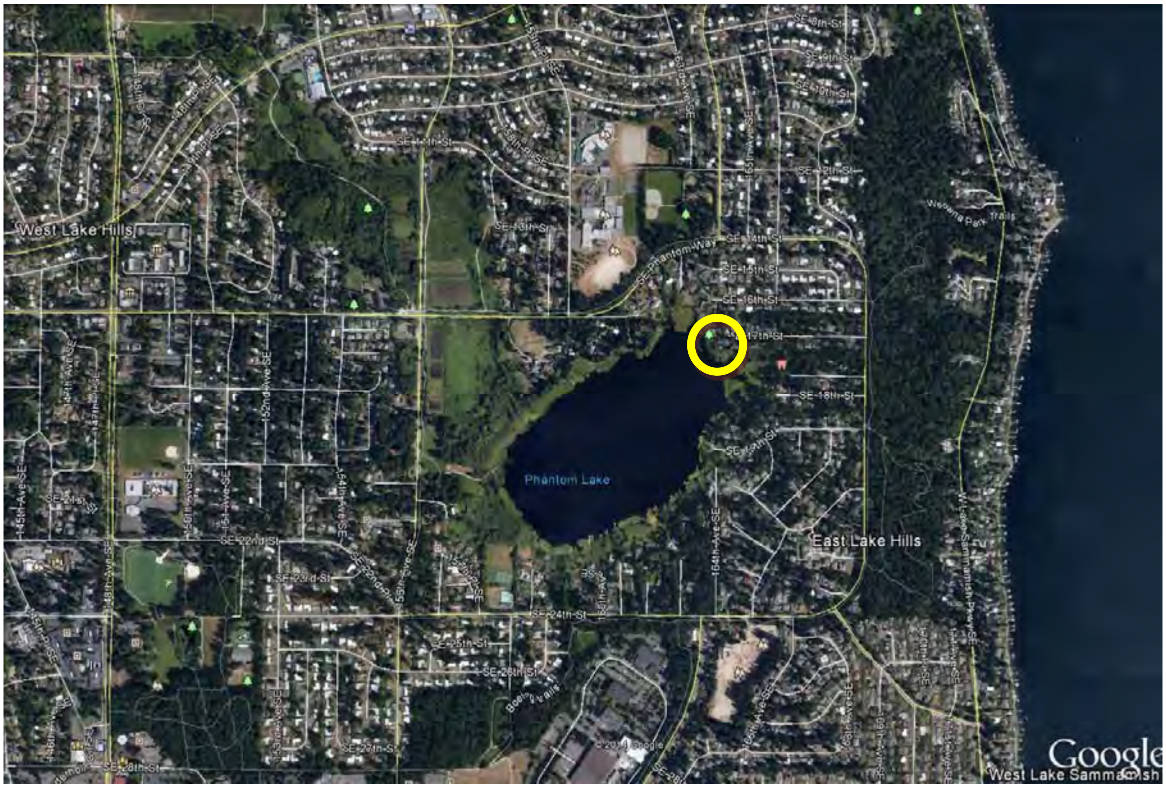


Figure 21-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 22
STATION 6



22.1 Station 6 General Description

Date of Visit	June 16th, 2014
City of Bellevue Asset No.	187622
Address	16358 SE 16th St
Station configuration	Submersible
Original Construction	1968
Major Rehabilitation/Upgrade	1988
Number of Pumps	2
Pump Horsepower	10
Station Voltage/Phase	480/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	115 – 125 gpm

22.1.1 Summary of Findings

Station 6 is located in a park adjacent to Phantom Lake. This pump station does not receive flows from other stations and it discharges to a gravity line. Some electrical deficiencies observed at this site include overfull conduits and a terminal cabinet not rated for explosion proof conditions. Rust was also observed on the non-used terminals for the submersible cable termination enclosure block and the conduits to the wet well are not sealed.

Table 22-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 22-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S6-1	Conduits penetrating the wet well do not have seal offs	Install seal offs	2020-2025	$148,000
	Conduit overfull with 6-480 and 6-120 conductors	Replace with bigger conduits		
	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters		
	City owned meter base aging	Replace City owned meter base		
	Service entrance disconnect equipment aging	Replace service entrance disconnect equipment		
	Some rust on non-used terminals from submersible cable termination enclosure block	Replace submersible cable termination enclosure		
	Standby power phase relay aging	Replace standby power phase relay		
	Telephone network interface termination box aging	Replace telephone network interface termination box		
	Dry transformer running hot	Replace dry transformer		
	Primary and backup level indicators aging	Replace primary and backup level indicators		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

22.2 Site

22.2.1 Site Description

Vehicle access to site	Gravel access off dead end road, parking adjacent to site
Landscaping	In a park surrounded by grass, next to Phantom Lake
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access to site

General observations/notes from field visit:

- Wet well access prevents safe access to control cabinet

Gravel access off dead end road

In a park surrounded by grass, adjacent to Phantom Lake

22.3 Station Facilities

22.3.1 Wet Well – Structure and Accessories

22.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inside diameter
Ladder/grating platform	Ladder, no grating
Sewer invert(s)	8”, above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

22.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Corrosion of all materials in the wet well, including stainless steel rails
- Electrical components corroded
- Coating appears to be in good shape
- Water surface appears to be about 12 feet below ground surface

Wet well access hatch and ladder

Interior of wet well appears to be in good condition

22.3.2 Wet Well Blower and Check Valve/Isolation Valve Vault – Structure and Accessories

22.3.2.1 Wet Well Blower and Check Valve/Isolation Valve Vault General Description

Area	Current Classification	Rationale
Wet Well Blower and Check Valve/Isolation Valve Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	5’ inside diameter 8’-6” deep
Lighting	No working lights noticed
Ventilation	None
Ventilation continuous	N/A

22.3.2.2 Wet Well Blower and Check Valve/Isolation Valve Vault Findings

Condition	**1**	2	3	4	5
Criticality	1	2	3	**4**	
Serviceability	1	**2**	3	4	

Condition Rating 1 – Interior of vault appears to be in good condition.

Criticality Rating 4 – Station could not operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- No drain or sump, sump pump sitting on floor, some standing water at bottom
- Outside air intake through valve vault to fan, blows to wet well (direct connection) – continuous ventilation reduces potential for issues, but lack of mechanical supply to valve vault does not reduce classification rating

Wet well blower and check valve/isolation valve vault location

Interior of wet well blower and check valve/isolation valve vault

22.4 Mechanical

22.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at Station 6 indicates that the facility is pumping at a slightly lower flow (~120 gpm vs. 180 gpm) and a slightly lower head (59 ft vs. 61 ft) than the design point. The measured flow and head appears to be in reasonable alignment with the original design point but may indicate some wear since the measured flow is below the original pump curve.

The following table documents the pump run hours and starts by month over the past year.

Table 22-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	49.2	1,361	46.66	1,361
May-13	36.65	1,046	36.35	1,048
Jun-13	31.14	947	31.15	947
Jul-13	28.83	896	28.43	895
Aug-13	25.78	781	25.33	780
Sep-13	29.65	883	29.62	883
Oct-13	34.36	1,021	34.43	1,020
Nov-13	34.47	1,034	34.54	1,034
Dec-13	33.88	1,026	34.19	1,028
Jan-14	39.5	1,162	39.79	1,162
Feb-14	41.38	1,161	41.62	1,162
Mar-14	61.28	1,584	62.05	1,583
Total	**446.12**	**12,902**	**444.16**	**12,903**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.2	1.5	1.2	1.5

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Pump Model #:	CP-3127-484X with 4-inch discharge		
Design RPM:	1750		
Performance:			
Specified:		180 GPM @ 61' TDH	
Tested:	#1	145 GPM @ 64.5' TDH	
	#2	149 GPM @ 64.5' TDH	
Motor Horsepower:	10 HP		

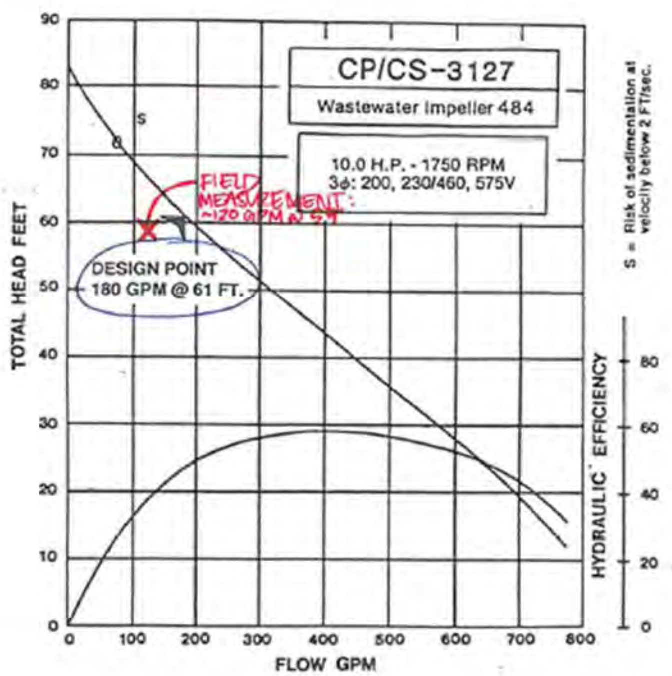
Local Representative

Whitney Equipment Co.
P.O. Box 1202
Bellevue, WA. 98009
Ph: 455-3526

Manufacturer

Flygt Corporation
129 Glover Avenue
Norwalk, CT. 06856

Note: Field pump tests give only approximate results due to measurement and equipment limitations.



Operation & Maintenance Manual Phantom Lake Pump Station No. 6	**Figure 3** Pump Inventory

22.4.1.1 Pump 1 – City of Bellevue Asset No. 193848

Pump style	Submersible
Make	Flygt*
Model	CP-3127-484X*
Serial No.	Unknown
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	180 gpm @ 61 feet TDH*
Able to isolate pump?	Yes, plug valve in adjacent valve vault
Ability to access/remove pump from station	Yes rent gantry crane and use City owned boom truck

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

Pump 1 Drawdown Test

Static head (feet)	Unknown
Calculated pumping capacity	115 – 125 gpm
Total Dynamic head (feet)	58
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static pressure during testing
- Pump appears to be operating near the design point, however operating below the original pump curve indicating potential wear

Submersible station, unable to observe pumps

22.4.1.2 Pump 2 – City of Bellevue Asset No. 193849

Pump style	Submersible
Make	Flygt*
Model	CP-3127-484X*
Serial No.	Unknown
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	180 gpm @ 61 feet TDH
Able to isolate pump?	Yes, plug valve in adjacent valve vault
Ability to access/remove pump from station	Yes rent gantry crane and use City owned boom truck

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

Pump 2 Drawdown Test

Static head (feet)	Unknown
Calculated pumping capacity	120 gpm
Total Dynamic head (feet)	59.5
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static pressure during testing
- Pump appears to be operating near the design point, however operating below the original pump curve indicating potential wear

Submersible station, unable to observe pumps

22.4.2 Exposed Piping and Valves

22.4.2.1 Discharge Piping/Valve(s) Description

Size	4”
Material	DI
Valve Type(s)	Plug valve and swing check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve vertical axis of rotation – not ideal

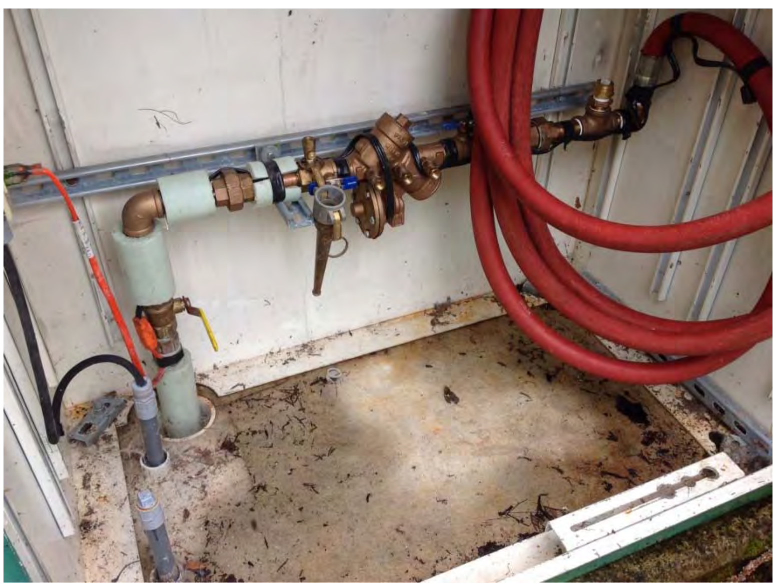
22.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

22.4.4 Washdown Water

Supply	Domestic/Metered
Access	Inside back flow preventer box
Backflow prevention assembly	Wilkins reduced pressure backflow device
Enclosure/Freeze protection	Metal painted enclosure/Heat tape

Plug valve and swing check valve located in adjacent underground vault



Wilkins reduced pressure backflow assembly located in enclosure with heat tape

22.4.5 Ventilation

22.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Adjacent wet well blower and check valve/isolation valve vault
Fan type	Axial
Airflow rate	300 CFM @ 0.375"SP*

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Fan draws air through gooseneck into valve vault and pushes it into wet well
- Wet well vents through open hatch (fan only turns on when hatch is open) and exhaust gooseneck

Wet well blower vault located in adjacent underground vault

22.5 Electrical

22.5.1 Electrical Service

22.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Overhead
Service meter location	Outside of enclosure

22.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base and main disconnect appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from street

22.5.2 Backup Power

22.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Outside of power enclosure
Transfer switch type	Manual
Transfer switch location	Inside power enclosure

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Manual transfer switch and generator receptacle appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator receptacle accessible from the street

Outdoor power enclosure

Electrical service meter and generator receptacle located outside of power enclosure

22.5.3 Site – Panelboard

22.5.3.1 Panelboard Description

Location	In power enclosure
Voltage/Phase	240/120/1 phase
Manufacturer	ITE
Model	CDP-7

22.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Panel in good condition, dry transformer running hot

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

22.5.4 Site - Starters

22.5.4.1 Starters Description

Starters	(2) FVNR Starters

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

22.5.4.2 Starters Findings

Condition Rating 2 – The Cutler Hammer starters appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Outdoor power enclosure

Panelboard and starters located in outdoor enclosure.
Panel in good condition, Cutler Hammer starters
aging

22.5.5 Site – Telemetry Control Panel

22.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376872
Location	In control enclosure
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	Float Relay
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In old telemetry cabinet

22.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- All power/control conductors come thru 1-3/4 galvanized rigid conduit with seal rotting including float cord

22.5.6 Site - Submersible Cable Termination Enclosure

22.5.6.1 Submersible Cable Termination Enclosure Description

Location	In power enclosure
Material	CDP-7

22.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 4 – Conduits undersized and no seal offs installed

Criticality Rating 4 – Critical, transmits power from the starters to the pump cords

Serviceability Rating 1 – Standard parts; equipment is in dry pit

General observations/notes from field visit:

- Conduits to wet well are not sealed – term part of explosion proof area but not built to explosion proof rating

All power and control conductors come through 1-3/4” galvanized rigid conduit with seal rotting

Telemetry control panel with operator interface located in control enclosure

Submersible cable termination enclosure

22.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 22-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Conduits penetrating the wet well do not have seal offs	Potential for sewer/explosive gas transfer	• Install seal offs
Conduit overfull with 6-480 and 6-120 conductors	Potential heat build-up – decreases rating of conductors	• Replace with bigger conduits
Rotating assembly degrading based on perceived age	Loss of service at site	• Replace rotating assembly
City owned meter base is aging	Loss of power at site	• Replace City owned meter base
Service entrance disconnect equipment is aging	Loss of power at site	• Replace service entrance disconnect
Some rust on non-used terminals from submersible cable termination enclosure block	Loss of power at site	• Replace termination enclosure
Standby power phase relay is aging	Loss of power at site	• Replace standby power phase relay
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box
Dry transformer running hot	Loss of power at site	• Replace dry transformer
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

22.6.1 Project Recommendations

Due to the location of Station 6 and its impact to the general public, it is recommended that a single project be completed to address all deficiencies identified and avoid returning for a second project soon after. The timing of the recommended project is driven by the replacement of the rotating assemblies which is critical to the operation of the station.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the wet well blower and check valve/isolation valve vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 22-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
S6-1	Conduits penetrating the wet well do not have seal offs	Install seal offs	2020-2025	$148,000
	Conduit overfull with 6-480 and 6-120 conductors	Replace with bigger conduits		
	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters		
	City owned meter base is aging	Replace City owned meter base		
	Service entrance disconnect equipment is aging	Replace service entrance disconnect equipment		
	Some rust on non-used terminals from submersible cable termination enclosure block	Replace submersible cable termination enclosure		
	Standby power phase relay is aging	Replace standby power phase relay		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Dry transformer running hot	Replace dry transformer		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

22.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the rotating assembly including the pumps, motors and motor drivers. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

22.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 22-4 have been implemented in the timeline identified.

22.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 22-5 and 22-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 22-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 22-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	2	0	0	-	2	10-15
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 22-6 includes project estimated remaining useful life when the recommended projects provided in Table 22-4 are complete. Upon completion of the recommended projects the remaining useful life for most asset groups will increase significantly with the exception of the telemetry system. The estimated remaining useful life will remain the same since the recommended projects do not include the replacement of significant telemetry equipment including the telemetry control panel.

Table 22-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

22.7.2 Rehabilitation/Replacement Schedule Cost Planning

Figure 22-1 graphically represents the rehabilitation and replacement cost projections for Station 6 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 22-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 22-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 22-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 22-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

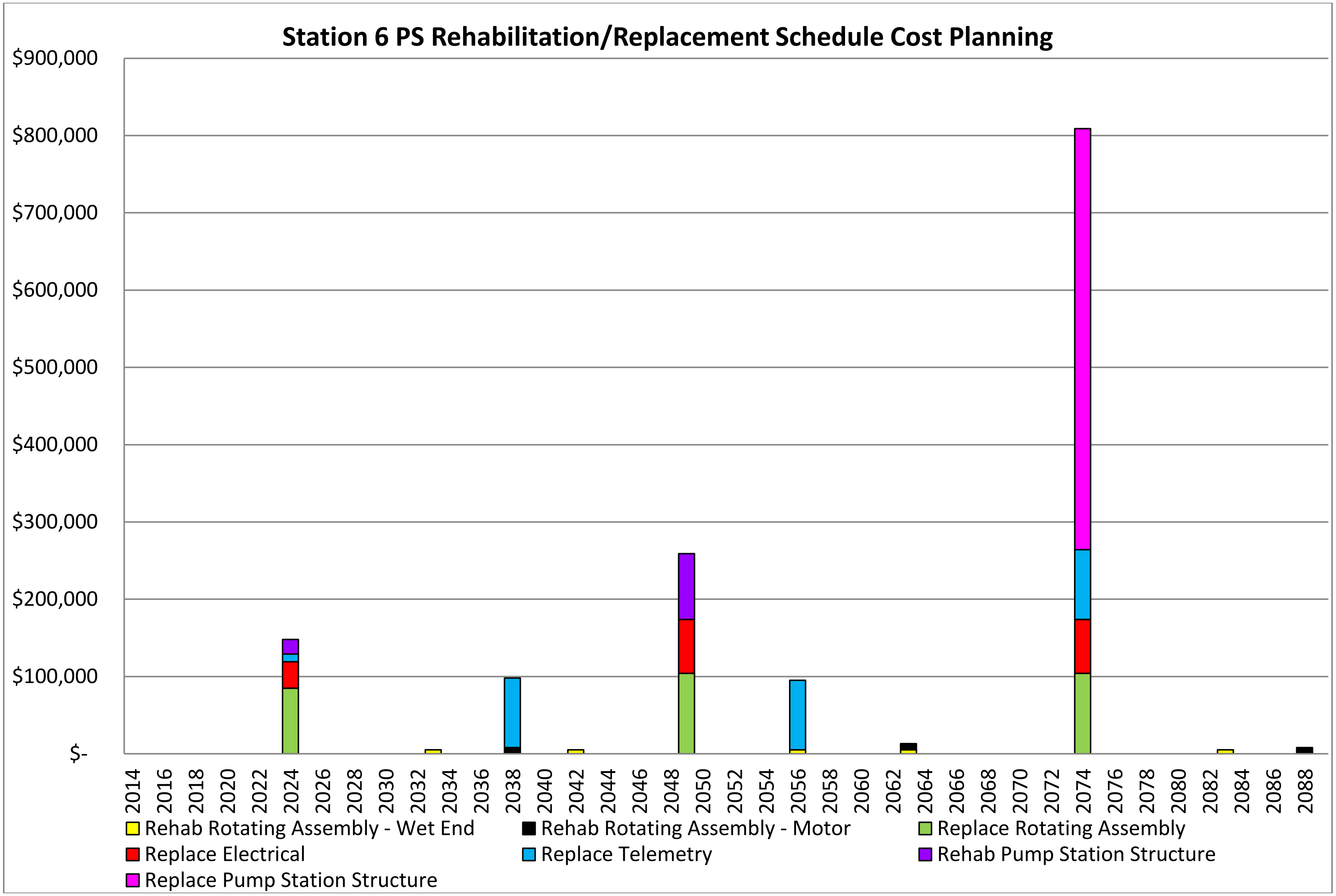
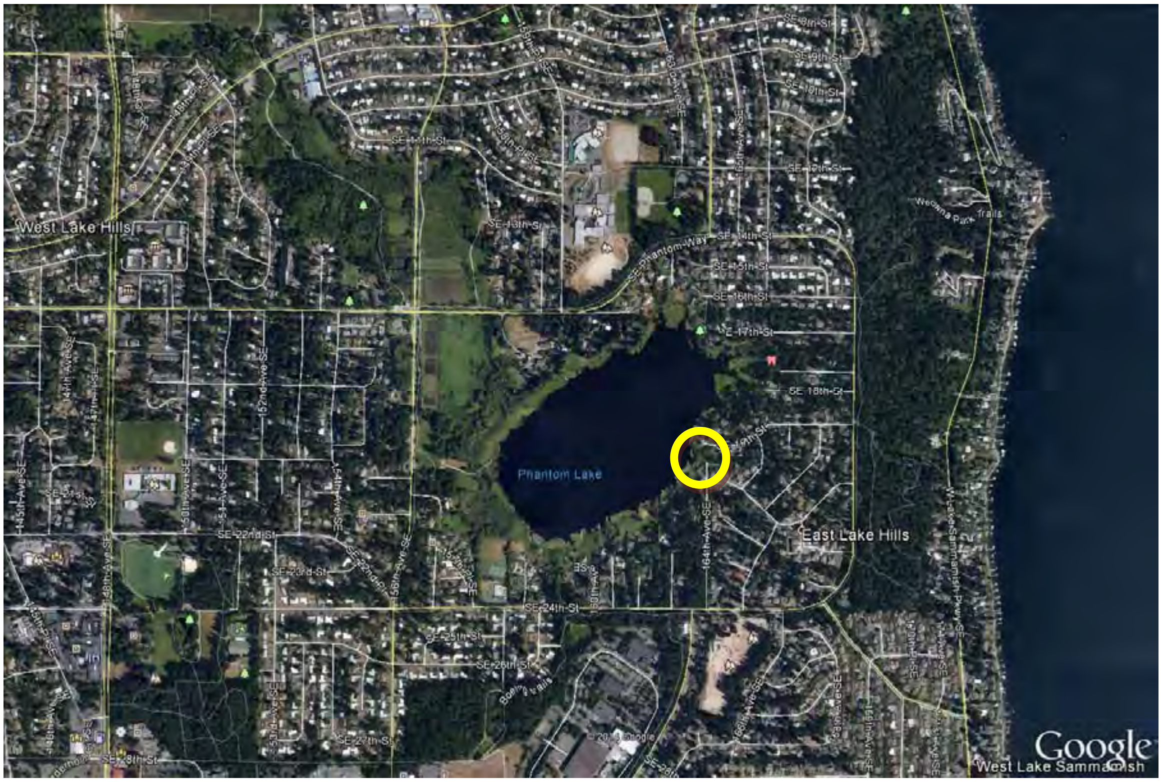


Figure 22-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 23
STATION 7



23.1 Station 7 General Description

Date of Visit	June 16th, 2014
City of Bellevue Asset No.	187627
Address	16280 SE 24th St
Station configuration	Submersible
Original Construction	1968
Major Rehabilitation/Upgrade	1988
Number of Pumps	2
Pump Horsepower	10
Station Voltage/Phase	480/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	175 – 190 gpm

23.1.1 Summary of Findings

Station 7 is located in a greenway adjacent to Phantom Lake and private residences. The station does not receive flows from other station and discharges to a gravity line. There were a few deficiencies observed at this site but most were due to age related degradation.

Table 23-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 23-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S7-1	City owned meter base is aging	Replace City owned meter base	2020-2025	$137,000
	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Dry transformer and panelboard are aging	Replace dry transformer and panelboard		
	Service entrance disconnect equipment and standby power phase monitor (relay) are aging	Replace service entrance disconnect equipment and standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

23.2 Site

23.2.1 Site Description

Vehicle access to site	Single lane private drive dead end, parking adjacent to site
Landscaping	Overgrown gravel surfacing (grass and weeds)
Site lighting	None
Fencing/security	None
Public accessibility to site	Full access but hatches locked

General observations/notes from field visit:

- Concrete box around high point in vent line is 12” high – potential tripping hazard

General site, overgrown gravel surfacing and concrete box around high point in vent line approximately 12" high – potential tripping hazard

Single lane private drive dead end vehicle access to site

23.3 Station Facilities

23.3.1 Wet Well – Structure and Accessories

23.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	6’ inside diameter, ~10’ to water surface
Ladder/grating platform	Ladder, no grating platform
Sewer invert(s)	(2) 8”, above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

23.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior coating appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Corrosion level similar to station 6

Wet well access hatch and ladder

Alternate view of interior of wet well

23.3.2 Wet Well Blower and Check Valve/Isolation Valve Vault – Structure and Accessories

23.3.2.1 Wet Well Blower and Check Valve/Isolation Valve Vault General Description

Area	Current Classification	Rationale
Wet Well Blower and Check Valve/Isolation Valve Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	5’ inside diameter, 8’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

23.3.2.2 Wet Well Blower and Check Valve/Isolation Valve Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Interior of vault appears to be in good condition.

Criticality Rating 4 – Station could not operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- Outside air intake through valve vault to fan, blows to wet well (direct connection) – continuous ventilation reduces potential for issues, but lack of mechanical supply to valve vault does not reduce classification rating.

Wet well blower and check valve/isolation
valve vault location

Interior of wet well blower and check valve/isolation
valve vault

23.4 Mechanical

23.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at Station 7 measured a lower flow (~185 gpm vs. 230 gpm) and lower head (52 ft vs. 56 ft) than the design point. The measured flow and head appear to be in reasonable alignment with the original design point. However measuring the flow/head below the pump curve likely indicates some pump wear and at more than 26 years in service, the pumps remaining life is expected to be limited. As the capacity continues to diminish, the City should confirm that the peak influent design flow does not exceed the reliable pumping capacity.

The following table documents the pump run hours and starts by month over the past year.

Table 23-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	26.51	1,076	26.13	1,078
May-13	23.72	973	22.53	971
Jun-13	22	949	20.85	950
Jul-13	24.22	997	22.17	997
Aug-13	20.83	969	19.44	967
Sep-13	21.35	1,039	21.63	1,038
Oct-13	22.62	1,091	22.74	1,090
Nov-13	25.93	1,225	26.13	1,224
Dec-13	23.88	1,161	24.27	1,159
Jan-14	26.74	1,245	27.04	1,244
Feb-14	29.57	1,297	29.8	1,297
Mar-14	35.97	1,459	36.43	1,460
Total	**303.34**	**13,481**	**299.16**	**13,475**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.8	1.5	0.8	1.5

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Pump Model #: CP-3127-484X with 4-inch discharge

Design RPM: 1750

Performance:

Specified:		230 GPM @ 56' TDH
Tested:	#1	220 GPM @ 60.5' TDH
	#2	205 GPM @ 60.5' TDH

Motor Horsepower: 10 HP

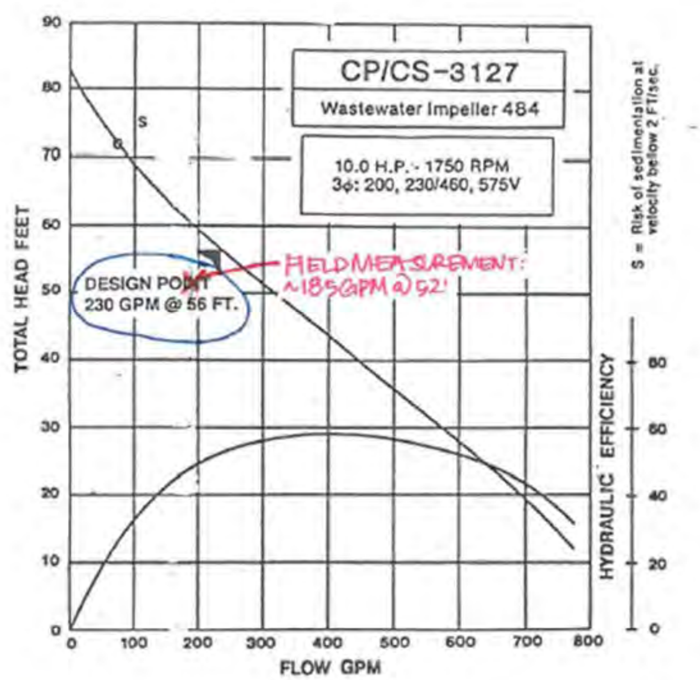
Local Representative

Whitney Equipment Co.
P.O. Box 1202
Bellevue, WA. 98009
Ph: 455-3526

Manufacturer

Flygt Corporation
129 Glover Avenue
Norwalk, CT. 06856

Note: Field pump tests give only approximate results due to measurement and equipment limitations.



Operation & Maintenance Manual Phantom Lake Pump Station No. 7	**Figure 3** Pump Inventory

23.4.1.1 Pump 1 – City of Bellevue Asset No. 193880

Pump style	Submersible
Make	Flygt*
Model	CP-3127-484X*
Serial No.	Unknown
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	230gpm @ 56 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane and use City owned boom truck

*Based on Record Documents, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, pumps are somewhat difficult to access due to location and must rent gantry crane to remove pumps

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	185 – 190 gpm
Total Dynamic head (feet)	51’
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static pressure during testing
- Measured point below pump curve may indicate some wear

Submersible station, unable to observe pumps

23.4.1.2 Pump 2 – City of Bellevue Asset No. 193836

Pump style	Submersible
Make	Flygt*
Model	CP-3127-484X
Serial No.	Unknown
Horsepower	10
Voltage/phase	230/460/3
Date of installation	1988
Design Conditions	230gpm @ 56 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane and use City owned boom truck

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump, but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, pumps are somewhat difficult to access due to location and must rent gantry crane to remove pumps

Pump 2 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	175 – 185 gpm
Total Dynamic head (feet)	52’
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static pressure during testing
- Measured point below pump curve may indicate some wear

Submersible station, unable to observe pumps

23.4.2 Exposed Piping and Valves

23.4.2.1 Discharge Piping/Valve(s) Description

Size	4”
Material	DI
Valve Type(s)	Plug valve and swing check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve vertical axis of rotation – not ideal

23.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

23.4.4 Washdown Water

Supply	Domestic/Metered
Access	Inside back flow preventer box
Backflow prevention assembly	Wilkins reduced pressure backflow device
Enclosure/Freeze protection	Painted metal enclosure/Heat tape

Plug valve and swing check valve located in adjacent underground vault

Wilkins reduced pressure backflow assembly and hose bibb located in enclosure with heat tape

23.4.5 Ventilation

23.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower and Isolation/Check valve vault
Fan type	Belt-driven axial
Airflow rate	300 CFM @ 0.375" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Fan did not operate during evaluation visit, source of problem unknown
- Wet well switch is corroded however, and switch sticks in position – replacement/inspection is recommended

Wet well supply fan located in wet well blower and
check valve/isolation valve vault

23.5 Electrical

23.5.1 Electrical Service

23.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Overhead
Service meter location	Outside of enclosure

23.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base and main disconnect appears to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from street

General observations/notes from field visit:

- City owned meter base needs painting

23.5.2 Backup Power

23.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Homeowners backyard in brambles
Transfer switch type	Manual
Transfer switch location	Power enclosure

23.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Manual transfer switch and generator receptacle appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; generator receptacle accessible from the street

Outdoor power enclosure

Generator receptacle located in homeowner’s backyard in brambles

Manual transfer switch located in outdoor power enclosure

23.5.3 Site – Panelboard

23.5.3.1 Panelboard Description

Location	Power enclosure
Voltage/Phase	120/240 VAC
Manufacturer	ITE
Model	CDP-7 Series 8

23.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Panel and dry transformer in good condition, but aging

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

23.5.4 Site - Starters

23.5.4.1 Starters Description

Starters	(2) FVNR Starters

23.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The Cutler Hammer starters are in good condition, but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Outdoor power enclosure

Panelboard located in outdoor power enclosure

23.5.5 Site – Telemetry Control Panel

23.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376890
Location	Control enclosure
Configuration	Integral w/ telemetry
Primary Level Indication	Submersible type
Secondary Level Indication	Float/ISR/TDR
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	On pole at 18’

23.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

23.5.6 Site - Submersible Termination Enclosure

23.5.6.1 Submersible Termination Enclosure Description

Location	Inside explosion proof junction box/On pipe rack
Material	Unknown

23.5.6.2 Submersible Termination Enclosure Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Conduits and explosion proof junction box and terminals appear to be in good condition

Criticality Rating 3 – Critical but redundant, transmits power from the starters to the pump cords but if one cord or termination fails the other pair will still operate

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Control enclosure located on opposite side of outdoor power enclosure

Submersible termination enclosure located in explosion proof junction box on pipe rack

23.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 23-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
City owned meter base is aging	Loss of power at site	• Replace City owned meter base
Rotating assembly degrading based on perceived age	Loss of service at site	• Replace rotating assemblies
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box
Dry transformer and panelboard are aging	Loss of power at site	• Replace dry transformer and panelboard
Service entrance disconnect equipment and standby power phase monitor (relay) are aging	Loss of power at site	• Replace service entrance disconnect equipment and standby power phase monitor
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators

23.6.1 Project Recommendations

The deficiencies were lumped into one project and the timing of the recommended project is driven by the replacement of the rotating assembly and City owned meter base, which is critical to the operation of the station.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the wet well blower and check valve/isolation valve vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 23-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
S7-1	City owned meter base is aging	Replace City owned meter base	2020-2025	$137,000
	Rotating assembly degrading based on perceived age	Replace pumps, motors and motor starters		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Dry transformer and panelboard area aging	Replace dry transformer and panelboard		
	Service entrance disconnect equipment and standby power phase monitor (relay) are aging	Replace service entrance disconnect equipment and standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

23.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the rotating assemblies and City owned meter base (due to its criticality and serviceability ratings). The consequence of failure of either of these components will reduce the level of service to the station below industry standards and regulatory requirements.

Continued deterioration of the meter base will eventually jeopardize power service to the site and create an unsafe situation with exposed wiring and the potential for stray current. Failure of the power service will require the station to operate off of the standby generator until the service is temporarily repaired and new meter based installed.

23.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 23-4 have been implemented in the timeline identified.

23.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 23-5 and 23-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 23-5 includes the current estimated remaining useful life prior to the completion of the capital improvement projects.

Table 23-5
Current Estimated Remaining Useful Life

	Trigger Scores					Est.
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	2	1	0	-	2	10-15
Telemetry System	2	1	0	-	2	5-10
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 23-6 includes project estimated remaining useful life when the recommended projects provided in Table 23-4 are complete. Upon completion of the recommended projects most of the asset groups remaining useful life will increase significantly. The pump station estimated remaining life will remain the same since the recommended projects does not include any upgrades to the current structures.

Table 23-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

23.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 23-1 graphically represents the rehabilitation and replacement cost projections for Station 7 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 23-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 23-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 23-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 23-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

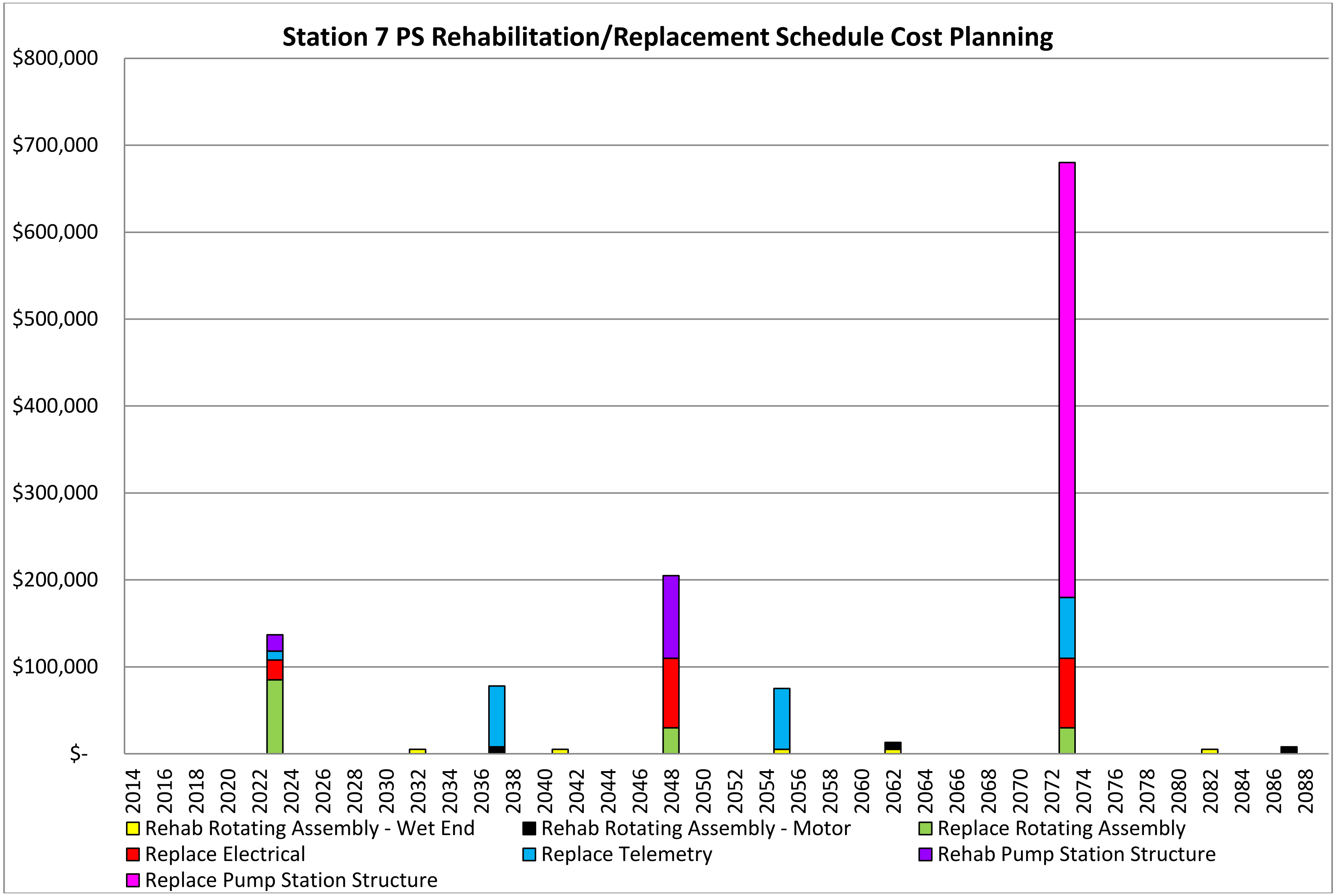
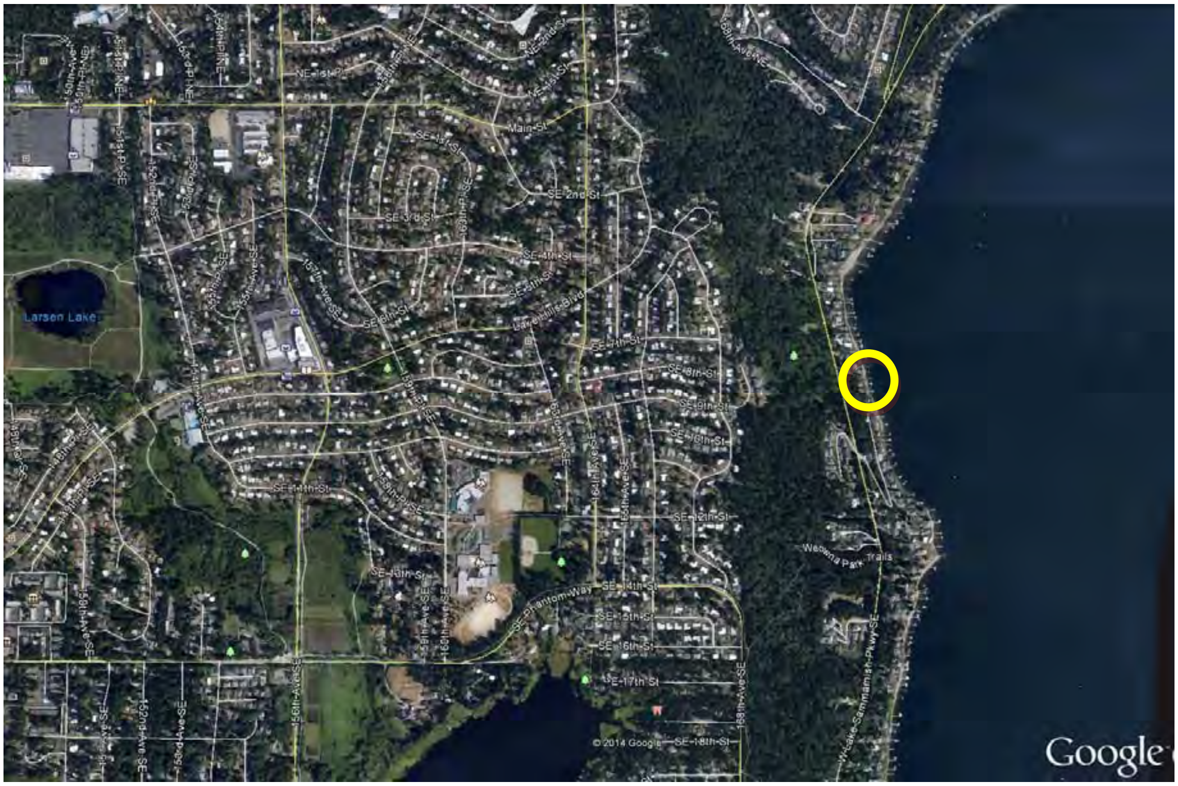


Figure 23-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 24
FLUSH 10



24.1 Flush 10 General Description

City of Bellevue Asset No.	187599
Address	562 W Lake Sammamish Parkway SE
Station configuration	Dry pit, no wet well – draws from lake
Original Construction	1968
Major Rehabilitation/Upgrade	2001
Number of Pumps	1
Pump Horsepower	2
Station Voltage/Phase	240/120/3 Phase
Standby Power	None

24.1.1 Summary of Findings

Flush 10 is located adjacent to the lake in a deck area near Flush 9. The access to Flush 10 is challenging from the vehicle parking to the station. Flush 10 provides flow to Station 1 and 2. Some deficiencies observed at the site include electrical clearance issues between the pump motor, the pump motor connection to the wall and the motor. The pump at this site is a Paco pump which is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized.

Table 24-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 24-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F10-1	Electrical clearance between panel to pump motor and pump motor connection to wall does not meet code requirements	Provide clearance	2020-2025	$145,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Intake piping degrading based on perceived age (installed in 1968)	Replace intake piping (~200 LF)		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

24.2 Site

24.2.1 Site Description

Vehicle access to site	Park on West Lake Sammamish Parkway, parking is 200 yards away from site
Landscaping	None
Site lighting	None
Fencing/security	None
Public accessibility to site	Adequate security for keeping public off site, but not private residents

General observations/notes from field visit:

- Challenging access from parking to station

Parking on West Lake Sammamish Parkway, start of trail to station

Portion of path to station from parking area

Challenging access to site, a lot of landscaping in pathway

Station within deck area adjacent to lake

24.3 Station Facilities

24.3.1 Dry Pit – Structure and Accessories

24.3.1.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Unclassified	-

Construction materials	Concrete, coated
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	9’x7’-8”x15’ deep
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

24.3.1.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Heater is corroded
- Coating near floor is flaking – possibly due to water intrusion through wall
- Less than the required 3’ clearance from Flush 10 panel to pump motor and from pump motor connection to wall

Dry pit access hatch and ladder

Heater in dry pit is significantly corroded

24.4 Mechanical

24.4.1 Pumps

Pump System Performance

Capacity testing was not possible at this facility, as the pumps draw directly from the lake and there is no wet well to allow calculations. The single pump runs only to provide the lake line with additional flow to help push sediment through the pipe. The pump operates on a regular schedule and runs for approximately one hour every night.

24.4.1.1 Pump 1 – City of Bellevue Asset No. 193834

Pump style	Centrifugal
Make	Paco Pumps
Model	52-407021-XV1004-98
Serial No.	00A0096201
Horsepower	2
Voltage/phase	460/230
Date of installation	Unknowns
Design Conditions	300 gpm @ 9 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Chain fall, rail and trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations the pump is in good condition and the reliability is still acceptable.

Criticality Rating 3 – Pump 1 is critical to the function of the station. In the event that this pump fails, downstream solids buildup is likely to create a blockage of the lake line.

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump and motor #1

24.4.2. Exposed Piping and Valves

24.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve, vertical installation – not ideal

24.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve and ball check valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Ball check valve, vertical installation
- Automated discharge plug valve to prevent siphoning

Discharge and piping configuration

Automated discharge plug valve to prevent siphoning, ball check valve located below discharge plug valve

24.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

24.4.4 Washdown Water

Supply	Lake water
Access	Booster package for service
Backflow prevention assembly	None
Enclosure/Freeze protection	N/A

24.4.5 Ventilation

24.4.5.1 Dry Pit Ventilation (Supply Fan)

Location	5’-6” AFF in dry pit
Fan type	Axial
Airflow rate	1,363 CFM @ 0.5” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located 5’-6” AFF in the dry pit

Booster package for water service

Booster package for water service, water supply from lake

Supply fan located 5’-6” AFF in dry pit

24.5 Electrical

24.5.1 Electrical Service

24.5.1.1 Electrical Service Description

Voltage	240/120
Phases	3
Utility transformer	Overhead
Service meter location	Customer service pole along West Lake Sammamish Parkway

24.5.1.2 Electrical Service Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Meter base and main disconnect appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from street

General observations/notes from field visit:

- No back-up power

24.5.2 Panelboard for Both Flush 9 and 10

24.5.2.1 Panelboard for Both Flush 9 and 10 Description

Location	In Flush 10 dry pit
Voltage/Phase	240/120/3 phase
Manufacturer	SQ D
Model	NQOD424M100

24.5.2.2 Panelboard for both Flush 9 and 10 Findings

Condition	1	**2**	3	4	5
Criticality	1	2	3	**4**	
Serviceability	1	2	**3**	4	

Condition Rating 2 – Panel and dry transformer appears to be in good condition, but aging

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 3 – Standard parts; equipment in dry pit is down five flights of stairs

Service meter located on pole along West Lake Sammamish Parkway

Panelboard for both Flush 9 and 10 located in Flush 10 dry pit, appears to be in good condition but aging

24.5.3 Site - Starters

24.5.3.1 Starters Description

Starters	240 VAC, FVNR Starter

24.5.3.2 Starter Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The starters appear to be in good condition, but aging

Criticality Rating 3 – Critical to the function of the station. In the event that the starter and the pump fails, downstream solids buildup is likely to create a blockage of the lake line.

Serviceability Rating 3 – Standard parts; equipment is in power and control panel, down five flights of stairs

24.5.4 Site – Telemetry Control Panel

24.5.4.1 Telemetry Control Panel Description

City of Bellevue Asset No.	377589
Location	In Flush 10 dry pit
Configuration	Separate from telemetry
Primary Level Indication	None
Secondary Level Indication	None
RTU/PLC	Zetron Inc/601-0231
Telephone Modem	RTP Power/GSM/GPRS Fixed Wireless Terminal
Telephone Network Interface	None

24.5.4.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 3 – Standard parts; equipment is in dry pit, down five flights of stairs

Flush 10 telemetry panel

Flush 10 starter/control panel adjacent to Flush 9 starter/control panel in Flush 10 dry pit

24.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 24-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Electrical clearance between panel to pump motor and pump motor connection to wall does not meet code requirements	Does not meet code requirements	• Provide clearance
Paco pumps are obsolete and condition is deteriorating	Service/replacement parts will be difficult to obtain causing significant maintenance/repair delays	• Replace Paco pump, motor and motor driver
Intake piping degrading based on perceived age (installed in 1968)	Loss of service at site	• Replace intake piping

24.6.1 Project Recommendations

Due to the challenging access at this site it is recommended that a single project be completed to address all deficiencies. The timing of the recommended project is driven by the replacement of the Paco pump which is critical to the operation of the station.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the dry pit to provide safety for the public and staff when the vault hatches are in the open position. The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 24-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost[(1)(2)(3)]
F10-1	Electrical clearance between panel to pump motor and pump motor connection to wall does not meet code requirements	Provide clearance	2020-2025	$145,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Intake piping degrading based on perceived age (installed in 1968)	Replace intake piping (~200 LF)		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

24.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the Paco pump due to its serviceability rating. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pump is no longer manufactured, making the pumps obsolete. With the pump no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. With continued wear on the pump, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

24.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 24-4 have been implemented in the timeline identified.

24.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 24-5 and 24-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 24-5 includes the current estimated remaining useful life prior to completion of the capital improvement projects.

Table 24-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	2	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	2	5	0	-	5	0-5

Table 24-6 includes project estimated remaining useful life when the recommended projects provided in Table 24-4 are complete. Upon completion of the recommended projects the estimated remaining life for the rotating assembly asset group will increase significantly. The other asset groups estimated remaining life will stay the same since the recommended projects do not address significant rehabilitation or replacement of equipment within those asset groups.

Table 24-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

24.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 24-1 graphically represents the rehabilitation and replacement cost projections for Flush 10 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 24-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 24-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 24-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 N/A $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components			N/A N/A		
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 24-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping			N/A		
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

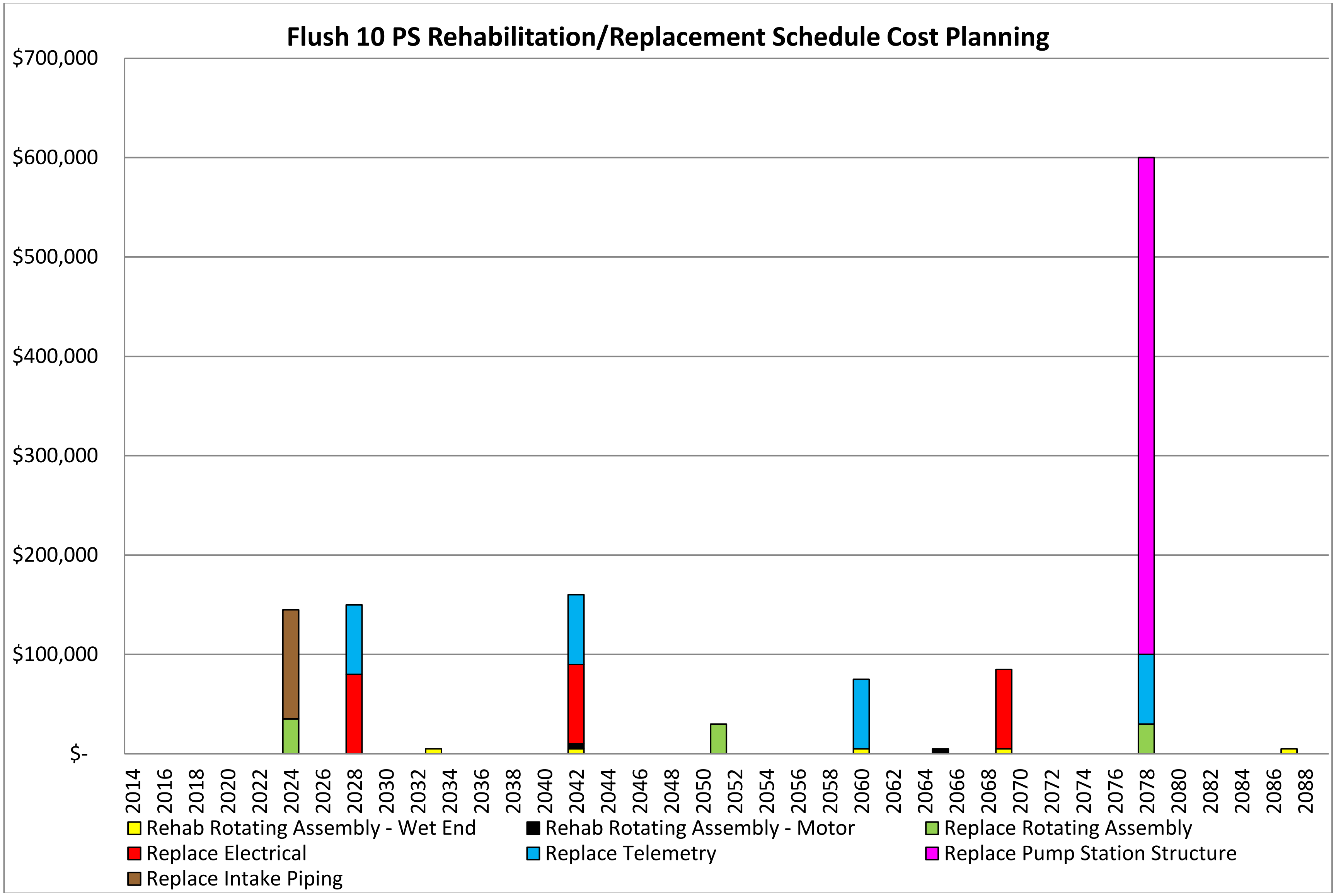
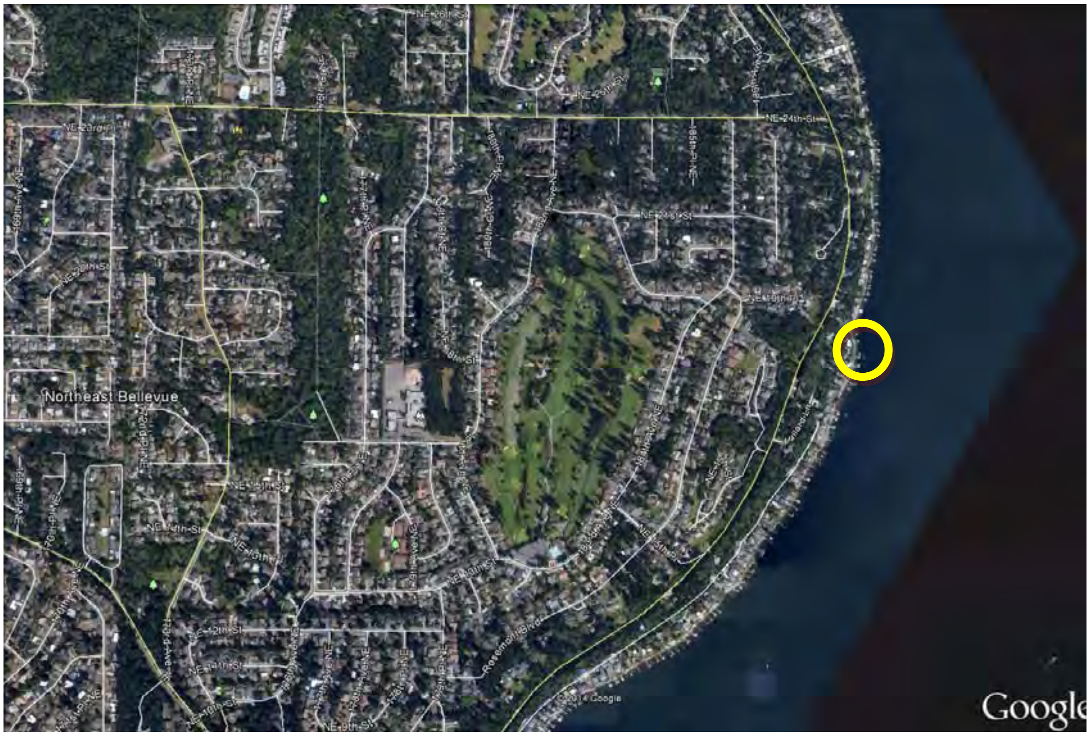


Figure 24-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 25
STATION 19



25.1 Station 19 General Description

Date of Visit	June 18th, 2014
City of Bellevue Asset No.	187628
Address	1830 W Lake Sammamish Parkway NE
Station configuration	Submersible
Original Construction	1966
Major Rehabilitation/Upgrade	1989
Number of Pumps	2
Pump Horsepower	3
Station Voltage/Phase	240/120/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	220 gpm

25.1.1 Summary of Findings

Station 19 is located adjacent to a private residence near the lake. There are approximately 100 steps with intermediate landings to access the station from the road and electrical equipment. There is a lot of landscaping near the area including roots and ivy that could present a potential tripping hazard. This station does not receive flow from other stations and discharges to the lake line. A significant deficiency includes the location of the submersible cable termination block which is located in the wet well and presents a code violation and potential safety hazard. Upon the site visit there was also some evidence of lower level corrosion in the wet well structure.

Table 25-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 25-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S19-1	Submersible cable termination block and conduit located in wet well – code/safety violation	Move and replace submersible cable termination block and conduit out of wet well and keep above grade adjacent to site	2020-2025	$143,000
	Eye bolt used for level instrument too far in wet well to safely reach	Provide higher hook to safely reach level instrument		
	Submersible pumps, motors and starters and degrading based on perceived age	Replace pumps, motors and motor drivers		
	Lower level corrosion in wet well	Inspect/evaluate wet well for corrosion		
	Backup level indicators are aging	Replace backup level indicators		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

25.2 Site

25.2 Site Description

Vehicle access to site	One lane paved road, parking on road above station. Must walk down approximately 100 steps to station.
Landscaping	Surrounding ivy and roots
Site lighting	Some near electrical equipment and steps down to path as well as one fixture directly adjacent to the station
Fencing/security	None
Public accessibility to site	No, adjacent to someone's home

One lane paved road above station

Access to station from road, entrance through gate to stairs down to station

Many stairs to access site, adjacent to someone's home

Site lighting adjacent to station

25.3 Station Facilities

25.3.1 Wet Well – Structure and Accessories

25.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Lift assist hatch
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inside diameter, 15’-20’ deep
Ladder/grating platform	None
Sewer invert(s)	(2) 8”, above operating level
Lighting	Yes
Ventilation	None
Ventilation continuous	N/A

*Based on Record Drawings, unable to confirm in field.

25.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Ground surface inspection identified the lower 1’-2’ of the wet well appears to have exposed aggregate – no other significant signs of corrosion.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Lake inlet allows flow at head of lake line

Interior of wet well, no access ladder

Some lower level corrosion and exposed aggregate on the lower 1‘-2’ of well

5.3.2 Check Valve and Isolation Valve Vault – Structure and Accessories

5.3.2.1 Check Valve and Isolation Valve Vault – General Description

Area	Current Classification	Rationale
Check Valve and Isolation Valve Vault	Unclassified	-

Construction materials	Concrete
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	No
Access intrusion alarm	No
General dimensions	4’x4’x10’ deep
Lighting	Light can be plugged in with extension cord
Ventilation	None
Ventilation continuous	N/A

25.3.2.2 Check Valve and Isolation Valve Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Interior of vault appears to be in good condition.

Criticality Rating 4 – Station cannot operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- Flooding evident
- Pumps stagnant water in vault to wet well

Check valve and isolation valve vault,
flooding evident

Valve vault light can be plugged in with extension cord,
extension cord located in vault upon site visit

25.4 Mechanical

25.4.1 Pumps

Pump System Performance

The field measured performance of the pumps at Station 19 only captured flow rates, as operating pressures were not available. Without the pressure information, little can be understood regarding the operation of the pumps, but with the measured flow similar to the design flow (~220 gpm vs. 245 gpm), it is assumed that the pumps are operating similar to the original design intent.

The following table documents the pump run hours and starts by month over the past year.

Table 25-2
Summary of Pump Run Hours and Starts

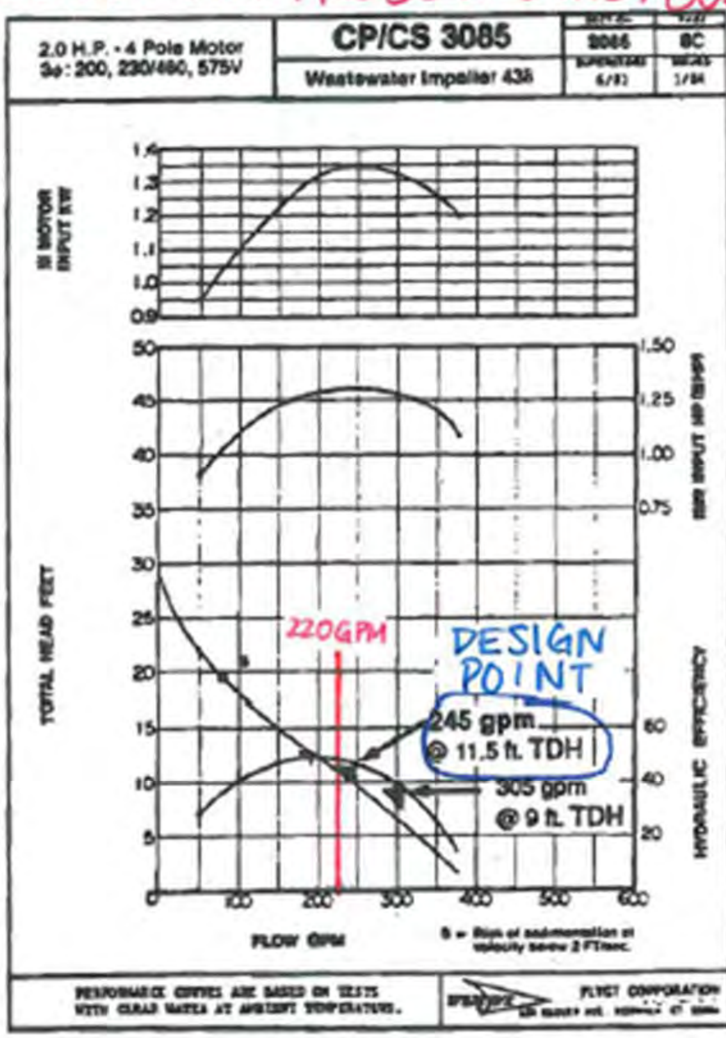
Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	17.33	655	17.12	655
May-13	16.15	599	16.07	599
Jun-13	13.15	487	13.14	489
Jul-13	12.91	477	12.81	479
Aug-13	11.9	446	11.61	446
Sep-13	12.39	468	11.89	468
Oct-13	12.78	491	12.47	492
Nov-13	13.56	513	13.47	515
Dec-13	17.88	689	17.84	688
Jan-14	17.61	672	17.45	670
Feb-14	15.03	564	14.92	564
Mar-14	17.37	617	15.99	615
Total	**178.06**	**6,678**	**174.78**	**6,680**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.5	0.8	0.5	0.8

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Stations: Lake Hills No. 17, No. 18 and No. 19
Pump Model No.: CP 3085-438X with 4-inch discharge
Design RPM: 1750 Impeller Type: 438
Specified Performance: 245 gpm at 11.5 feet TDH and 305 gpm at 9 feet TDH

Motor Horsepower: 2 HP

FIELD FLOW MEASUREMENT:
~220GPM, NO PRESSURE MEASURED



25.4.1.1 Pump 1 – City of Bellevue Asset No. 193825

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Horsepower	3
Voltage/phase	240/3
Date of installation	1989
Design Conditions	245 gpm @ 11 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 25 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	220 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Measured flow appears to be similar to the design flow

Submersible station, unable to observe pumps

25.4.1.2 Pump 2 – City of Bellevue Asset No. 193852

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Horsepower	3
Voltage/phase	240/3
Date of installation	1989
Design Conditions	245 gpm @ 11 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, rent gantry crane

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 25 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access

Pump 2 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	220 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Measured flow appears to be similar to the design flow

Submersible station, unable to observe pumps

25.4.2 Exposed Piping and Valves

25.4.2.1 Discharge Piping/Valve(s) Description

Size	4” or 6”
Material	Plastic ABS
Valve Type(s)	Gate valve with hand wheel and swing check valve with outside weight and lever

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Wet well also has gravity relief pipe

25.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

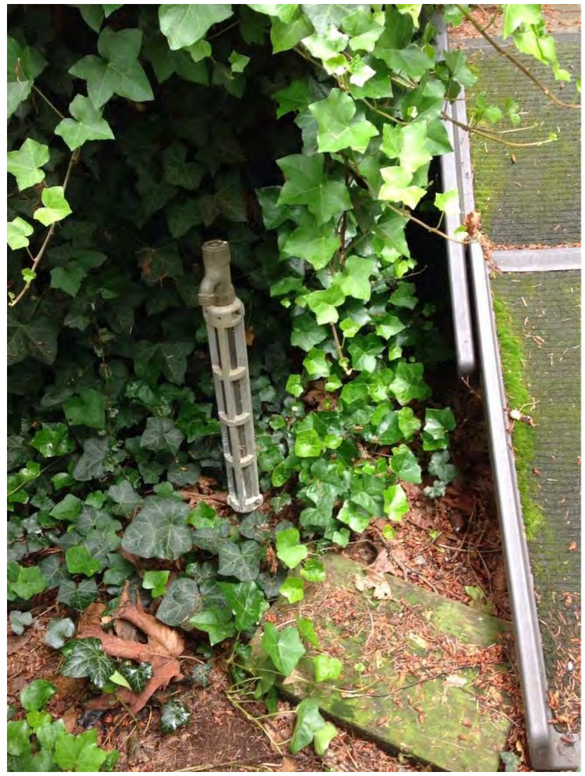
25.4.4 Washdown Water

Supply	Domestic/Metered
Access	Hose at top of wet well, freeze-less yard hydrant adjacent to check valve/isolation valve vault
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In check valve/isolation valve vault/None

General observations/notes from field visit:

- Backflow assembly does not drain to daylight – does not meet code for installation

Gate valve with hand wheel for isolation and swing check valve with outside weight and lever



Freeze-less yard hydrant adjacent to check/valve/isolation valve vault

Hose for wash down water located at top of wet well

Backflow prevention assembly located in check valve/isolation valve vault

25.5 Electrical

25.5.1 Electrical Service

25.5.1.1 Electrical Service Description

Voltage	240/120
Phases	3
Utility transformer	Overhead
Service meter location	Power and control panel along driveway between house and garage

25.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and main disconnect appear to be in good condition and are relatively new

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 2 – Standard parts; accessible from driveway. Tight area to read meter or plug in mobile standby generator

25.5.2 Backup Power

25.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Side of power and control panel
Transfer switch type	Manual
Transfer switch location	Power and control panel

25.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

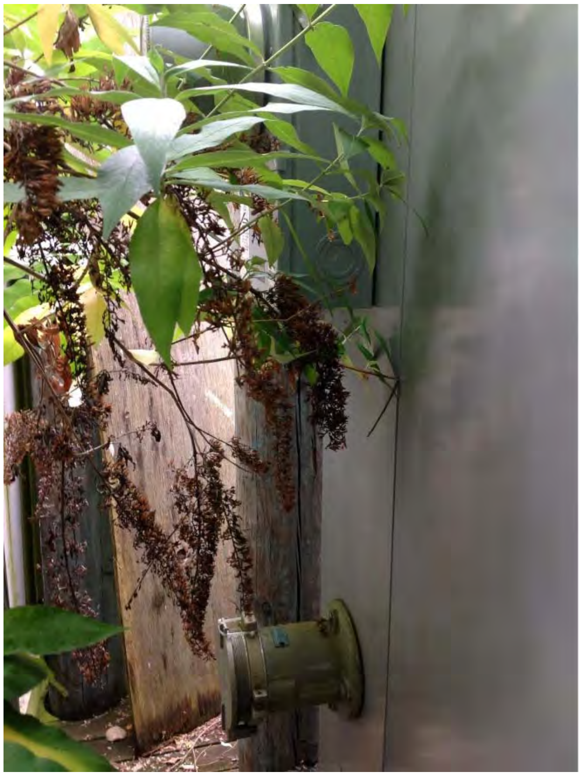
Condition Rating 1 – Manual transfer switch and generator receptacle appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator receptacle accessible from driveway

General observations/notes from field visit:

- Generator receptacle on side of power and control panel adjacent to fence, would have to remove fencing to plug in power from standby generator



Service meter and generator receptacle located on side of power and control panel enclosure near paved road

Overhead utility transformer, a lot of exposed cable

25.5.3 Site - Panelboard

25.5.3.1 Panelboard Description

Location	Power and control panel
Voltage/Phase	120/240 VAC/1 phase
Manufacturer	Siemens
Model	E8816ML1125FCU

25.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Panel appears to be in good condition, dry transformer running hot – no transformer required however, small load center

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

25.5.4 Site – Starters

25.5.4.1 Starters Description

Starters	(2) FVNR Starters

10.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Siemens starters appear to be in good condition, newer equipment

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard located in outdoor power and control panel enclosure, appears to be in good condition

Starters located in outdoor power and control panel enclosure, appear to be in good condition

25.5.5 Site – Telemetry Control Panel

25.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376893
Location	At top of stairs by driveway
Configuration	Integral w/ telemetry
Primary Level Indication	Submersed level transmitter
Secondary Level Indication	Float switch
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	On customer service pole

25.5.5.2 Telemetry Control Panel Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Appears to be in good condition, no vent fan however, panel could overheat

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

General observations/notes from field visit:

- No vent fan in telemetry cabinet, it is sheltered however so it should stay cool

25.5.6 Site - Submersible Cable Termination Enclosure

25.5.6.1 Submersible Cable Termination Enclosure Description

Location	In wet well near top
Material	Unknown

25.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	1	2	**3**	4	5
Criticality	1	2	3	**4**	
Serviceability	1	2	3	**4**	

Condition Rating 3 – Junction boxes appear to be in poor shape, too small for their duty and not properly secured to wall, only 4/6 bolts used; poses a safety hazard – should relocate terminal box outside of wet well

Criticality Rating 4 – Critical, transmits power from the starters to the pump cords

Serviceability Rating 4 – Standard parts; junction boxes in the mouth of the wet well safety hazard to access; hatch blocking easier access to junction boxes.

Telemetry control panel with operator interface located in outdoor power and control panel enclosure, appears to be in good condition

No vent fan in outdoor power and control panel enclosure, it is sheltered however, so it should stay cool

Submersible cable termination enclosure located in wet well, not fully secured and some corrosion evident

25.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 25-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Submersible cable termination block and conduit located in wet well – code/safety violation	Code and safety violation	• Move and replace submersible cable termination block and conduit out of wet well and keep above grade adjacent to site
Eye bolt used for level instrument too far in wet well to safely reach	Safety hazard	• Provide higher hook to safely reach level instrument
Submersible pumps, motors and starters and degrading based on perceived age	Loss of service at site	• Replace pumps, motors and motor drivers
Lower level corrosion in wet well	Potential degradation of wet well structural integrity	• Inspect/evaluate wet well for corrosion
Backup level indicators are aging	Loss of control at site	• Replace backup level indicators
Backflow assembly enclosure requires drain to daylight.	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure

25.6.1 Project Recommendations

Due to the difficult access to the station and the impact to the private resident adjacent to the site, one project is recommended to address all deficiencies. The timing of the recommended project is driven by the replacement of the rotating assemblies that are critical to the operation of the station.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 25-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S19-1	Submersible cable termination block and conduit located in wet well – code/safety violation	Move and replace submersible cable termination block and conduit out of wet well and keep above grade adjacent to site	2020-2025	$143,000
	Eye bolt used for level instrument too far in wet well to safely reach	Provide higher hook to safely reach level instrument		
	Submersible pumps, motors and starters and degrading based on perceived age	Replace pumps, motors and motor drivers		
	Lower level corrosion in wet well	Inspect/evaluate wet well for corrosion		
	Backup level indicators are aging	Replace backup level indicators		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

25.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the rotating assemblies. The consequence of failure of either of this component will reduce the level of service to the station below industry standards and regulatory requirements.

25.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 25-4 have been implemented in the timeline identified.

25.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 25-5 and 25-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 25-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement project.

Table 25-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 25-6 includes project estimated remaining useful life when the recommended projects provided in Table 25-4 are complete. Upon completion of the recommended projects the rotating assembly and pump station estimated remaining life will increase significantly. The electrical and telemetry system asset groups estimated remaining life will remain the same since the recommended projects do not include significant rehabilitation or replacement of equipment within those asset groups.

Table 25-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

25.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 25-1 graphically represents the rehabilitation and replacement cost projections for Station 19 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 25-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 25-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 25-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	N/A N/A				
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 25-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

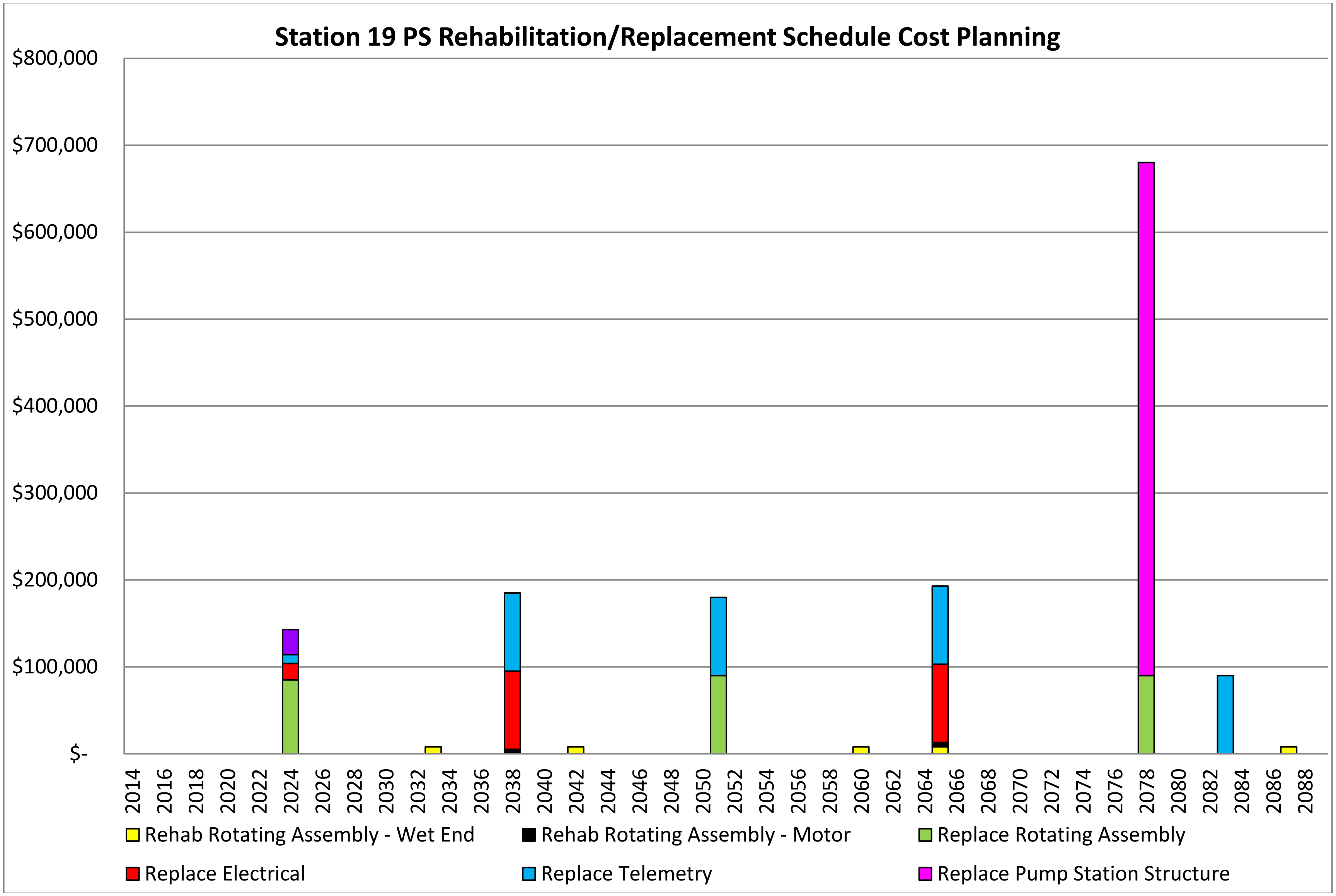
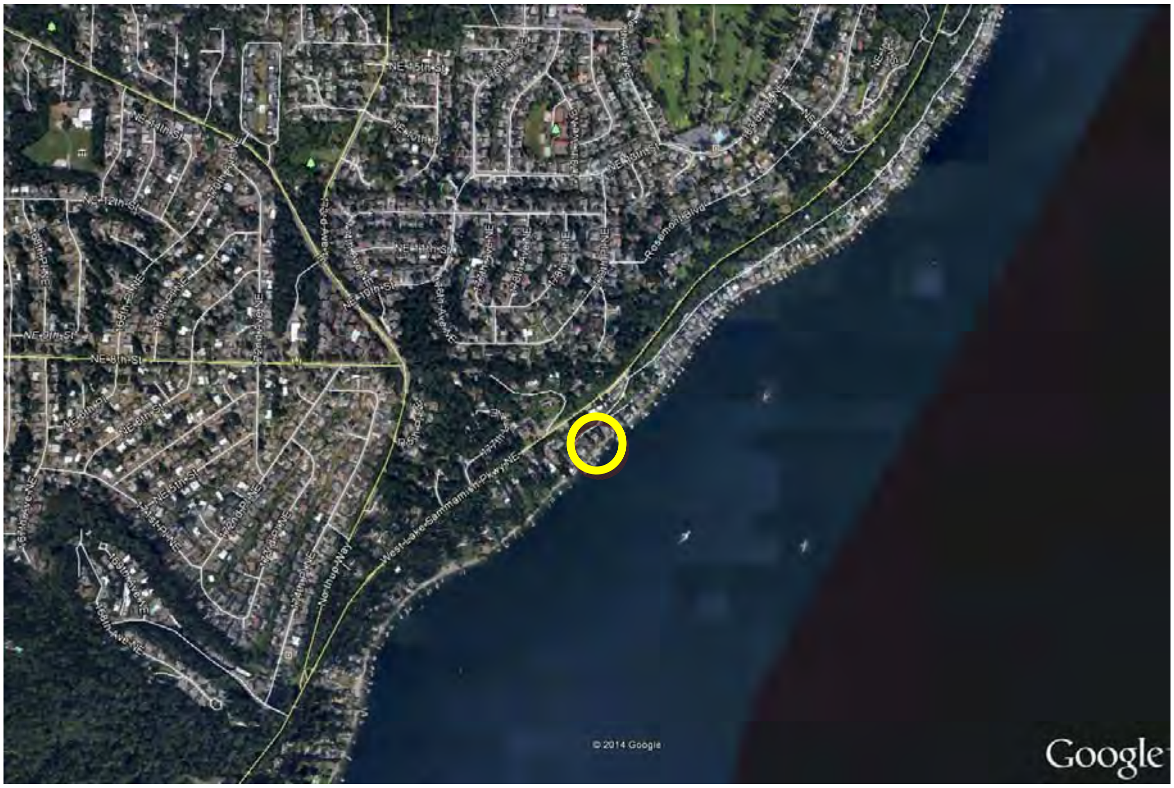


Figure 25-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 26
STATION 17



26.1 Station 17 General Description

Date of Visit	June 18th, 2014
City of Bellevue Asset No.	187578
Address	628 W Lake Sammamish Parkway
Station configuration	Submersible
Original Construction	1966
Major Rehabilitation/Upgrade	1988
Number of Pumps	2
Pump Horsepower	2
Station Voltage/Phase	240/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	205 – 210 gpm

26.1.1 Summary of Findings

Station 17 is located in a private resident's deck/porch area near the lake. Upon the site visit, the homeowner had constructed a new deck covering over the station and it was difficult to remove and replace the check valve and isolation valve vault manhole lid without damaging the newly constructed deck. The station receives flow from stations 18 and 19 and discharges to the lake line. A deficiency identified at the site is the possible tripping in the power and control panel due to lack of ventilation.

Table 26-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 26-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
S17-1	No ventilation in power and control panel – potential tripping issue	Ventilate power and control panel	2020-2025	$116,000
	Submersible pumps, motors and motor drivers degrading based on perceived age	Replace submersible pumps, motors and motor drivers		
	Some seepage in concrete wet well	Inspect/evaluate wet well for corrosion		
	Backflow assembly enclosure requires drain to daylight	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

26.2 Site

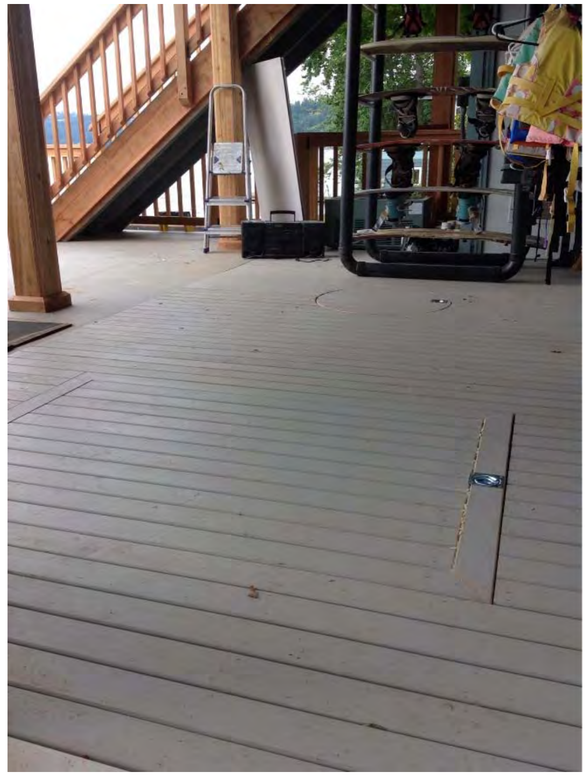
26.2.1 Site Description

Vehicle access to site	One lane paved road on Rosemont, vehicle parking near the power and control panel on the paved road, approximately 50 steps away from station
Landscaping	Under false deck
Site lighting	One light on house – inadequate for looking in wet well
Fencing/security	None
Public accessibility to site	No access, in someone's deck

General observations/notes from field visit:

- New deck over wet well and valve vault – impeded ability to remove and replace valve vault access lid

One lane paved road on Rosemont, parking adjacent to power and control panel



New deck over wet well and valve vault impeded ability to remove and replace wet well access lid

Steps from parking to station, adjacent to home

26.3 Station Facilities

26.3.1 Wet Well – Structure and Accessories

26.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Halliday double hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inside diameter, 15-20’ deep
Ladder/grating platform	Ladder, no grating platform
Sewer invert(s)	8”, above operating level 6”, above operating level
Lighting	None
Ventilation	None
Ventilation continuous	N/A

26.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Some seepage in concrete wet well, ground water intrusion in three locations, estimated at < 0.5 gpm
- No significant issues noted – some mild grease in wet well
- Operation above hopper

Wet well double hatch and ladder

Interior of wet well

Some seepage in wet well, ground water intrusion in three locations, near bottom of wet well

26.3.2 Check Valve and Isolation Valve Vault – Structure and Accessories

26.3.2.1 Check Valve and Isolation Valve Vault General Description

Area	Current Classification	Rationale
Check Valve/Isolation Valve Vault	Unclassified	-

Construction materials	Concrete
Access description	Manhole lid and ladder
Access fall protection	No
Access locked	No
Access intrusion alarm	No
General dimensions	4’x4’x10’ deep
Lighting	Extension cord located in vault for lighting
Ventilation	None
Ventilation continuous	N/A

26.3.2.2 Check Valve and Isolation Valve Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Interior of vault appears to be in good condition.

Criticality Rating 4 – Station could not operate upon failure of the valves

Serviceability Rating 2 – Parts are available but vault is somewhat difficult to access

General observations/notes from field visit:

- Flooding evident in valve vault
- Hole in false deck
- Valves look to be completely submerged in water with just the tops of the valves above water

Check valve and isolation valve vault with manhole lid and ladder

Valves look to be completely submerged in water with just the tops of the valves above water

26.4 Mechanical

26.4.1 Pumps

Pump System Performance

The field measured performance of the pumps at Station 17 only captured flow rates, as operating pressures were not available. Without the pressure information, little can be understood regarding the operation of the pumps, but with the measured flow similar to the design flow (~210 gpm vs. 245 gpm), it is assumed that the pumps are operating similar to the original design intent. The slight degradation in flow may be attributed to normal wear of the pump.

The following table documents the pump run hours and starts by month over the past year.

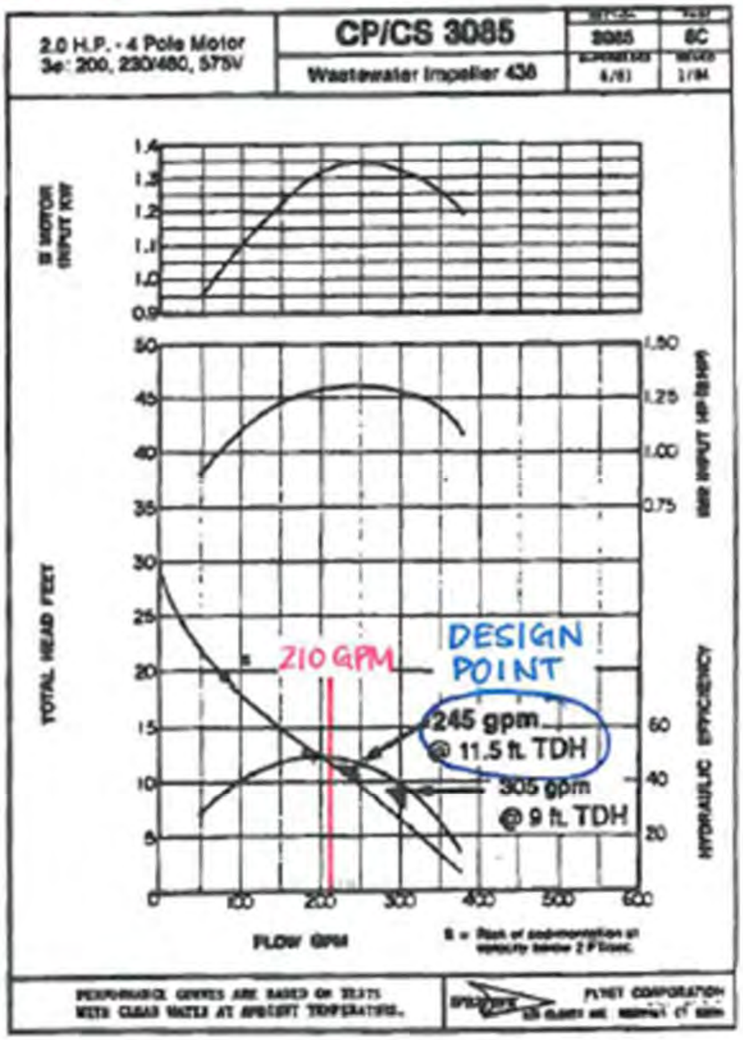
Table 26-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	29.63	1,291	31.23	1,292
May-13	28.21	1,244	30.58	1,243
Jun-13	25.04	1,119	27.82	1,121
Jul-13	26.03	1,168	28.12	1,166
Aug-13	40.61	1,829	11.44	490
Sep-13	51.14	2,269	0.11	30
Oct-13	38	1,688	11.26	507
Nov-13	25.85	1,128	25.96	1,128
Dec-13	29.7	1,313	29.99	1,319
Jan-14	29.96	1,330	30.48	1,329
Feb-14	26.45	1,165	26.86	1,165
Mar-14	30.86	1,385	32.86	1,386
Total	**381.48**	**16,929**	**286.71**	**12,176**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.0	1.9	0.8	1.4

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

Stations: Lake Hills No. 17, No. 18 and No. 19
Pump Model No.: CP 3085-438X with 4-inch discharge
Design RPM: 1750 Impeller Type: 438
Specified Performance: 245 gpm at 11.5 feet TDH and 305 gpm at 9 feet TDH
Motor Horsepower: 2 HP

FIELD FLOW MEASUREMENT:
~210 GPM, NO PRESSURE MEASURED



26.4.1.1 Pump 1 – City of Bellevue Asset No. 193819

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Horsepower	2
Voltage/phase	240/3
Date of installation	1988
Design Conditions	245 gpm @ 11 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, portable hoist

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access due to location and the need for a portable hoist to remove pumps

General observations/notes from field visit:

- Unable to confirm condition of submersible pumps
- Unsure of impact on deck if/when portable hoist needs to be used

Pump 1 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	205 – 210 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressures during testing
- Measured flow appears to be similar to the design flow

Submersible station, unable to observe pumps

26.4.1.2 Pump 2 – City of Bellevue Asset No. 193820

Pump style	Submersible
Make	Flygt*
Model	CP 3085-438X*
Serial No.	Unknown
Horsepower	2
Voltage/phase	240/3
Date of installation	1988
Design Conditions	245 gpm @ 11 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, portable hoist

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Submersible station, could not observe condition of pump but at more than 26 years of life, the remaining life is expected to be limited

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 2 – Submersible station, Pumps are somewhat difficult to access due to location and the need for a portable hoist to remove pumps

General observations/notes from field visit:

- Unable to confirm condition of submersible pumps
- Unsure of impact on deck if/when portable hoist needs to be used

Pump 2 Drawdown Test

Static head (feet)	Unable to confirm
Calculated pumping capacity	205 – 210 gpm
Total Dynamic head (feet)	Unable to confirm
Number of tests performed	2

General observations/notes from drawdown test:

- Could not confirm static or dynamic pressure during testing
- Measured flow appears to be similar to the design flow

Submersible station, unable to observe pumps

26.4.2 Exposed Piping and Valves

26.4.2.1 Discharge Piping/Valve(s) Description

Size	6”?
Material	Plastic, ABS
Valve Type(s)	Gate valve w/ hand wheel and swing check valve with outside weight and lever

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Both valves were submerged completely in water in the check valve and isolation valve vault upon visit

26.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

26.4.4 Washdown Water

Supply	Shared with resident
Access	Freeze-less yard hydrant adjacent to wet well, against house
Backflow prevention assembly	Reduced pressure backflow device
Enclosure/Freeze protection	In check valve and isolation valve vault/None

General observations/notes from field visit:

- Reduced pressure backflow assembly does not drain to daylight – does not meet code for installation

Gate Valve with hand wheel for isolation and swing check valve with outside weight and lever located in check valve and isolation valve vault, submerged in water upon site visit

Reduced pressure backflow assembly located in check valve and isolation valve vault

26.5 Electrical

26.5.1 Electrical Service

26.5.1.1 Electrical Service Description

Voltage	240
Phases	3
Utility transformer	Overhead
Service meter location	Unknown

26.5.1.2 Electrical Service Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	1	**2**	3	4	

Condition Rating 1 – Meter base and main disconnect appear to be in good condition and are relatively new

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 2 – Standard parts; accessible from driveway although tight area to read meter or plug in mobile standby generator

26.5.2 Backup Power

26.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	Side of power and control panel
Transfer switch type	Manual
Transfer switch location	Power and control panel

26.5.2.2 Backup Power Findings

Condition	**1**	2	3	4	5
Criticality	1	2	**3**	4	
Serviceability	**1**	2	3	4	

Condition Rating 1 – Manual transfer switch and generator receptacle appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator receptacle accessible from driveway

General observations/notes from field visit:

- There is no surge protection on the manual transfer switch

Service meter and generator receptacle located on side of power and control panel enclosure near paved road

Power and control panel layout in outdoor enclosure

26.5.3 Site - Panelboard

26.5.3.1 Panelboard Description

Location	Power and control panel
Voltage/Phase	240/120/1 phase
Manufacturer	Siemens
Model	E0816ML1125FCUSCU

26.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Panel appears to be in good condition, dry transformer running hot – no transformer required however, small load center

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment in power and control panel

26.5.4 Site – Starters

26.5.4.1 Starters Description

Starters	(2) FVNR Starters

26.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Siemens starters appear in good condition, newer equipment

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard located in outdoor power enclosure, appears to be in good condition

Starters located in outdoor power enclosure, appears to be in good condition

26.5.5 Site – Telemetry Control Panel

26.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376788
Location	On side of street in shed
Configuration	Integral w/ telemetry
Primary Level Indication	Submerged pressure transmitter
Secondary Level Indication	Float switch, ISR, TDR
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	Could not locate

26.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

26.5.6 Site - Submersible Cable Termination Enclosure

26.5.6.1 Submersible Cable Termination Enclosure Description

Location	In wet well
Material	Unknown

26.5.6.2 Submersible Cable Termination Enclosure Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Newer stainless steel boxes appear to be in good condition

Criticality Rating 4 – Critical, transmits power from the starters to the pump cords

Serviceability Rating 3 – Standard parts; junction boxes in the mouth of wet well; difficult to access

General observations/notes from field visit:

- No terminal block, bolted connections, cannot see (3 flights down), wet well to 12”x12”x12” HH in walkway

Telemetry control panel with operator interface located in outdoor power enclosure, appears to be in good condition

Junction boxes located in mouth of wet well, difficult to access

26.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 26-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
No ventilation in power and control panel – potential tripping issue	Potential tripping issues due to over temperature	• Ventilate power and control panel
Submersible pumps, motors and motor drivers degrading based on perceived age	Loss of service at site	• Replace submersible pumps, motors and motor drivers
Some seepage in concrete wet well	Integrity of wet well structure unknown	• Inspect/evaluate wet well for corrosion
Backflow assembly enclosure requires drain to daylight.	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure

26.6.1 Project Recommendations

Due to the location of the station and the impact to the private resident the deficiencies were lumped into one project. The timing of the recommended project is driven by the replacement of the rotating assembly which is critical to the operation of the station.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 26-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
S17-1	No ventilation in power and control panel – potential tripping issue	Ventilate power and control panel	2020-2025	$116,000
	Submersible pumps, motors and motor drivers degrading based on perceived age	Replace submersible pumps, motors and motor drivers		
	Some seepage in concrete wet well	Inspect/evaluate wet well for corrosion		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

26.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the rotating assemblies. The consequence of failure of either of this component will reduce the level of service to the station below industry standards and regulatory requirements.

26.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 26-4 have been implemented in the timeline identified.

26.7.1 Asset Scoring

The trigger and asset scoring shown in Tables 26-5 and 26-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 26-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement project.

Table 26-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	1	1	0	-	1	15-20

Table 26-6 includes the estimated remaining useful life when the recommended projects provided in Table 26-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for the rotating assembly will increase significantly. The estimated remaining life for the other asset groups will not change since the recommended projects do not address significant rehabilitation or replacement of equipment within the asset groups.

Table 26-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

26.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 26-1 graphically represents the rehabilitation and replacement cost projections for Station 17 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 26-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 26-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 26-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 26-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

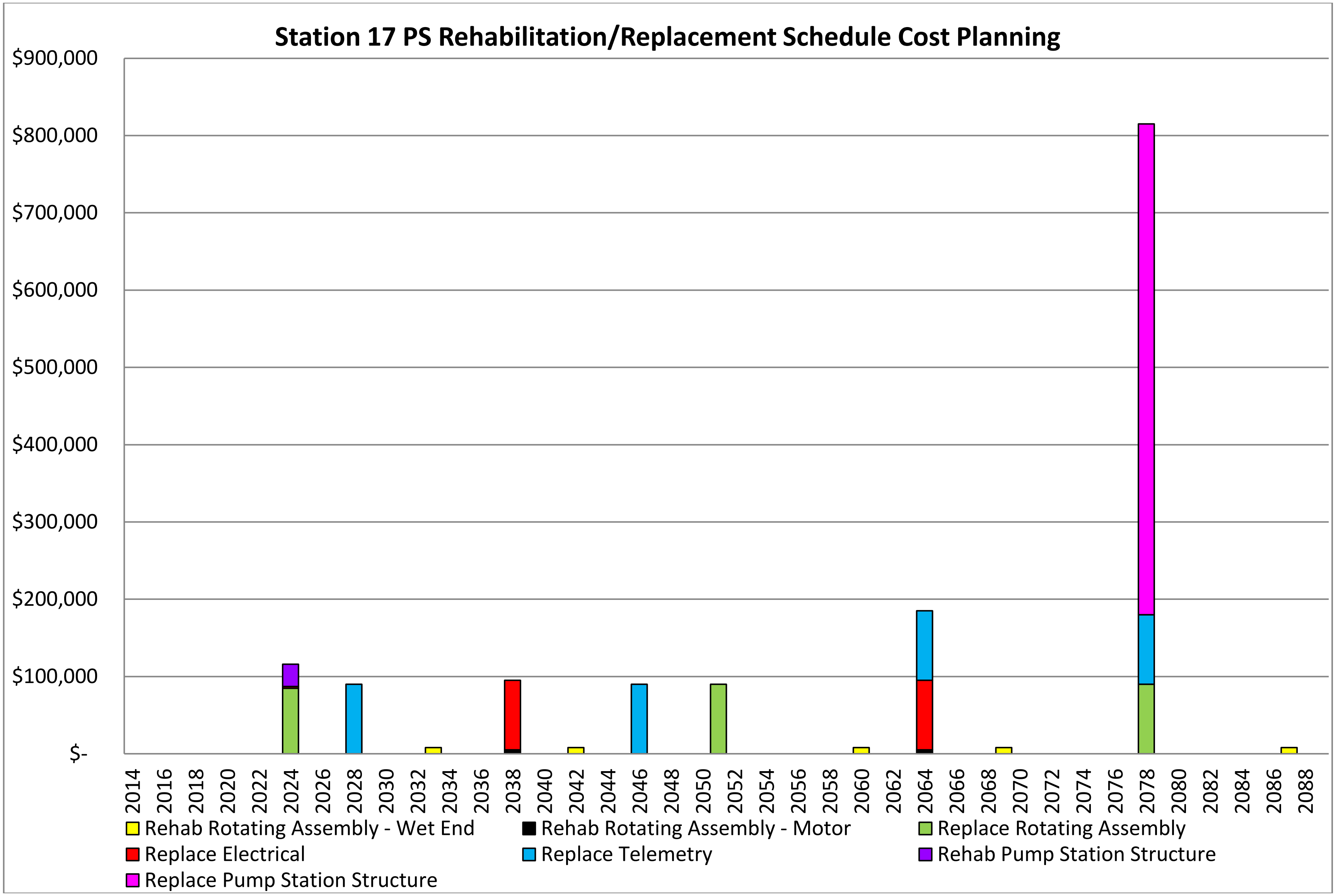
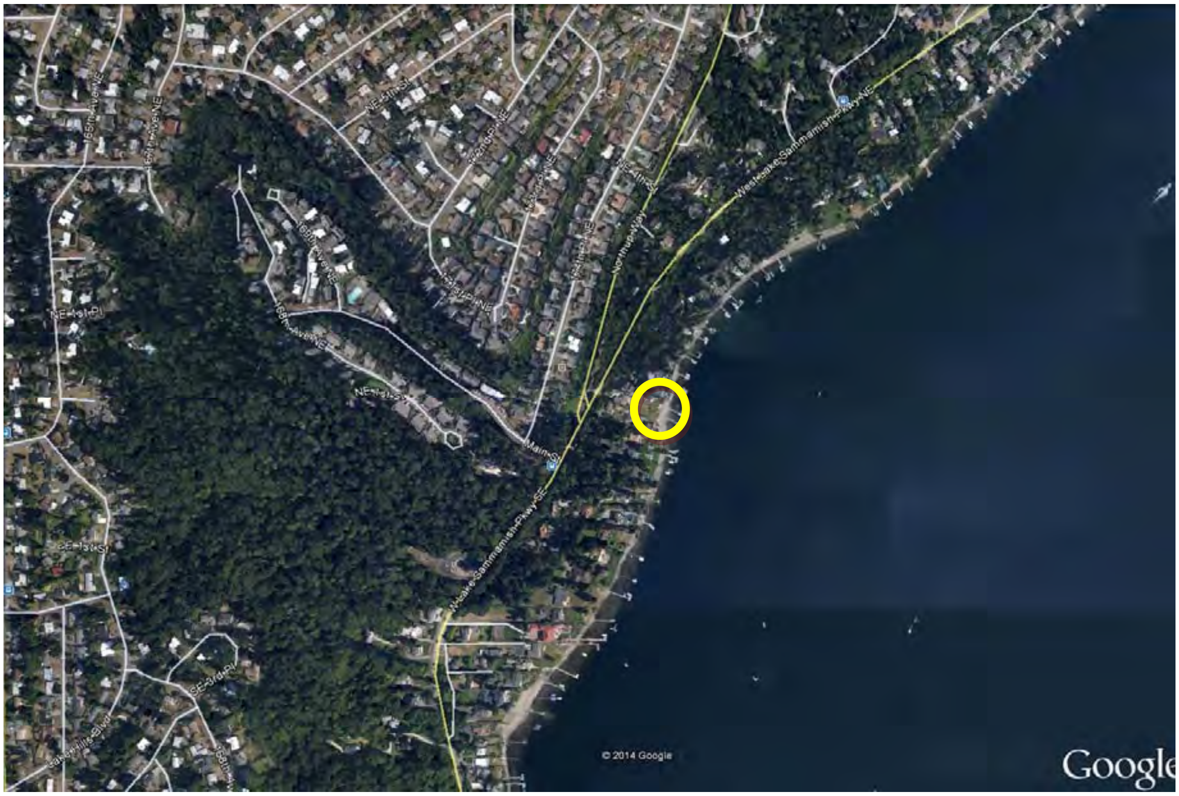


Figure 26-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 27
STATION 16



27.1 Station 16 General Description

Date of Visit	June 18th, 2014
City of Bellevue Asset No.	187630
Address	254 W Lake Sammamish Pkwy NE
Station configuration	Wet well/Dry pit
Original Construction	1966
Major Rehabilitation/Upgrade	1995
Number of Pumps	2
Pump Horsepower	15
Station Voltage/Phase	480/3 Phase
Standby Power	Generator Receptacle
Field-measured Station Firm Capacity	255 – 260 gpm

27.1.1 Summary of Findings

Station 16 is located adjacent to the lake and a private residence. There are many steps down to the station and no hand railing available for part of the steps down. This station receives flow from Flush 9, Station 17, 18 and 19 and discharges flow to Station 12. There are quite a few significant deficiencies at this site including potential pitting in the lower section of the wet well as well as electrical clearance and ISR clearance violations within the issues for the power and control panel. During the site visit while walking down the stairs to the station there was some exposed pipe beneath the stairs that is possibly the exposed force main. Station 16 discharges flow to the gravity system while receiving flow in a series from Station 17, 18 and 19. This makes Station 16 the most critical station of the series since Station 17, 18 and 19 gravity into the lake line if the series is backed up.

Table 27-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 27-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S16-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$258,000
	Electrical code violations – clearance not per code in front of power and control panel in dry pit	Provide adequate clearance		
	Pitting in lower sections of wet well	Investigate to determine structural integrity of wet well		
	Intrinsically safe relay clearance violations	Provide barrier		
	Fall protection creates an unsafe alternative than access without it, must step over opening then latch harness onto ladder	Consider standardizing fall protection to match other stations		
	City owned meter base needs to be painted/refurbished	Paint and refurbish		
	Paint coating on side of dry pit is delaminating	Recoat interior		
	Utility power phase monitor and standby power phase monitor are aging	Replace utility power phase monitor and standby power phase monitor		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

27.2 Site

27.2.1 Site Description

Vehicle access to site	Along busy two way street, West Lake Sammamish Parkway, vehicle, distance from vehicle access to station is 200 yards down stairs
Landscaping	Native vegetation, gravel near station
Site lighting	None
Fencing/security	None
Public accessibility to site	No, adjacent to lake and homeowners deck

Parking along busy two way street on West lake Sammamish Parkway adjacent to main electrical equipment

Stairs down to station from roadway, adjacent to home

Station adjacent to lake and homeowners deck

27.3 Station Facilities

27.3.1 Wet Well – Structure and Accessories

27.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Lift assist hatch and fiberglass ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	6’ inside diameter, 10’ deep*
Ladder/grating platform	Ladder and grating platform
Sewer invert(s)	(2) 8”, above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

27.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior coating appears to be in good condition, but with potential lower level pitting.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Some coating delaminating, but no signs of corrosion
- Pitting in lower sections – still coated but should be inspected

Interior of wetwell, some pitting in lower sections – still coated but should be inspected

Some delaminating in interior, but no signs of corrosion

27.3.2 Dry Pit – Structure and Accessories

27.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Steel can
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	7’ inside diameter
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

27.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Some delamination of paint coating on side.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Fall protection available but you need to step over opening before latching on
- Cathodic protection, no anodes, assumes cathodic protection is successfully operating – paint coating on side needs to be replaced (delaminating)
- Tight space, only two people can fit at one time

Interior of dry pit, tight space, only two people can fit at one time

Fall protection available but you need to step over opening before latching on

End of ladder, above/adjacent to sump pump and drain

27.3.3 Wet Well Blower Vault – Structure and Accessories

27.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete, aluminum hatch
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	3’x2’x2’-6” deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

27.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Air valve adjacent to vault
- Directly connected to wet well – no automated valve – manual valve is always open
- No issues noted

Interior of wet well blower vault, appears to be in good condition.

Air valve adjacent to vault

27.4 Mechanical

27.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at Station 16 measured considerably lower flow (~260 gpm vs. 400 gpm) and lower head (75 ft vs. 78 ft) than the design point. The location of the measured point and even the design operating point is extremely far to the left of the curve. Operating at this end of the curve has the potential to experience a number of hydraulic problems, largely surrounding low velocities through the pump that may contribute to ragging and recirculation. From a capacity perspective, however, the apparently diminished flow rate is likely inconsequential since the upstream pump station (Station 17) can only deliver 210 gpm.

The following table documents the pump run hours and starts by month over the past year.

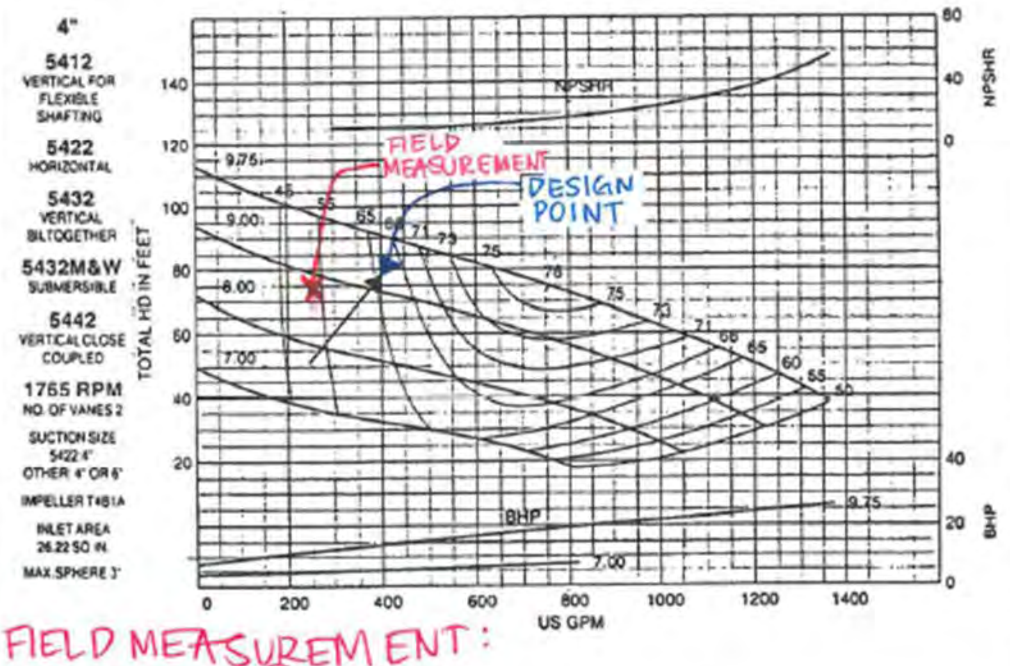
Table 27-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	47.01	1,919	55.54	1,916
May-13	46.21	1,898	50.53	1,897
Jun-13	42.61	1,746	47.34	1,747
Jul-13	43.14	1,795	49.43	1,792
Aug-13	43.04	1,760	47.62	1,761
Sep-13	40.73	1,729	48.47	1,731
Oct-13	39.93	1,667	50.23	1,667
Nov-13	42.85	1,768	52.76	1,770
Dec-13	45.62	1,872	54.85	1,866
Jan-14	44.68	1,890	56.23	1,897
Feb-14	42.4	1,757	53.02	1,758
Mar-14	49.85	2,086	58.11	2,082
Total	**528.07**	**2,1887**	**624.13**	**21,884**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.4	2.5	1.7	2.5

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

TABLE 1 PUMP INVENTORY	
Manufacturer	Fairbanks Morse Pump Corporation 3601 Fairbanks Avenue Kansas City, Kansas 66106-0906 (913) 371-5000
Local Representative	Granich Engineering 300 120th Ave. N.E. Bldg. 7, Suite #116 Bellevue, WA 98009 (206) 451-9696 FAX: 451-1304
Description	4" Model 5432 Non-Clog "Vertical Biltogether" Pump w/ 6" suction 480 V, 15HP, 3 phase 1800 RPM, US Electric Motor
Design Point:	400 GPM at 78 feet TDH
Serial No's.:	Pump 1 K4C1 - 074353 -0 (South) Pump 2 K4C1 - 074353 -1 (North)

Performance Curve:



FIELD MEASUREMENT:
~260 GPM @ 75'

27.4.1.1 Pump 1 – City of Bellevue Asset No. 193821

Pump style	Vertical, close-coupled non-clog
Make	Fairbanks Morse
Model	K4C1-074353-0
Serial No.	None
Horsepower	15
Voltage/phase	230/460/3 phase
Date of installation	1995
Design Conditions	400 gpm @ 78 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Lifting eye and chain fall attached to ceiling of metal can

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical but redundant

Serviceability Rating 1 – Easily accessed in dry pit

General observations/notes from field visit:

- Pumps reverse rotation from one another
- Lifting eye and chain fall is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	66.5
Calculated pumping capacity	260 gpm
Total Dynamic head (feet)	74
Number of tests performed	2

General observations/notes from drawdown test:

- Flow measurement is much lower than design point while head conditions are relatively the same

Pump and motor #1

Lifting eye and chain fall attached to ceiling of metal can#1

27.4.1.2 Pump 2 – City of Bellevue Asset No. 193822

Pump style	Vertical, close-coupled non-clog
Make	Fairbanks Morse
Model	K4C1-074353-0
Serial No.	None
Horsepower	15
Voltage/phase	230/460/3 phase
Date of installation	1995
Design Conditions	400 gpm @ 78 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Lifting eye and chain fall attached to ceiling of metal can

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump is in good condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical but redundant

Serviceability Rating 1 – Easily accessed in dry pit

General observations/notes from field visit:

- Pumps reverse rotation from one another
- Lifting eye and chain fall is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	66.5
Calculated pumping capacity	255 – 260 gpm
Total Dynamic head (feet)	76.5
Number of tests performed	2

General observations/notes from drawdown test:

- Flow measurement is much lower than design point while head conditions are relatively the same

Pump and motor #2

27.4.2. Exposed Piping and Valves

27.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve horizontal axis of rotation – ideal

27.4.2.2 Discharge Piping/Valve(s)

Size	4”
Material	DI
Valve Type(s)	Plug valve and swing check valve with outside lever and spring

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve vertical axis of rotation – not ideal
- Swing check valve is 4”x6”

Plug valve horizontal axis of rotation - ideal

Swing check valve with outside weight and lever 4” x 6”

Plug valve and swing check valve with outside weight and lever located on discharge piping, plug valve vertical installation – not ideal

27.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

27.4.4 Washdown Water

Supply	Domestic/Metered
Access	At surface adjacent to wet well and in dry pit
Backflow prevention assembly	Reduced pressure backflow assembly
Enclosure/Freeze protection	Below grade vault adjacent to road and electrical equipment/Heat tape

General observations/notes from field visit:

- Below grade and no free drain in backflow assembly – does not meet code for installation

Reduced pressure backflow assembly located in below grade water meter vault adjacent to West Lake Sammamish Parkway

Wash down water supply adjacent to wet well

Wash down water hose in dry pit

27.4.5 Ventilation

27.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	230 CFM @ 0.22" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

27.4.5.2 Dry Pit Ventilation (Supply Fan)

Location	6' AFF in dry pit
Fan type	Axial
Airflow rate	374 CFM @ 0.1" SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is 6' AFF in the dry pit

Wet well supply fan located in wet well blower vault

Dry pit supply fan located 6’ AFF in dry pit

27.5 Electrical

27.5.1 Electrical Service

27.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Along West Lake Sammamish Parkway
Service meter location	On rack at West Lake Sammamish Parkway

27.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Enclosed meter base needs repair, main disconnect appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; on outdoor rack adjacent to West Lake Sammamish Pkwy

General observations/notes from field visit:

- Meter base needs to be painted

27.5.2 Backup Power

27.5.2.1 Backup Power Description

Type	Generator Receptacle
Location	On rack at West Lake Sammamish Parkway
Transfer switch type	Manual
Transfer switch location	On rack at West Lake Sammamish Parkway

27.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Manual transfer switch and generator receptacle appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; receptacle adjacent to West Lake Sammamish Pkwy

General observations/notes from field visit:

- Manual transfer switch is a double throw enclosed switch

Utility service and back-up power located adjacent to West Lake Sammamish Parkway on steel rack

Generator receptacle located on rack

27.5.3 Site – Panelboard

27.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120/1 phase
Manufacturer	SQ D
Model	Unknown

27.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Panel and transformer appear to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 3 – Standard parts; equipment is in dry pit

27.5.4 Site - Starters

27.5.4.1 Starters Description

Starters	(2) FVNR Starters

27.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Westinghouse Advantage starters appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel in dry pit

Panelboard located in dry pit, appears to be in good condition

Starters located in dry pit, appears to be in good condition but aging

27.5.5 Site – Telemetry Control Panel

27.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376899
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic level transmitter
Secondary Level Indication	Float switch, ISR, TDR
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	Along West Lake Sammamish Parkway in NEMA 4 box

27.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition but with some clearance violations

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment in dry pit

General observations/notes from field visit:

- ISR clearance violations on the side: 24” to switch for fan, 28” to vent duct, 28” to transformer and LP, 40” to fall arrest, 42” to ladder

Telemetry control panel located in dry pit with operator interface, appears to be in good condition but with some clearance violations

Telephone network interface located on rack along West Lake Sammamish Parkway in NEMA 4 box, showing signs of aging

27.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 27-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Electrical code violations – clearance not per code in front of power and control panel in dry pit	Does not meet code requirement	• Provide adequate clearance
Pitting in lower sections of wet well	May decrease integrity of wet well structure	• Recoat interior of wet well
Intrinsically safe relay clearance violations	Does not meet code requirements	• Provide barrier
Fall protection creates an unsafe alternative than access without it	Life safety issue	• Consider standardizing fall protection to match other stations
City owned meter base needs to be painted/refurbished	Loss of power at site	• Paint and refurbish
Paint coating on side of dry pit is delaminating	May decrease integrity of dry pit structure	• Recoat interior of dry pit
Utility power phase monitor and standby power phase monitor are aging	Loss of power at site	• Replace utility power phase monitor and standby power phase monitor
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators
Backflow assembly enclosure requires drain to daylight.	Does not meet code, potential for cross-connection	• Install device above grade in an enclosure

27.6.1 Project Recommendations

Due to the location of the pump station and its impact to the private residence, it is recommended that a single project be completed to address all deficiencies identified and avoid returning for a second project soon after. The timing of the recommended project is driven by the replacement of the City owned meter base which is critical to the operation of the station.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is significantly more expensive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 27-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost[(1)(2)(3)]
S16-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$258,000
	Electrical code violations – clearance not per code in front of power and control panel in dry pit	Provide adequate clearance		
	Pitting in lower sections of wet well	Investigate to determine structural integrity of wet well		
	Intrinsically safe relay clearance violations	Provide barrier		
	Fall protection creates an unsafe alternative than access without it	Consider standardizing fall protection to match other stations		
	City owned meter base needs to be painted/refurbished	Paint and refurbish		
	Paint coating on side of dry pit is delaminating	Recoat interior		
	Utility power phase monitor and standby power phase monitor are aging	Replace utility power phase monitor and standby power phase monitor		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	Backflow assembly enclosure requires drain to daylight.	Install device above grade in an enclosure		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

27.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the City owned meter base due to its criticality rating. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

27.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 27-4 have been implemented in the timeline identified.

27.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 27-5 and 27-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 27-5 includes the current estimated remaining useful life prior to implementation of the capital improvement projects.

Table 27-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	2	1	0	-	2	20-25
Electrical System	3	1	0	-	3	5-10
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	2	1	0	-	2	10-15

Table 27-6 includes project estimated remaining useful life when the recommended projects provided in Table 27-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups will increase significantly. The telemetry system estimated remaining life will stay the same since the recommended projects do not include significant rehabilitation or replacement of a majority of the equipment within this asset group.

Table 27-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	no onsite generator at this facility					
Rotating Assembly	0	0	0	-	0	30

27.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 27-1 graphically represents the rehabilitation and replacement cost projections for Station 16 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 27-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 27-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 27-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure repair/recoating	$30,000	$40,000	$50,000	$60,000	$70,000
	Bypass pumping	$15,000	$20,000	$25,000	$30,000	$35,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pump wet end rebuild	$5,000	$8,000	$11,000	$14,000	$17,000
	Motor rewind	$5,000	$8,000	$11,000	$14,000	$17,000

Table 27-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	N/A				
	Ancillary components	N/A				
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

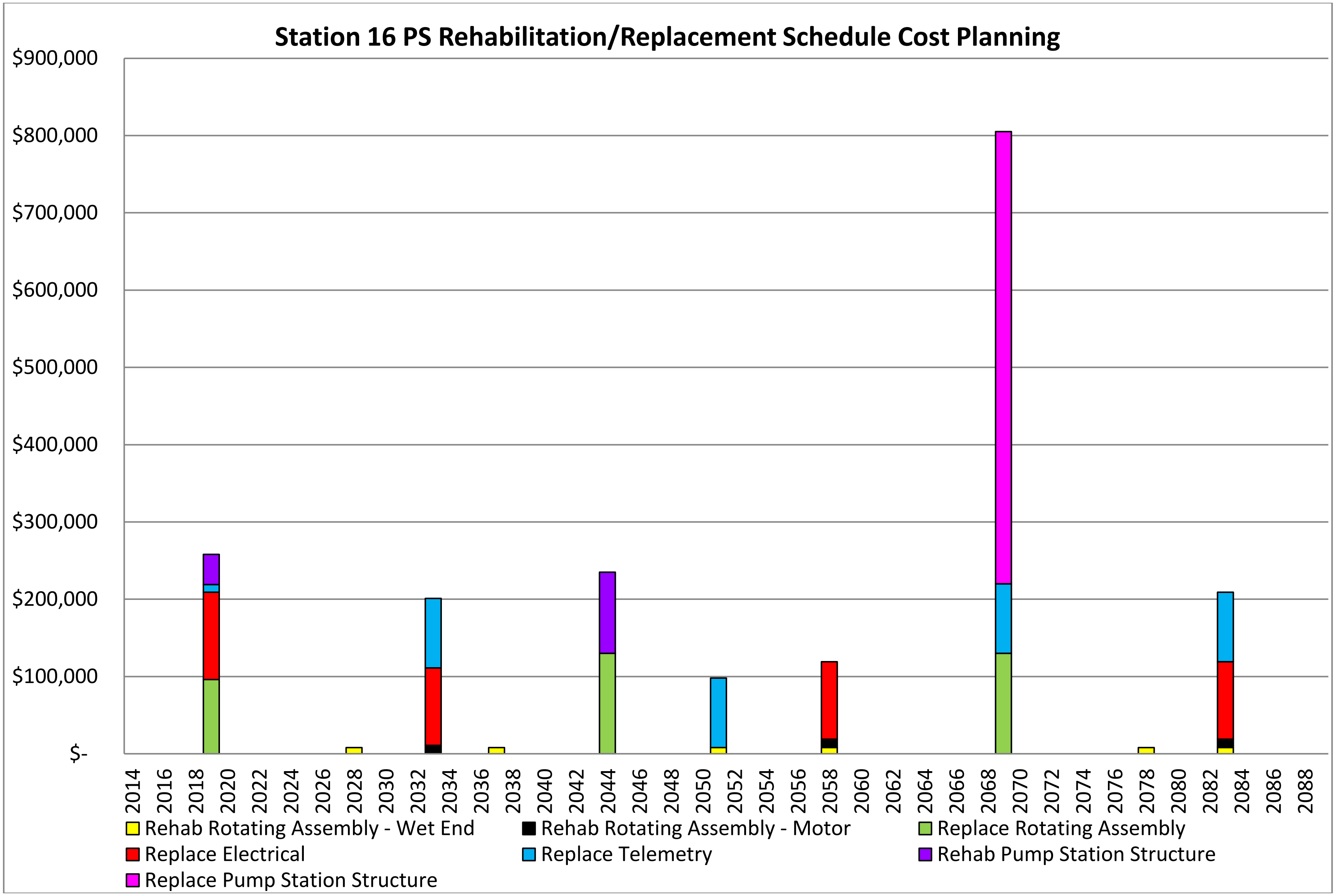
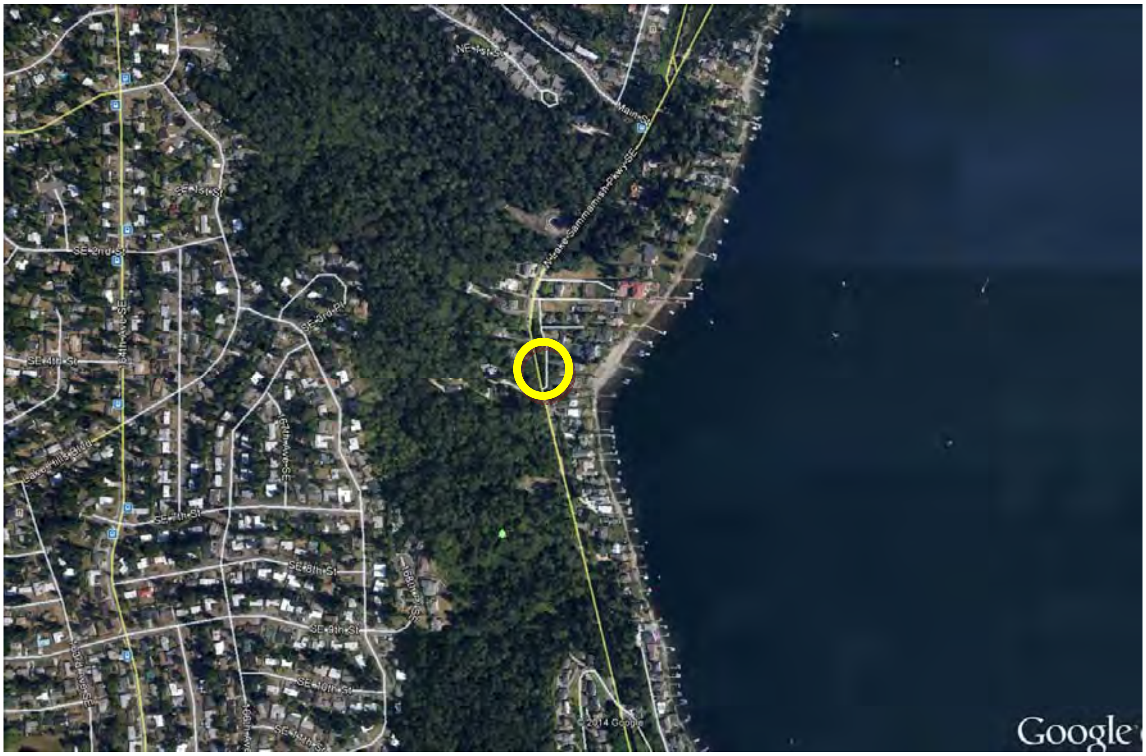


Figure 27-1: 75-year cost planning

<u>Note:</u>

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 28
STATION 12



28.1 Station 12 General Description

Date of Visit	June 23rd, 2014
City of Bellevue Asset No.	187631
Address	365 W Lake Sammamish Parkway
Station configuration	Wet well/Dry pit – series pumping
Original Construction	1963
Major Rehabilitation/Upgrade	2004
Number of Pumps	4
Pump Horsepower	50
Station Voltage/Phase	480/3 Phase
Standby Power	Onsite generator in control building
Field-measured Station Firm Capacity	689-691 gpm

28.1.1 Summary of Findings

Station 12 is located adjacent to West Lake Sammamish Parkway in front of a private residence. A control building that houses the electrical equipment and standby generator and sits atop the dry pit and wet well. This station receives flow from Flush 9 and Stations 16, 17, 18 and 19 and discharges flow through a dedicated force main. There is a Douglas fir approximately 80' tall that could likely fall on the station and put it out of service for a significant amount of time. The wet ends of pumps 2A and 2B were investigated during the site visit and significant pitting was observed in both pumps at the bottom of the volute. This station has a history of problems and numerous studies have been performed on the pumps to determine the source of the significant pitting and wear on the pumps.

Table 28-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 28-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S12-1	An approximately 80' tall Douglas Fir is adjacent to the station and could likely fall on the station	Remove Douglas Fir	2015-2018	$10,000
S12-2	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers	2020-2025	$861,000
	City owned meter base is degrading based on perceived age and there is a corroding CT component	Replace City owned meter base and repair corroding CT component		
	Service entrance disconnect equipment is aging	Replace service entrance disconnect equipment		
	Auto transfer switch and standby generator are aging	Replace auto transfer switch and standby generator		
	Dry transformer is aging	Replace dry transformer		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Backup level indicator is aging	Replace backup level indicator		
	Panelboard is aging	Replace panelboard		

Note:
1. Cost represented in 2014 dollars. Project costs include construction, sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

28.2 Site

28.2.1 Site Description

Vehicle access to site	Pull off on side of West Lake Sammamish Parkway, very busy 2-way street, parking adjacent to station
Landscaping	A lot of trees overhanging near vent
Site lighting	None
Fencing/security	None
Public accessibility to site	No

General observations/notes from field visit:

- There is a large Douglas Fir approximately 80’ tall, that could potentially fall on the station – should consider removing
- Box for chain-fall is 5.5’ AFF, potential safety hazard

Station adjacent to West Lake Sammamish Parkway and private residence

Approximately 80' tall Douglas Fir snag adjacent to/above station that could likely fall on station – should be removed

Box for chain fall is 5'-6" AFF, potential safety hazard

28.3 Station Facilities

28.3.1 Wet Well – Structure and Accessories

28.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete, coated
Access description	Stairs down to wet well, separate door connected to control building
Access fall protection	Yes
Access locked	Yes
Access intrusion alarm	No
General dimensions	11’-6”x8’x17’ deep
Ladder/grating platform	Stairs and grating
Sewer invert(s)	(2) 8”, above operating level
Lighting	Yes
Ventilation	Supply and Exhaust Fan
Ventilation continuous	Yes

*Based on Record Drawings, unable to confirm in field.

28.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior coating appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Stairs and railing to wet well, lock on exterior door

Path to wet well access adjacent to control building

Interior of room above wet well

Stairs to access wet well

28.3.2 Dry Pit/Control Building – Structure and Accessories

28.3.2.1 Dry Pit/Control Building General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Steel frame, tilt up concrete panels
Access description	Doors, stairs to middle level, ladder to pump level
Access fall protection	N/A
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	23’x20’ top level
Lighting	Yes, adequate
Ventilation	Supply Fan
Ventilation continuous	No

28.3.2.2 Dry Pit/Control Building Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

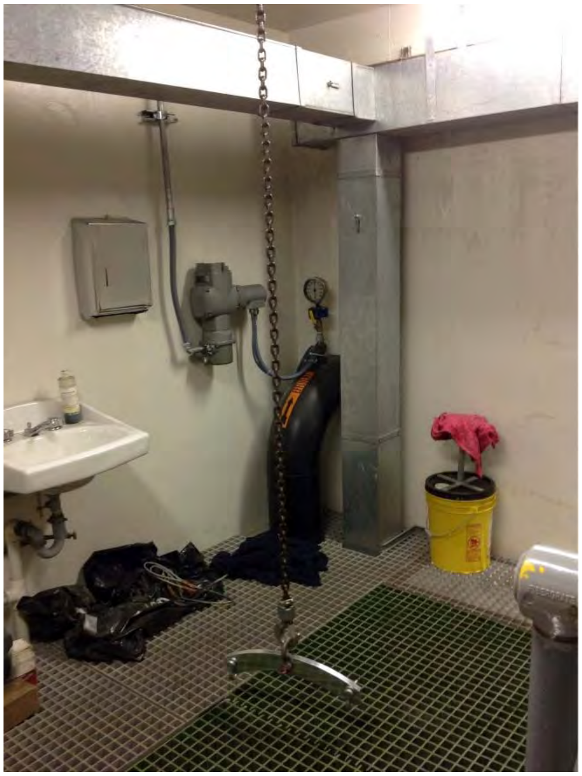
Condition Rating 1 – Dry pit/control building appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit/control building

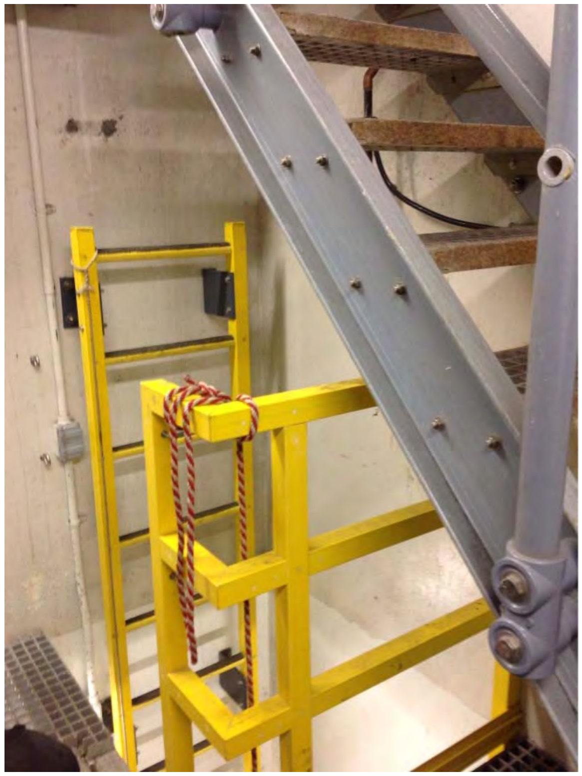
Serviceability Rating 1 – The dry pit/control building is easily accessed and parts are readily available

General observations/notes from field visit:

- Upper level of the structure contains the electrical and instrumentation equipment as well as the generator. Stairs lead down to a mid-level landing, and a ladder leads down to the pump level.



Mid-level landing



Ladder to pump level from mid-level

Interior of dry pit pump level

28.4 Mechanical

28.4.1 Pumps

Pump System Performance

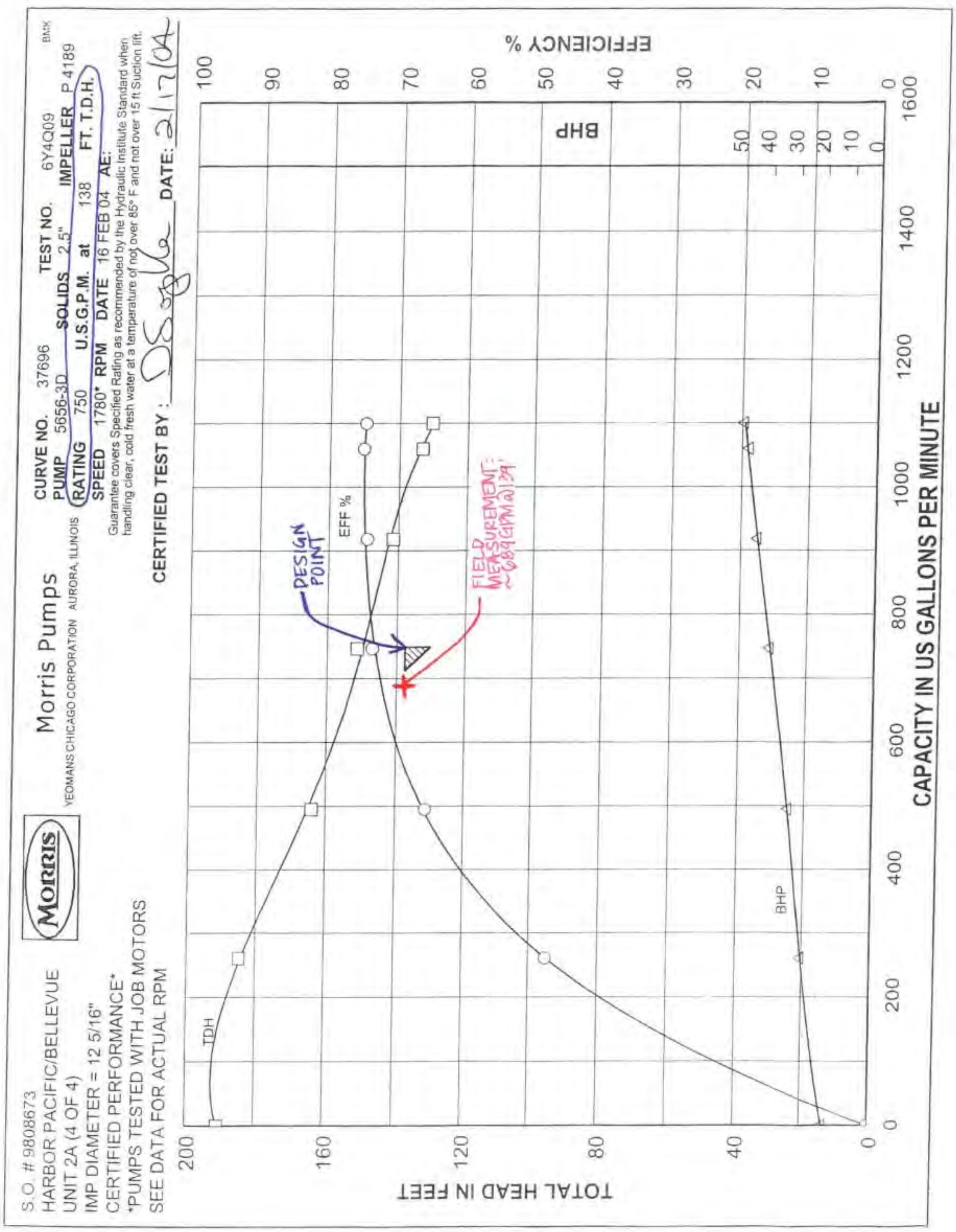
The configuration of this station is unique since there are four pumps total at this station with two sets of two pumps pumping in series, meaning that pump B discharges directly into the suction of pump A. The field tested performance of the pumps at Station 12 measured similar flow (~690 gpm vs. 750 gpm) and similar head conditions (137 ft vs. 138 ft). Given the significant pitting within the volute, it is possible that the pump degradation is at least partly responsible for the decrease in flow. Additional hydraulic evaluation efforts were completed at Station 12 to determine the source(s) of hydraulic issues, the findings of this testing can be found in Appendix C.

The following table documents the pump run hours and starts by month over the past year.

Table 28-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	84.17	1,290	72.35	1,118
May-13	67.21	1,068	72.3	1,145
Jun-13	56.05	898	78.64	1,246
Jul-13	66.68	1,050	65.82	1,049
Aug-13	65.61	1,042	64.88	1,047
Sep-13	77.18	1,211	55.35	892
Oct-13	66.64	1,035	66.46	1,041
Nov-13	70.98	1,074	69.54	1,077
Dec-13	112.16	1,655	36.82	568
Jan-14	155.32	2,189	0.42	9
Feb-14	150.49	2,039	3.44	60
Mar-14	98.1	1,286	91.34	1,285
Total	**1070.59**	**15,837**	**677.36**	**10,537**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	2.9	1.8	1.9	1.2

The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated due to these indicators. However, the observed pitting indicates a significant issue, which will continue to degrade and ruin these pumps. Further, specific testing and documentation is recommended to avoid pump failure.


S.O. # 9808673
HARBOR PACIFIC/BELLEVUE
UNIT 2A (4 OF 4)
IMP DIAMETER = 12 5/16"
CERTIFIED PERFORMANCE*
*PUMPS TESTED WITH JOB MOTORS
SEE DATA FOR ACTUAL RPM
MORRIS
Morris Pumps
YEOMANS CHICAGO CORPORATION AURORA, ILLINOIS
CURVE NO. 37696 TEST NO. 6Y4Q09
BMK
PUMP 5656-3D SOLIDS 2.5" IMPELLER P 4189
RATING 750 U.S.G.P.M. at 138 FT. T.D.H.
SPEED 1780* RPM DATE 16 FEB 04 AE:
Guarantee covers Specified Rating as recommended by the Hydraulic Institute Standard when handling clear, cold fresh water at a temperature of not over 85° F and not over 15 ft Suction lift.
CERTIFIED TEST BY : DSogle DATE: 2/17/04
TDH
EFF %
BHP
DESIGN POINT
FIELD MEASUREMENT: ~689GPM@139'
TOTAL HEAD IN FEET
200
160
120
80
40
0
0
200
400
600
800
1000
1200
1400
1600
CAPACITY IN US GALLONS PER MINUTE
EFFICIENCY %
100
90
80
70
60
50
40
30
20
10
0
BHP
50
40
30
20
10
0

28.4.1.1 Pump 1A and 1B – City of Bellevue Asset No. 193850

Pump style	Centrifugal, series pumping
Make	Morris Pumps
Model	5656-3D
Serial No.	9808673
Horsepower	50
Voltage/phase	460/3
Date of installation	2004
Design Conditions	750 gpm @ 138 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes bridge – chain fall trolley, crane on upper level of control building drops to lower level

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations and drawdown testing the pump appears to be in good condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1A/1B is critical to the function of the station but redundant

Serviceability Rating 1 – Pump is easily accessed in dry pit and parts are available

General observations/notes from field visit:

- Noisy pump under operation
- Hoisting rail is not marked with load capacity, as required by code

Pump 1A and 1B Drawdown Test

Static head (feet)	120
Calculated pumping capacity	691 gpm
Total Dynamic head (feet)	135-139
Number of tests performed	1

General observations/notes from drawdown test:

- Run time data used to calculate the pump capacity was based on pump start-to-pump stop. Due to the operation of the pump control valve, it was discovered during the supplemental hydraulic testing that 35-45 seconds of pump run time are consumed during both startup and shut down sequences. Pump 1A and 1B were not tested during this supplemental evaluation, however the capacity was estimated using a modified run time to reflect the time consumed before the control valve fully opens and closes.

Pumps 1A and 1B

Pump and motor 1A

Pump and motor 1B

28.4.1.2 Pump 2A and 2B – City of Bellevue Asset No. 193851

Pump style	Centrifugal, series pumping
Make	Morris Pumps
Model	5656-3D
Serial No.	9808673
Horsepower	50
Voltage/phase	460/3
Date of installation	2004
Design Conditions	750 gpm @ 138 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes bridge – chain fall trolley, crane on upper level of control building drops to lower level

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Based on visual observations of the wet end the pump appears to be in good condition with the exception of pitting/grooves on the volute observed on both pumps

Criticality Rating 3 – Pump 2A/2B is critical to the function of the station but redundant

Serviceability Rating 1 – Pump is easily accessed in dry pit and parts are available

General observations/notes from field visit:

- Pump 2A and 2B were disassembled upon site visit and the interior of the volute for both pumps showed pitting and grooves
- Noisy pump under operation
- Hoisting rail is not marked with load capacity, as required by code

Pump 2A and 2B Drawdown Test

Static head (feet)	120
Calculated pumping capacity	689 gpm
Total Dynamic head (feet)	135-139
Number of tests performed	1

Pump 2A disassembled upon site visit to observe interior of volute

Interior of Pump 2A volute with pitting and grooves

Pump 2B disassembled upon site visit to observe interior of volute

Interior of Pump 2B volute with pitting and grooves

28.4.2. Exposed Piping and Valves

28.4.2.1 Suction Piping/Valve(s)

Size	10” through wall, reduce to 6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve on 10”

28.4.2.2 Discharge Piping/Valve(s)

Size	4” out of pump B, increase to 6” into pump A, 4” discharge, 4”x6” increase to common 10” steel header
Material	DI/Steel
Valve Type(s)	Plug valve and angled valve, piston actuated

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Automated check valve – high head station

Suction piping

Common discharge piping

Discharge piping with automated check valve

28.4.3 Other Station Piping

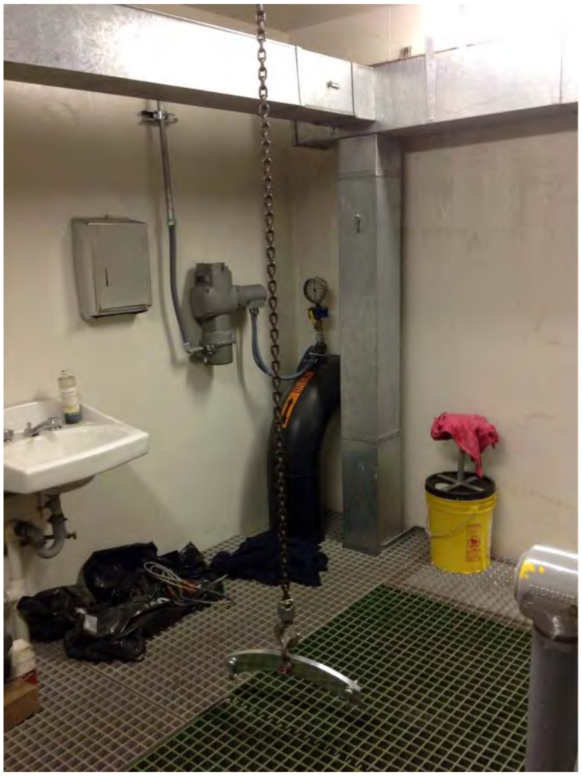
Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

28.4.4 Washdown Water

Supply	Domestic/Metered
Access	In bottom of dry pit
Backflow prevention assembly	Reduced pressure backflow assembly
Enclosure/Freeze protection	None, located in building

General observations/notes from field visit:

- Reduced pressure backflow assembly located in building top floor, drains to daylight



Sink located on mid-level landing

Backflow assembly located in building top floor, drains to daylight

28.4.5 Ventilation

28.4.5.1 Wet Well Ventilation (Supply Fan)

Location	4' AFF in wet well room
Fan type	Axial
Airflow rate	1,340 CFM*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

28.4.5.2 Wet Well Ventilation (Exhaust Fan)

Location	Wet well room
Fan type	Centrifugal on top of carbon canister
Airflow rate	300 CFM*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Dual system – unoccupied – continuous exhaust through no passive supply (negative pressure)
- Carbon system – occupied – continuous supply to lower levels
- Wet well odor treatment fan, inlet screen plugged
- The wet well room that the ventilation fans are located has direct access to the wet well. There is no covering/hatch on the wet well and the stairs down lead directly into it. This space should be classified and treated as a confined space.

Wet well supply fan located behind exhaust fan in wet well access room

Wet well ventilation exhaust fan and carbon canister located in wet well access room

Centrifugal exhaust fan located on top of carbon canister

28.4.5.3 Dry Pit Ventilation (Supply Fan)

Location	SE corner of building – 4’ AFF
Fan type	Axial
Airflow rate	700 CFM*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Screens were completely dusty could not see through

Dry pit supply fan located in corner of
control building 4' AFF

28.5 Electrical

28.5.1 Electrical Service

28.5.1.1 Electrical Service Description

Voltage	480
Phases	3
Utility transformer	Overhead
Service meter location	Back of building

28.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Meter base appears to be in good condition but current transformer compartment is rusty; needs repair or replacement. Main disconnect appears to be in good condition, but aging.

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from outside; main circuit breaker in motor control center

Utility transformer overhead adjacent to station

Utility service meter located in back of building, current transformer compartment very rusty

28.5.2 Backup Power

28.5.2.1 Backup Power Description

City of Bellevue Asset No.	193742
Type	Standby Generator (diesel)
Location	Top floor of building
Manufacturer	Cummins
Model	200 ODFP – 17R 30748M
Serial No.	FST0900160
Age	Unknown
Electrical Capacity (KW)	200
Fuel Storage	Veeder root with underground tank monitor
Cooling	Water (Domestic water supply)
Transfer switch type	Auto
Transfer switch location	Top floor of building

28.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Auto transfer switch and diesel generator appear to be in good condition, but aging. Underground fuel storage tank is monitored

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 1 – Standard parts; generator accessible

Standby generator located on top floor of control building, appears to be in good condition but aging

Transfer switch located in top floor of building, appears to be in good condition but aging

28.5.3 Site – Panelboard

28.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	240/120/3 phase
Manufacturer	SQ D
Model	NQOD 9033302

28.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Panel and transformer appear to be in good condition, but aging

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; panel in main control cabinet; transformer in dry pit

28.5.4 Site - Starters

28.5.4.1 Starters Description

Starters	250A, VFD

28.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The Siemens drives appear to be in good condition, but aging. Line reactors installed but likely don't keep harmonics to within IEEE 519 limits. Investigate operating harmonics

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment in main control cabinet

Panelboard located on top floor of control building

Starters for Pump 1A and 1B, appears to be in good condition but aging

Starters for Pump 2A and 2B, appears to be in good condition but aging

28.5.5 Site – Telemetry Control Panel

28.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376902
Location	Top floor of building
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	High on wall, top floor of building

28.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel with operator interface located on top floor of control building, appears to be in good condition

Interior of telemetry control panel

28.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 28-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
An approximately 80' tall Douglas Fir is adjacent to the station and could likely fall on the station	Could potentially take down station	• Remove Douglas Fir
Pumps, motors and motor drivers are degrading based on perceived age	Loss of service at station	• Replace pumps, motors and motor drivers
City owned meter base is degrading based on perceived age and there is a corroding CT compartment	Loss of power at site	• Replace City owned meter base and repair corroding CT compartment
Service entrance disconnect equipment is aging	Loss of power at site	• Replace service entrance disconnect equipment
Auto transfer switch and standby generator are aging	Loss of power at site	• Replace auto transfer switch and standby generator
Dry transformer is aging	Loss of power at site	• Replace dry transformer
Telephone network interface termination box is aging	Loss of control at site	• Replace telephone network interface termination box
Backup level indicator is aging	Loss of control at site	• Replace backup level indicator
Panelboard is aging	Loss of power at site	• Replace panelboard

28.6.1 Project Recommendations

The Douglas fir adjacent to the station could potentially take it down and there would be a loss of service at the site for a significant amount of time. This deficiency is shown as its own project since work will not be done on the station itself.

The remaining deficiencies were lumped into one project driven by the replacement of the pumps and the City owned meter base during the 2020-2025 timeline.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 28-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost[(1)(2)(3)]
S12-1	An approximately 80' tall Douglas Fir is adjacent to/above the station and could likely fall on the station	Remove Douglas Fir	2015-2018	$10,000
S12-2	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers	2020-2025	$861,000
	City owned meter base is degrading based on perceived age and there is a corroding CT compartment	Replace City owned meter base and repair corroding CT compartment		
	Service entrance disconnect equipment is aging	Replace service entrance disconnect equipment		
	Auto transfer switch and standby generator are aging	Replace auto transfer switch and standby generator		
	Dry transformer is aging	Replace dry transformer		
	Telephone network interface termination box is aging	Replace telephone network interface termination box		
	Backup level indicator is aging	Replace backup level indicator		
	Panelboard is aging	Replace panelboard		

Note:

1. Cost represented in 2014 dollars. Project costs include construction, sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

28.6.2 Project Justification

The Douglas fir should be removed as soon as possible since it is a direct threat to the structure and function of the station. If this tree falls on the station the station will be out of service for a significant amount of time due to re-construction and planning.
The timing of the second recommended project is driven by the replacement of the pumps and City owned meter base. The consequence of failure of either of these components will reduce the level of service to the station below industry standards and regulatory requirements.

Continued deterioration of the meter base will eventually jeopardize power service to the site. Failure of the power service will require the station to operate off of the standby generator until the service is temporarily repaired and new meter based installed.

28.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 28-4 have been implemented in the timeline identified.

28.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 28-5 and 28-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 28-5 includes the current estimated remaining useful life prior to the implementation of the capital improvement projects.

Table 28-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	2	1	0	-	2	15-20
Telemetry System	2	1	0	-	2	5-10
Generator	3	1	0	-	3	5-10
Rotating Assembly	3	1	0	-	3	5-10

Table 28-6 includes project estimated remaining useful life when the recommended projects provided in Table 28-4 are complete. Upon completion of the recommended projects the estimated remaining useful life for most asset groups will increase significantly. The pump station asset group estimated remaining useful life will stay the same since the recommended projects do not include significant rehabilitation or replacement of the structure.

Table 28-6
Estimated Remaining Useful Life Following CIP Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	0	0	0	-	0	30
Telemetry System	1	1	0	-	1	10-15
Generator	0	0	0	-	0	40
Rotating Assembly	0	0	0	-	0	30

28.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 28-1 graphically represents the rehabilitation and replacement cost projections for Station 12 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 28-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 28-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 28-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	$10,000 $5,000	$15,000 $10,000	$20,000 $15,000	$25,000 $20,000	$30,000 $25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 28-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

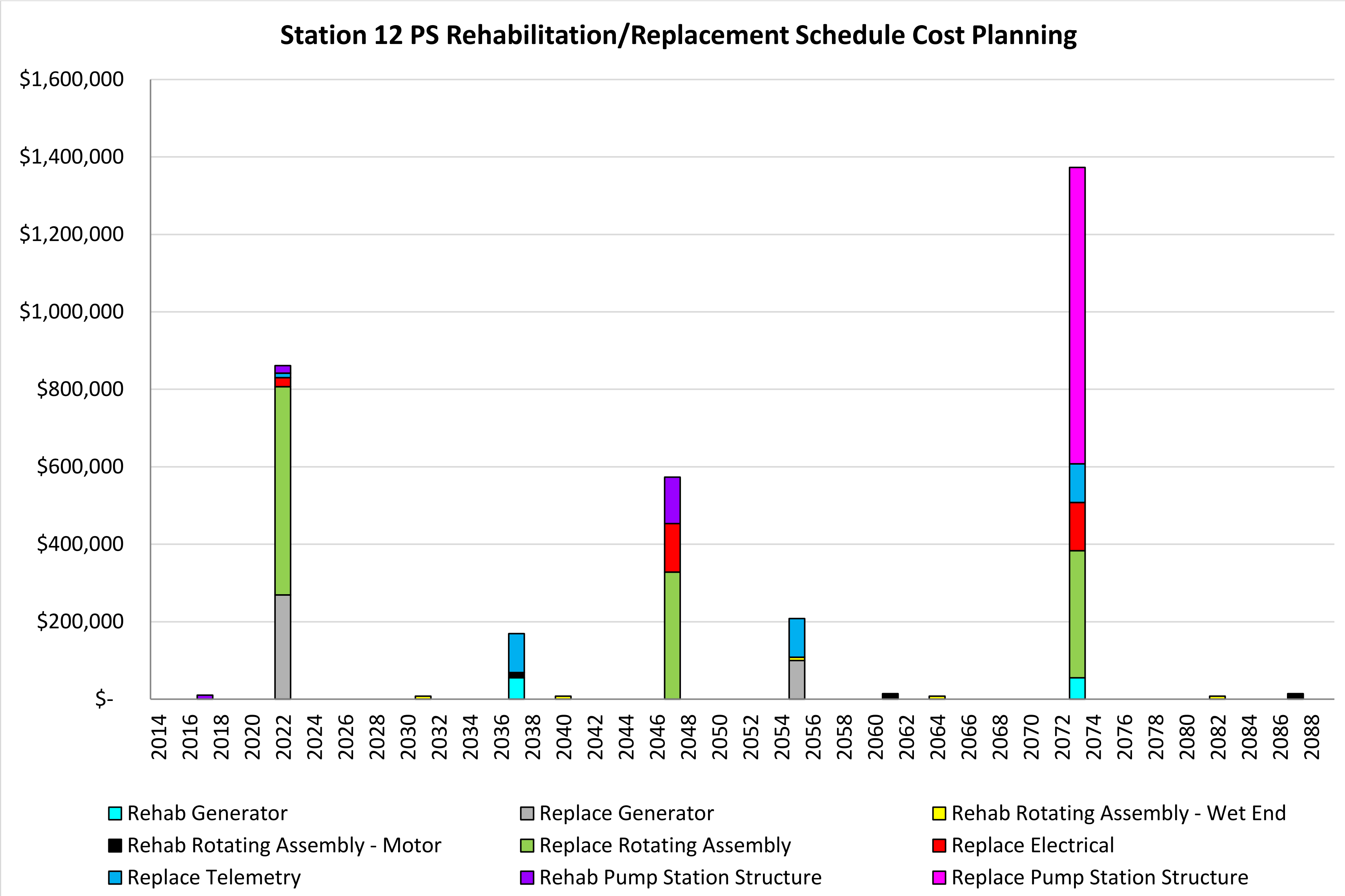
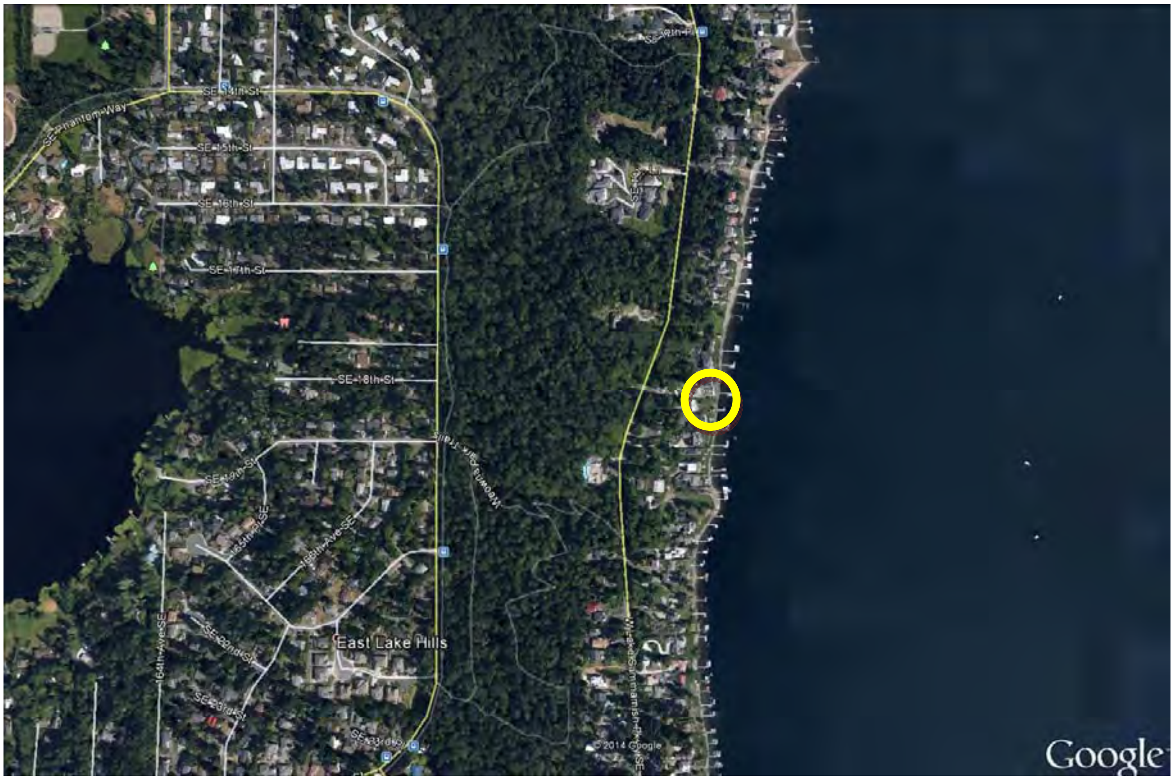


Figure 28-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 29
STATION 2



29.1 Station 2 General Description

Date of Visit	June 23rd, 2014
City of Bellevue Asset No.	187576
Address	1802 W Lake Sammamish Parkway SE
Station configuration	Wet well/Dry pit
Original Construction	1968
Major Rehabilitation/Upgrade	2001
Number of Pumps	2
Pump Horsepower	2
Station Voltage/Phase	240/120/3 Phase
Standby Power	Onsite generator in dry pit
Field-measured Station Firm Capacity	300 – 315 gpm

29.1.1 Summary of Findings

Station 2 is located in a paved deck area adjacent to the lake and a private residence. The station receives flow from Flush 10 and discharges to the lake line. There is a railing on the deck area but it does not wrap around entirely and there is a potential safety issue. There are two Paco pumps at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech).

Table 29-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 29-1
Summary of Station Deficiencies and Recommended Improvements

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S2-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$220,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Standby generator is obsolete and condition is deteriorating	Replace standby generator and auto transfer switch		
	Panelboard is aging	Replace panelboard		
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Backup level indicator is aging	Replace backup level indicator		
	No interior coating in wet well	Inspect/evaluate wet well for corrosion		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

29.2 Site

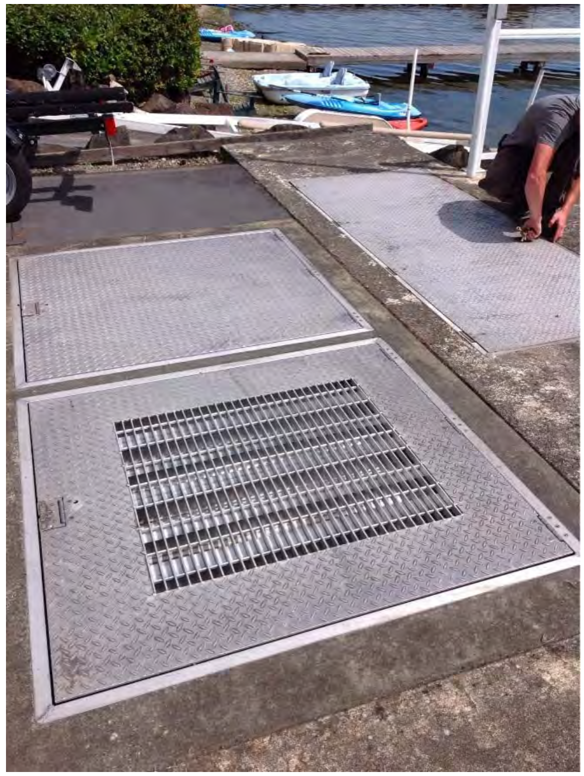
29.2.1 Site Description

Vehicle access to site	Private drive off West Lake Sammamish Parkway, parking adjacent to station
Landscaping	Paved area with private landscaping on sides
Site lighting	Yes – between dry pit and wet well
Fencing/security	None
Public accessibility to site	Adequate for public, not for private residents

General observations/notes from field visit:

- Drop-off alongside of site where railing does not wrap around – potential safety issue

Vehicle parking adjacent to site



Station in paved desk area, site drops off to lake level with no railing around, potential safety issue

Site lighting between dry pit and wet well on deck area adjacent to station

29.3 Station Facilities

29.3.1 Wet Well – Structure and Accessories

29.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Manhole lid, Olympic Foundry Co. and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x10’-6”*
Ladder/grating platform	Ladder and grating
Sewer invert(s)	8”, above operating level
Lighting	Yes
Ventilation	Supply Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

29.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

General observations/notes from field visit:

- Upon failure of locking access lid, alternate lid will need to be purchased/fabricated or entire top of wet well will need to be replaced with new concrete top and hatch

Wet well manhole lid and ladder, interior appears to be in good condition

Interior of wet well appears to be in good condition

29.3.2 Dry Pit – Structure and Accessories

29.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete, coated
Access description	Lift assist hatch and stairs
Access fall protection	Yes, net near opening
Access locked	Yes
Access intrusion alarm	Yes
General dimensions	13’x15’x11’ deep
Lighting	Yes, adequate
Ventilation	Exhaust Fan
Ventilation continuous	No

29.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Some coating failure on ceiling – appears to be due to poor prep work
- No equipment access hatch, will have to carry equipment up stairs

Dry pit fall protection net near stairway

Interior of dry pit appears to be in good condition

Some coating failure on ceiling – appears to be due to poor prep work

29.3.3 Wet Well Blower Vault – Structure and Accessories

29.3.3.1 Wet Well Blower Vault General Description

Area	Current Classification	Rationale
Wet Well Blower Vault	Class 1, Division 2	NFPA 820, table 4.2, row 20a

Construction materials	Concrete
Access description	Lift assist hatch and ladder
Access fall protection	No
Access locked	Yes
Access intrusion alarm	No
General dimensions	4’x4’x3’ deep
Lighting	None
Ventilation	None
Ventilation continuous	N/A

29.3.3.2 Wet Well Blower Vault Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Wet well blower vault appears to be in good condition.

Criticality Rating 1 – Not critical and its failure would not significantly affect pump station operation

Serviceability Rating 1 – Easily accessed and parts are readily available

General observations/notes from field visit:

- Grate covering for air intake vault adjacent to wet well blower vault, grate covering is locked

Wet well blower vault and air intake
vault in deck area

Interior of wet well blower vault appears
to be in good condition

29.4 Mechanical

29.4.1 Pumps

Pump System Performance

The field tested performance of Station 2 pumps indicate that the flow is slightly greater than the design rate (~310 gpm vs. 300 gpm) and the pressure head is approximately one third of the design rate (4 ft vs. 13 ft). Given that the flow is near the design rate but the pressure head is significantly lower, it is possible that the original design overestimated the downstream pressure losses, which would have originally delivered a greater flow rate. As pump wear has taken place, the flow rate would be reduced. As the capacity is similar to the original design, there are no concerns with the current pump.

The following table documents the pump run hours and starts by month over the past year.

Table 29-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	13.2	672	13.22	672
May-13	12.99	660	12.96	661
Jun-13	12.87	660	12.81	658
Jul-13	16.88	856	16.99	855
Aug-13	13.64	696	13.51	694
Sep-13	12.88	663	12.85	665
Oct-13	13.34	675	13.24	674
Nov-13	13.22	666	13.21	666
Dec-13	14.25	719	14.26	716
Jan-14	27	1,356	25.27	1,358
Feb-14	20.47	1,028	19.96	1,027
Mar-14	29.64	1,504	27.97	1,504
Total	**200.38**	**10,155**	**196.25**	**10,150**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	0.5	1.2	0.5	1.2

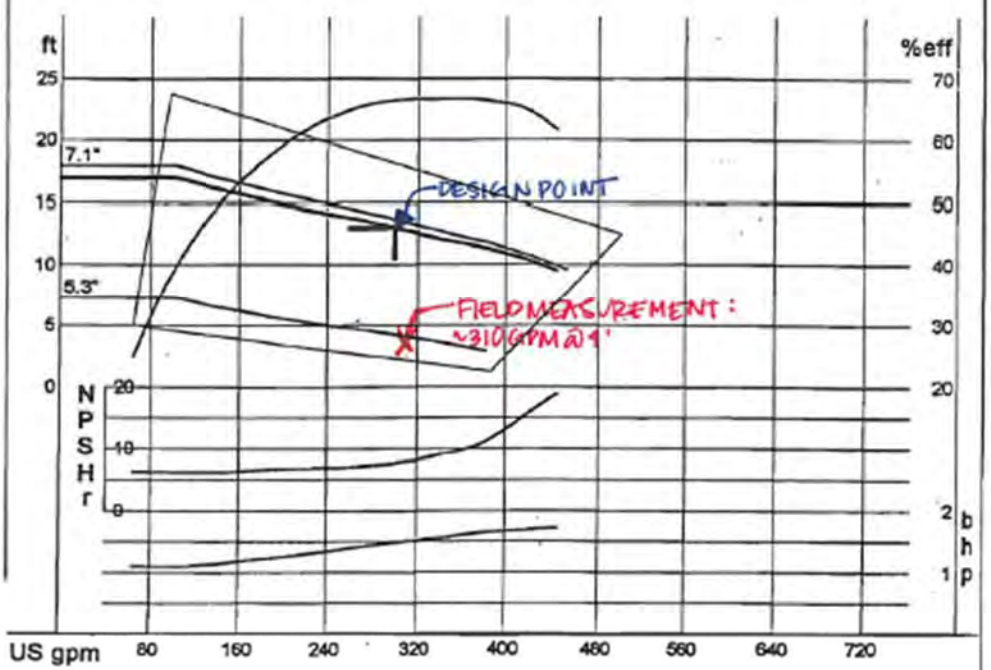
The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

FIGURE 5

PUMP INVENTORY

Manufacturer	PACO Pumps, Inc. P.O. Box 12924 845 – 92nd Avenue Oakland, CA 94603
Local Representative	PACO Pumps, Inc. 3215 S. 116th Street Seattle, WA 98168 (206) 433-2600; FAX 433-0263
Description	Model 4070-21/22 Dry Pit Non-Clog 2 HP, 230V, 3 phase, 1,150RPM Motor
Design Point	300 GPM at 13 feet TDH
Serial No's:	Pump 1: 00A0095101B (West) Pump 2: 00A0095101A (East)

Performance Curve:



29.4.1.1 Pump 1 – City of Bellevue Asset No. 193811

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-407021-XV1004-2568
Serial No.	00A0095101B
Horsepower	2
Voltage/phase	460/230/ 3 phase
Date of installation	Unknown
Design Conditions	300 gpm @ 13 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, chain hoist/trolley (1/2 ton) and rail (no rating)

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized
- Hoisting rail is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	4
Calculated pumping capacity	300 – 315 gpm
Total Dynamic head (feet)	4
Number of tests performed	2

General observations/notes from drawdown test:

- Measured flow is below pump curve, may indicate possible wear

Duplex configuration, pump #1 in foreground

Pump and motor #1

Exterior of pump #1 showing signs of aging

29.4.1.2 Pump 2 – City of Bellevue Asset No. 193812

Pump style	Vertical, non-clog
Make	Paco Pumps
Model	52-407021-XV1004-2568
Serial No.	00A0095101A
Horsepower	2
Voltage/phase	460/230/ 3 phase
Date of installation	Unknown
Design Conditions	300 gpm @ 13 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, chain hoist/trolley (1/2 ton) and rail (no rating)

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 2 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech)
- Hoisting rail is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	4
Calculated pumping capacity	315 gpm
Total Dynamic head (feet)	4
Number of tests performed	2

General observations/notes from drawdown test:

- Measured flow is below pump curve, may indicate possible wear

Duplex configuration, pump #2 in background

Pump and motor #2

Exterior of pump #2 showing signs of aging

29.4.2. Exposed Piping and Valves

29.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve installed with horizontal axis of rotation on suction piping for pump 1 – ideal
- Plug valve installed with vertical axis of rotation on suction piping for pump 2 – not ideal. Should be addressed upon replacement of rotating assembly.

29.4.2.2 Discharge Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve and Swing check valve w/ outside lever and spring

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 – Station could not operate upon failure of the piping and/or valves

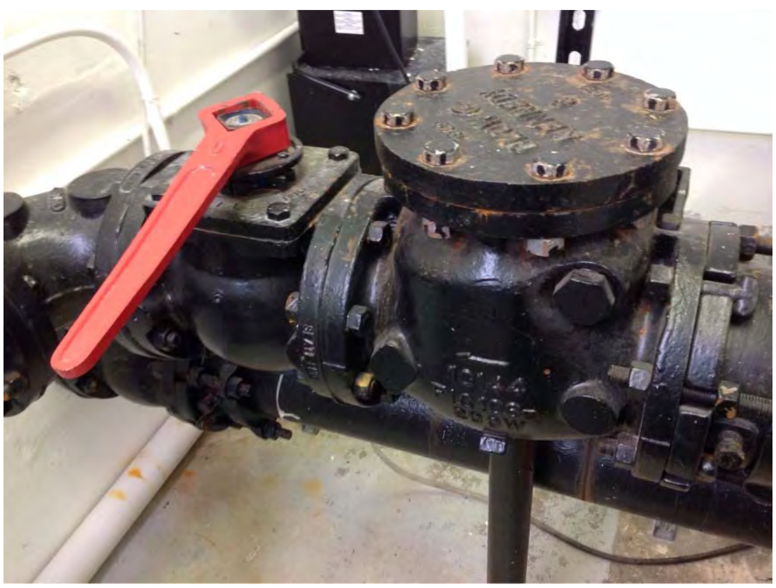
Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve installed with vertical axis of rotation – not ideal. Should be addressed upon replacement of rotating assembly.

Plug valve installed with horizontal axis of rotation on suction piping for pump1 - ideal

Plug valve installed with vertical axis of rotation on suction piping for pump 2 – not ideal



Discharge piping with plug valve and swing check valve with outside lever and spring, plug valve installed with vertical axis of rotation – not ideal

29.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

29.4.4 Washdown Water

Supply	From lake – pressure tank system
Access	Corner of dry pit
Backflow prevention assembly	None
Enclosure/Freeze protection	N/A

Washdown water supplied from lake using pressure tank system located in corner of dry pit

29.4.5 Ventilation

29.4.5.1 Wet Well Ventilation (Supply Fan)

Location	Wet well blower vault
Fan type	Centrifugal
Airflow rate	260 CFM @ 0.38” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Air intake through separate vault – shares intake for dry pit

29.4.5.2 Dry Pit Ventilation (Exhaust Fan)

Location	5’ AFF in dry pit
Fan type	Axial
Airflow rate	1180 CFM @ 0.18” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Exhausting dry pit does not meet NFPA 820 code, pressure differential, install supply fan and provide continuous ventilation

Wet well supply fan located in wet well blower vault

Air intake for wet well supply fan and dry pit exhaust fan located in vault

Dry Pit exhaust fan located 5’ AFF in dry pit

29.5 Electrical

29.5.1 Electrical Service

29.5.1.1 Electrical Service Description

Voltage	240/120
Phases	3
Utility transformer	Unknown
Service meter location	On power cabinet

29.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused disconnect appears to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway

29.5.2 Backup Power

29.5.2.1 Backup Power Description

City of Bellevue Asset No.	193754
Type	Standby Generator, Natural Gas
Location	In dry pit
Manufacturer	McGraw-Edison, ONAN
Model	7.5 JB-18R/25103AD
Serial No.	H820630360
Age	Unknown
Electrical Capacity (KW)	7.5, 3 phase
Fuel Storage	Natural gas, no storage tank
Cooling	Air cooled
Transfer switch type	Auto
Transfer switch location	In dry pit

29.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – Transfer switch and propane generator appear to be in good condition, but aging

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard; parts may not be available

Service meter located on outdoor power cabinet

Generator receptacle located on outdoor power cabinet

Interior of power cabinet

Standby generator located in dry pit

29.5.3 Site – Panelboard

29.5.3.1 Panelboard Description

Location	In dry pit
Voltage/Phase	208/120
Manufacturer	GE
Model	AQF318

29.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – GE panel appears to be in good condition, but aging

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

29.5.4 Site - Starters

29.5.4.1 Starters Description

Starters	(2) FVNR Starters

29.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The Cutler Hammer starters appear to be in good condition but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard located in dry pit

Starters located in dry pit

29.5.5 Site – Telemetry Control Panel

29.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376776
Location	In dry pit
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	In power enclosure along West Lake Sammamish Parkway

29.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Telemetry control panel with operator interface

Telephone network interface located in outdoor power cabinet

29.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 29-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Paco pumps are obsolete and condition is deteriorating	Paco pumps will not be serviceable in near future	• Replace pumps and motors
Standby generator is obsolete and condition is deteriorating	Loss of power at site	• Replace standby generator and auto transfer switch
Panelboard is aging	Loss of power at site	• Replace panelboard
Standby power phase monitor is aging	Loss of control at site	• Replace standby power phase monitor
Backup level indicator is aging	Loss of control at site	• Replace backup level indicator
No interior coating in wet well	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

29.6.1 Project Recommendations

Due to the location of the station and its impact to the private residence, it is recommended that a single project be completed to address all deficiencies identified and avoid returning for a second project soon after. The timing of the recommended project is driven by the replacement of the Paco pumps which is critical to the operation of the station.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is cost prohibitive.

In addition to addressing these deficiencies, access hatch fall protection should be installed for the wet well blower vault to provide safety for the public and staff when the vault hatches are in the open position. Installing fall protection on the wet well access is not recommended due to its infrequent use, but when it is open for an extended period of time, temporary handrail should be used.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 29-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S2-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$220,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Standby generator is obsolete and condition is deteriorating	Replace standby generator and auto transfer switch		
	Panelboard is aging	Replace panelboard		
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Backup level indicator is aging	Replace backup level indicator		
	No interior coating in wet well	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

29.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the Paco pumps due to its serviceability rating. The consequence of failure of either of these components will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pumps are no longer manufactured, making the pumps obsolete. Also, based on the drawdown tests, their capacity appears to have deteriorated. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

29.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 29-4 have been implemented in the timeline identified.

29.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 29-5 and 29-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 29-5 includes the current estimated remaining useful life prior to implementation of the capital improvement projects.

Table 29-5
Current Estimated Remaining Useful Life

	Trigger Scores				Asset Score	Est. Remain Life (years)
	Condition	Obsolescence	Call Outs	Capacity		
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	2	1	0	-	2	5-10
Generator	2	1	0	-	2	10-15
Rotating Assembly	3	5	0	-	5	0-5

Table 29-6 includes project estimated remaining useful life when the recommended projects provided in Table 29-4 are complete. Upon completion of the recommended projects the estimated remaining life for the telemetry system, generator and rotating assembly asset groups will increase significantly. The estimated remaining life for the pump station structure and electrical system will remain the same since the recommended project does not include significant rehabilitation or replacement of a majority of the equipment within the asset groups.

Table 29-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	Obsolescence	Call Outs	Capacity	Asset Score	Est. Remain Life (years)
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	0	0	0	-	0	40
Rotating Assembly	0	0	0	-	0	30

29.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 29-1 graphically represents the rehabilitation and replacement cost projections for Station 2 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 29-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 29-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 29-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	$10,000 $5,000	$15,000 $10,000	$20,000 $15,000	$25,000 $20,000	$30,000 $25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 29-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

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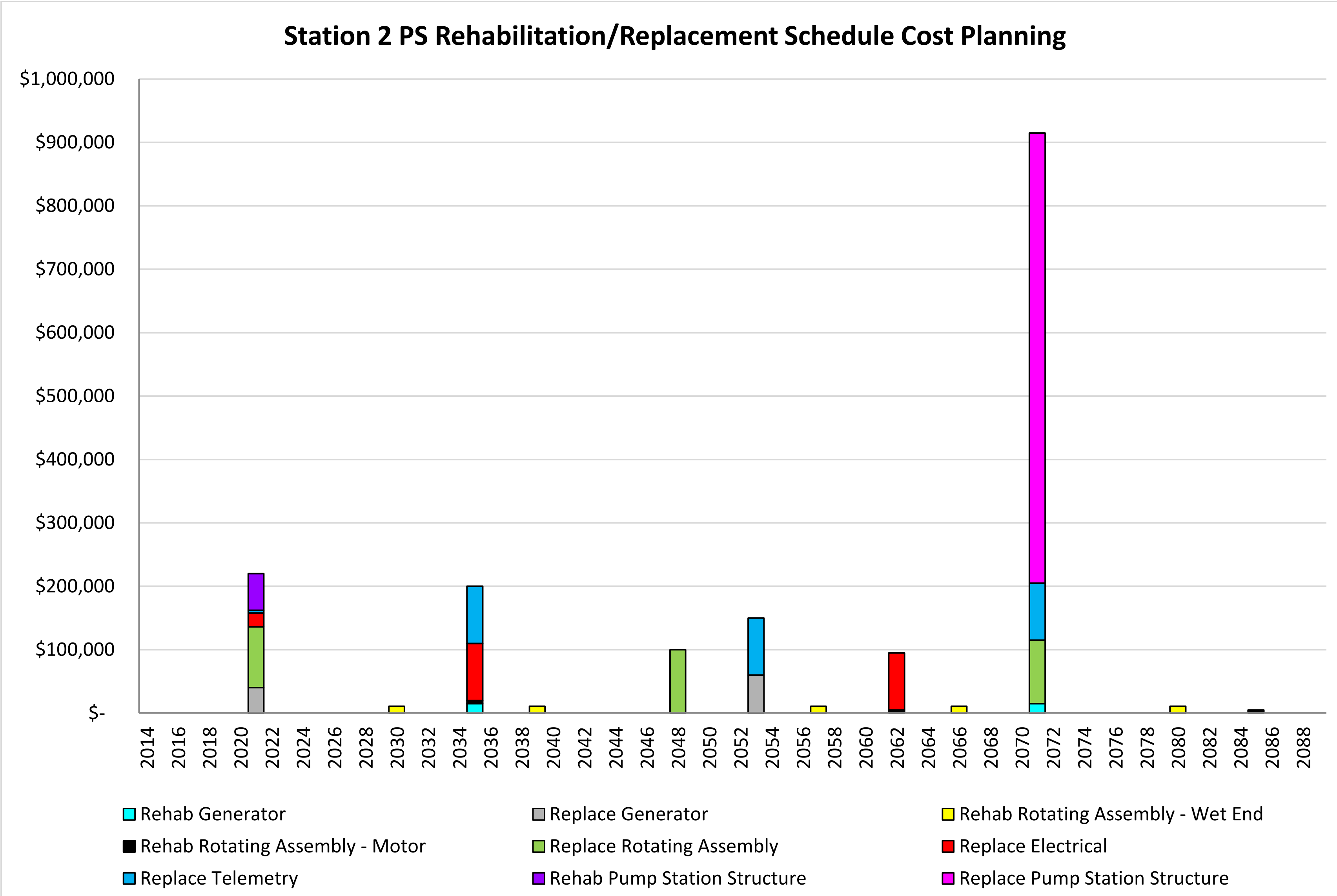
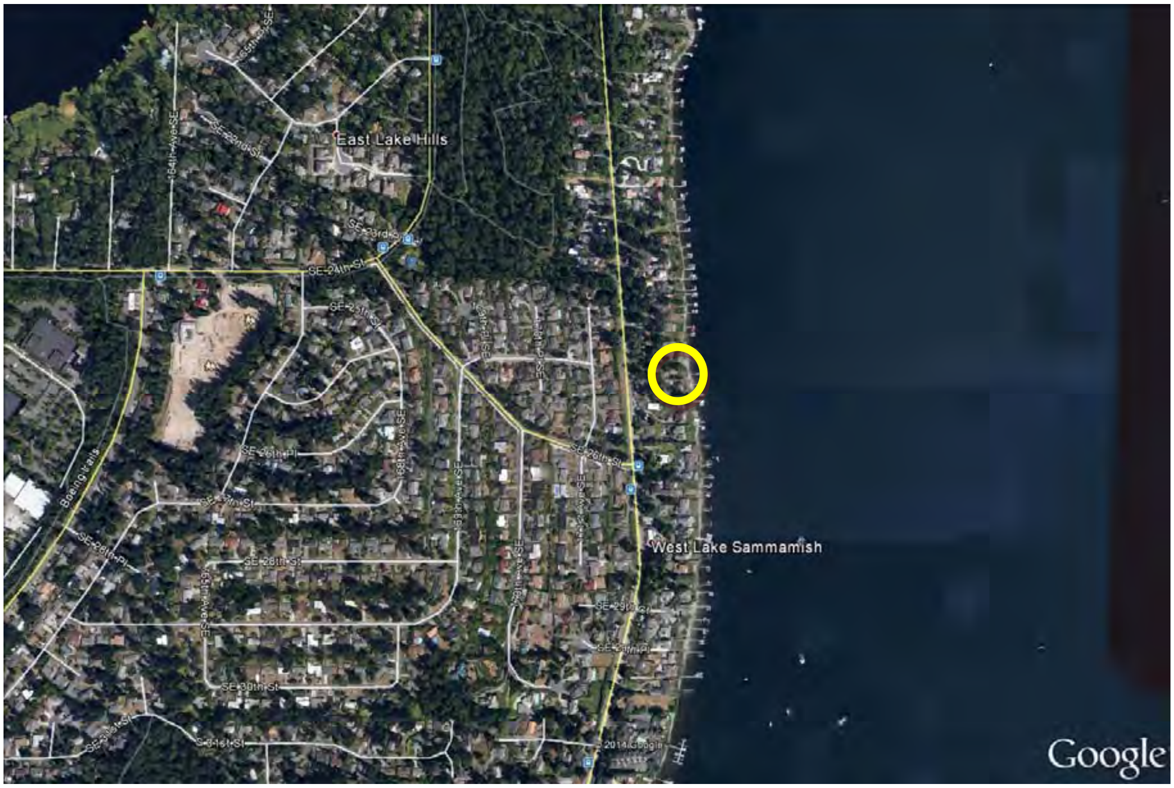


Figure 29-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 30
STATION 1



30.1 Station 1 General Description

Date of Visit	June 23rd, 2014
City of Bellevue Asset No.	187624
Address	2442 W Lake Sammamish Parkway SE
Station configuration	Wet well/Dry pit
Original Construction	1968
Major Rehabilitation/Upgrade	2001
Number of Pumps	2
Pump Horsepower	2
Station Voltage/Phase	240/120/3 Phase
Standby Power	Onsite generator at top floor of building
Field-measured Station Firm Capacity	500 – 525 gpm

30.1.1 Summary of Findings

This station is in a converted water treatment plant building. The control building sits on top of the dry pit and the wet well is adjacent and accessed through a separate door in the control building. This station receives flow from Flush 10 and Station 2 and discharges to the lake line. There are two Paco pumps at this station that are obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech).

Table 30-1 summarizes the deficiencies observed at this station along with the recommended improvements, project's timing and estimated cost.

Table 30-1
Summary of Station Deficiencies and Recommended Improvements

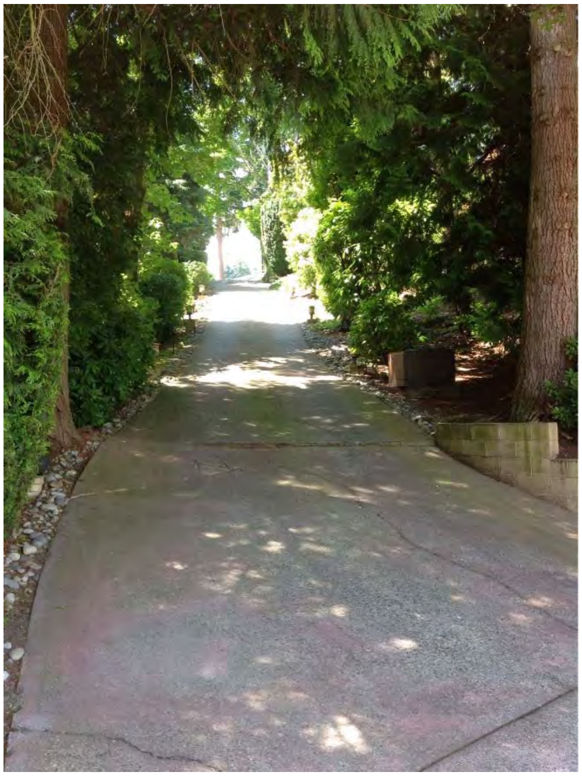
Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
S1-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$191,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Standby generator is obsolete and condition is deteriorating	Replace standby generator and auto transfer switch		
	Standby power phase monitor aging	Replace standby power phase monitor		
	Primary and backup level indicators aging	Replace primary and backup level indicators		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

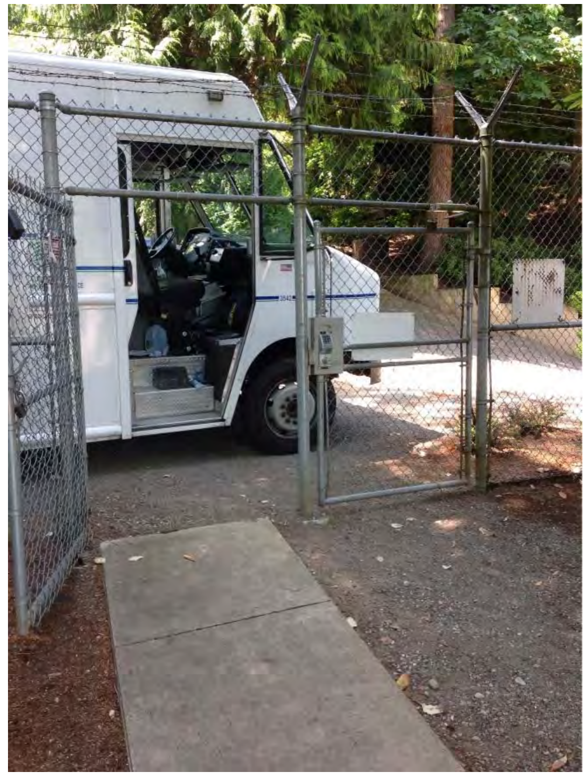
Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

30.2 Site

30.2.1 Site Description

Vehicle access to site	Steep one lane driveway, private, parking is approximately 25’ from the station
Landscaping	Lots of vegetation, maintained by homeowners beach club
Site lighting	None
Fencing/security	Chain link fence on two sides with barbed wire topping
Public accessibility to site	No access for public, but access security pad for homeowners beach club





One lane steep driveway access to station

Parking adjacent to station

Chain link fence with barbed wire topping, no access for public, but there is an access security pad for home owners beach club

30.3 Station Facilities

30.3.1 Wet Well – Structure and Accessories

30.3.1.1 Wet Well General Description

Area	Current Classification	Rationale
Wet Well	Class 1, Division 1	NFPA 820, table 4.2, row 16a

Construction materials	Concrete
Access description	Adjacent to control building, separate door, hatch and ladder
Access fall protection	No
Access locked	Yes, lock on exterior door
Access intrusion alarm	No
General dimensions	5’-8”x20’
Ladder/grating platform	Ladder and grating
Sewer invert(s)	8”, above operating level
Lighting	Yes
Ventilation	Supply and Exhaust Fan
Ventilation continuous	No

*Based on Record Drawings, unable to confirm in field.

30.3.1.2 Wet Well Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Ground surface inspection identified interior appears to be in good condition. The structural condition could not be determined.

Criticality Rating 4 – Station cannot operate without functioning wet well

Serviceability Rating 2 – Wet well structure, wall repair, ladder and grating materials must be ordered and may require bypass pumping

Wet well accessed through separate door adjacent to control building

Wet well access hatch

Interior of wet well appears to be in good condition

30.3.2 Dry Pit – Structure and Accessories

30.3.2.1 Dry Pit General Description

Area	Current Classification	Rationale
Dry Pit	Class 1, Division 2	NFPA 820, table 4.2, row 17b

Construction materials	Concrete
Access description	Door to control building, spiral staircase to pump level
Access fall protection	No
Access locked	Yes, lock on building access door only
Access intrusion alarm	Yes, building access door
General dimensions	28’x21’
Lighting	Yes, adequate
Ventilation	Supply and Exhaust Fan
Ventilation continuous	No

30.3.2.2 Dry Pit Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

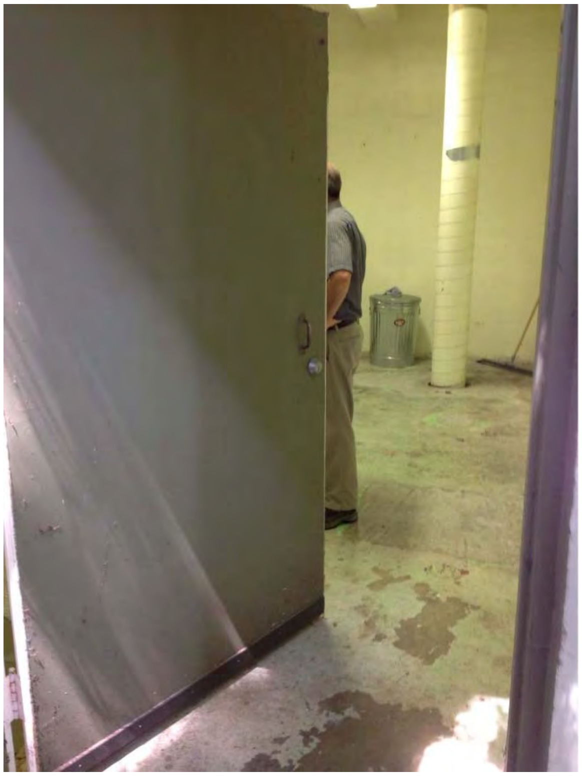
Condition Rating 1 – Dry pit appears to be in good condition.

Criticality Rating 4 – Station cannot operate without functioning dry pit

Serviceability Rating 1 – The dry pit is easily accessed and parts are readily available

General observations/notes from field visit:

- Control building sits on top of dry pit
- Lower level dimensions, 20 ½’ x 22’
- Flush 6” pipe from lake
- Minor concrete spall in the ceiling, should be monitored



Door to control building to access dry pit and pumps on lower level

Dry pit/pump level accessed from spiral staircase in control building

Interior of dry pit

Minor concrete spall on ceiling of dry pit, should be monitored

30.4 Mechanical

30.4.1 Pumps

Pump System Performance

The field tested performance of the pumps at Station 1 measured considerably higher flow (~515 gpm vs. 424 gpm) and a lower head (2 ft vs. 14 ft) than the design point. Assuming the accuracies of the measurements are reasonable and based on the pumping system head comparison in the following figure, it is possible that the design system head condition was overestimated relative to the current situation. Regardless, the pump appears to be operating near the end of the pump curve where cavitation could be a potential concern.

The following table documents the pump run hours and starts by month over the past year.

Table 30-2
Summary of Pump Run Hours and Starts

Month	P#1 Hours	P#1 Starts	P#2 Hours	P#2 Starts
Apr-13	27.93	362	25.15	340
May-13	27.09	335	25.53	342
Jun-13	27.38	334	25.77	339
Jul-13	30.11	411	32.16	404
Aug-13	25.47	344	21.92	352
Sep-13	23.94	331	23.21	331
Oct-13	31.34	352	34.48	346
Nov-13	29.62	356	34.27	331
Dec-13	31.04	367	32.21	363
Jan-14	29.24	325	29.52	339
Feb-14	29.77	340	29.81	345
Mar-14	40.46	370	35.33	382
Total	**353.39**	**4,227**	**349.36**	**4,214**
	Avg hrs/day	Avg starts/hr	Avg hrs/day	Avg starts/hr
	1.0	0.5	1.0	0.5

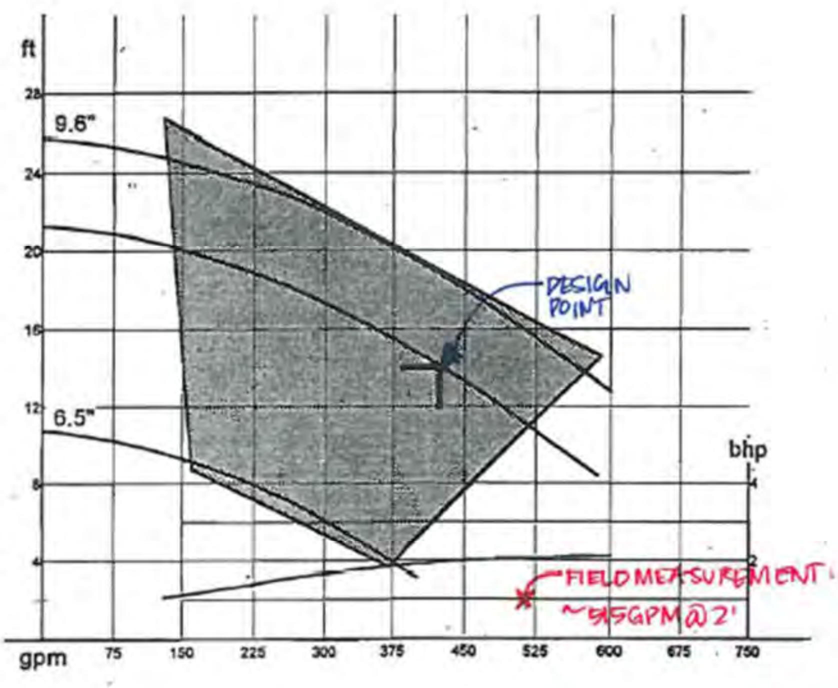
The pump run hours and starts for this facility seem to be reasonable and no accelerated wear is anticipated.

FIGURE 5

PUMP INVENTORY

Manufacturer	PACO Pumps, Inc. P. O. Box 12924 845 – 92nd Avenue Oakland, CA 94604-2924
Local Representative	PACO Pumps, Inc. 3215 S. 116th St. Seattle, WA 98168 (206) 433-2600; Fax (206) 433-0263
Description	Model 52-NCH-49513-346COX Dry Pit Non-Clog 2/hp, 230V, 3Ø, 850 RPM Motor
Design Point:	424 GPM at 14 feet TDH
Serial No's.:	Pump 1: 94A0205901B (North) Pump 2: 94A0205901A (South)

Performance Curve:



30.4.1.1 Pump 1 – City of Bellevue Asset No. 193813

Pump style	Horizontal, end-suction centrifugal
Make	Paco Pumps
Model	52-NCH-49513-346C0X
Serial No.	NK94A0205901B
Horsepower	2
Voltage/phase	208-230/460/3
Date of installation	Unknown
Design Conditions	424 gpm @ 14 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Hoisting rail is not marked with load capacity, as required by code

Pump 1 Drawdown Test

Static head (feet)	1.3
Calculated pumping capacity	510 gpm
Total Dynamic head (feet)	1.6
Number of tests performed	2

General observations/notes from drawdown test:

- The pump appears to be operating near the end of the pump curve, cavitation could be a potential concern.

Duplex configuration pump #1 on left

Pump 1 showing signs of aging on exterior

Pump and motor #1

30.4.1.2 Pump 2 – City of Bellevue Asset No. 193814

Pump style	Horizontal, end-suction centrifugal
Make	Paco Pumps
Model	52-NCH-49513-346C0X
Serial No.	NK94A0205901A
Horsepower	2
Voltage/phase	208-230/460/3
Date of installation	Unknown
Design Conditions	424 gpm @ 14 feet TDH
Able to isolate pump?	Yes
Ability to access/remove pump from station	Yes, chain hoist/trolley

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Based on visual observations and drawdown testing the pump is in fair condition and the reliability is still acceptable

Criticality Rating 3 – Pump 1 is critical to the function of the station but redundant

Serviceability Rating 3 – Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech), parts would need to be customized

General observations/notes from field visit:

- Pump is obsolete per follow-up calls with both manufacturer (Grundfos) and manufacturer's representative (Pumptech)
- Clogged upon visit – removal of suction piping required to de-rag pumps, victaulic fittings
- Ragging issues possibly due to slow turning pumps (850 rpm)
- Hoisting rail is not marked with load capacity, as required by code

Pump 2 Drawdown Test

Static head (feet)	1.3
Calculated pumping capacity	500 – 525 gpm
Total Dynamic head (feet)	1.6
Number of tests performed	2

General observations/notes from drawdown test:

- The pump appears to be operating near the end of the pump curve, cavitation could be a potential concern.

Pump and motor #2

Removal of rags upon site visit

Pump 2 showing signs of aging on exterior

30.4.2. Exposed Piping and Valves

30.4.2.1 Suction Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve with vertical axis of rotation – not ideal. Should be addressed upon replacement of rotating assembly.

30.4.2.2 Discharge Piping/Valve(s)

Size	6”
Material	DI
Valve Type(s)	Plug valve and swing check valve w/ outside lever and spring

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspections alone

Criticality Rating 4 –Station could not operate upon failure of the piping and/or valves

Serviceability Rating 1 – Parts are readily available and the components are easily accessed

General observations/notes from field visit:

- Plug valve seat is down (gravel trap) – not ideal. Should be addressed upon replacement of rotating assembly.

Plug valve on suction piping with vertical axis of rotation – not ideal

Swing check valve with outside lever and spring on discharge piping

Plug valve on discharge piping seats down – potential gravel trap

30.4.3 Other Station Piping

Bypass piping	No
Pig launching	No
Air release valves	No
Force main isolation	None known

30.4.4 Washdown Water

Supply	From lake – pressure tank installation
Access	Bottom of dry pit
Backflow prevention assembly	None
Enclosure/Freeze protection	N/A

Washdown water supply from lake using
pressure tank system

30.4.5 Ventilation

30.4.5.1 Wet Well Ventilation (Exhaust Fan)

Location	2’ AFF room above wet well
Fan type	Axial
Airflow rate	1230 CFM @ 0.25” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

30.4.5.2 Wet Well Ventilation (Supply Fan)

Location	4’ AFF room above wet well
Fan type	Axial
Airflow rate	820 CFM @ 0.16” SP*

*Based on Record Drawings, unable to confirm in field.

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 1 – Parts are readily available and component is easily accessed

General observations/notes from field visit:

- Switch for both in wet well building
- Two blowers one to wet well one to building area

Wet well ventilation configuration in wet well access room, supply fan in foreground, exhaust fan in background

Wet well exhaust fan located in raised area in wet well access room

30.4.5.3 Dry Pit Ventilation (Supply Fan)

Location	Roof of building
Fan type	Axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – The supply fan can be difficult to access since it is located on the roof of the building

30.4.5.4 Dry Pit Ventilation (Exhaust Fan)

Location	2’ AFF at pump level
Fan type	Axial
Airflow rate	Unknown

Condition	1	2	3	4	5	UNK
Criticality	1	2	3	4		
Serviceability	1	2	3	4		

Condition Rating Unknown – Could not be determined based on visual inspection alone

Criticality Rating 1 – Not critical and failure would not significantly affect pump station operation

Serviceability Rating 2 – Easily accessed

Supply fan duct work located in control building

Exhaust fan located 2' AFF at pump level

30.5 Electrical

30.5.1 Electrical Service

30.5.1.1 Electrical Service Description

Voltage	240/120
Phases	3
Utility transformer	On overhead pole along West Lake Sammamish Parkway
Service meter location	Outside west wall

30.5.1.2 Electrical Service Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Meter base and fused disconnect appear to be in good condition

Criticality Rating 3 – Critical but redundant, power could be provided by standby generator

Serviceability Rating 1 – Standard parts; accessible from driveway

Service meter located outside west wall of control building

30.5.2 Backup Power

30.5.2.1 Backup Power Description

City of Bellevue Asset No.	193743
Type	Standby Generator (diesel)
Location	Top floor of building
Manufacturer	McGraw-Edison, ONAN
Model	7.5JB-18R/25103AD
Serial No.	H820630359
Age	Unknown
Electrical Capacity (KW)	7.5, 3 phase
Fuel Storage	Unknown
Cooling	Air cooled
Transfer switch type	Auto
Transfer switch location	Top floor of building

30.5.2.2 Backup Power Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 3 – Transfer switch and propane generator appear to be in good condition but aging

Criticality Rating 3 – Critical but redundant, power could be provided by utility power

Serviceability Rating 2 – Standard parts; generator receptacle is too closely installed in power and control panel

Standby generator located on top floor of control building

30.5.3 Site – Panelboard

30.5.3.1 Panelboard Description

Location	South wall of control building
Voltage/Phase	240
Manufacturer	SQ D
Model	NQOD 412L100

30.5.3.2 Panelboard Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Square D panels appear to be in good condition

Criticality Rating 4 – Critical, panelboard provides the 120 V power for the telemetry control panel, PLC and floats

Serviceability Rating 1 – Standard parts; equipment is in dry pit

30.5.4 Site - Starters

30.5.4.1 Starters Description

Starters	(2) FVNR Starters

30.5.4.2 Starters Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 2 – The Cutler Hammer starters appear to be in good condition but aging

Criticality Rating 3 – Critical but redundant, starters needed to run the pumps but if one starter fails the other will still operate

Serviceability Rating 1 – Standard parts; equipment is in power and control panel

Panelboard located on south wall in the
control building

Starters located in control building

30.5.5 Site – Telemetry Control Panel

30.5.5.1 Telemetry Control Panel Description

City of Bellevue Asset No.	376881
Location	In control building
Configuration	Integral w/ telemetry
Primary Level Indication	Ultrasonic, Siemens Multiranger 100
Secondary Level Indication	High Level Float
RTU/PLC	Siemens/Simatic S7-200
Telephone Modem	Control Microsystems/5000 Series Option F
Telephone Network Interface	Outdoor west wall

30.5.5.2 Telemetry Control Panel Findings

Condition	1	2	3	4	5
Criticality	1	2	3	4	
Serviceability	1	2	3	4	

Condition Rating 1 – Appears to be in good condition

Criticality Rating 3 – Critical but redundant, PLC alternates and calls for pumping, backup operation is hardwired from the floats to the starter

Serviceability Rating 1 – Standard parts; equipment is in dry pit

Layout of electrical/telemetry equipment on top floor of control building

Telemetry control panel with operator interface located in control building

Telephone network interface located outdoor on west wall

30.6 Station Rehabilitation/Replacement Alternatives and Recommendations

The following discussion includes the project alternatives, where applicable, and the project recommendations for each deficiency identified at this station. Although there are alternatives for most deficiencies observed at this station, not all are discussed since some alternatives are impractical and/or cost prohibitive or do not produce a result that is accepted by sound engineering judgment.

The following summary of deficiencies and corrective action alternatives, if applicable, are provided in the table below.

Table 30-3
Summary of Deficiencies

Deficiency Description	Impact of Deficiency	Corrective Action Alternatives
Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Does not meet code requirements, possible fire and explosion hazard	• Install exhaust fan • Explosion proof all equipment in dry pit
Paco pumps are obsolete and condition is deteriorating	Paco pumps will not be serviceable in near future	• Replace pumps, motors and motor drivers
Standby generator is obsolete and condition is deteriorating	Loss of power at site	• Replace standby generator and auto transfer switch
Standby power phase monitor is aging	Loss of power at site	• Replace standby power phase monitor
Primary and backup level indicators are aging	Loss of control at site	• Replace primary and backup level indicators
No interior wet well coating	May decrease integrity of wet well structure	• Inspect/evaluate wet well for corrosion

30.6.1 Project Recommendations

The deficiencies were lumped into one project due to the location of the pump station and its impact to the general public. The timing of the recommended project is driven by the replacement of the Paco pumps which is critical to the operation of the station.

Installation of an exhaust fan is recommended to address the dry pit code issue rather than replace all equipment with components intended for the Class 1, Division 2 space, which is less expensive than adding ventilation.

The summary of deficiencies and recommendations represent the most cost effective alternative based on engineering judgment. This is represented in the table below.

Table 30-4
Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
S1-1	Dry pit not continuously ventilated – classified space that requires either ventilation or explosion proof equipment	Install exhaust fan	2018-2022	$191,000
	Paco pumps are obsolete and condition is deteriorating	Replace Paco pumps, motors and motor drivers		
	Standby generator is obsolete and condition is deteriorating	Replace standby generator and auto transfer switch		
	Standby power phase monitor is aging	Replace standby power phase monitor		
	Primary and backup level indicators are aging	Replace primary and backup level indicators		
	No interior wet well coating	Inspect/evaluate wet well for corrosion		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

30.6.2 Project Justification

The timing of the recommended project is driven by the replacement of the Paco pumps due to its serviceability ratings. The consequence of failure of this component will reduce the level of service to the station below industry standards and regulatory requirements.

The Paco pumps are no longer manufactured, making the pumps obsolete. Also, based on the drawdown tests, their capacity appears to have deteriorated. With the pumps no longer supported, service and replacement parts will be difficult to obtain, causing significant maintenance and repair delays. These delays will result in the station operating on the sole reliance of one pump, without redundancy which does not meet regulatory requirements. With continued wear on the pumps, maintaining and repairing the equipment that is obsolete will quickly become cost prohibitive.

30.7 Station Long-Term Rehabilitation and Replacement Needs Estimate

The 75-year replacement cycle is based on the anticipated condition of the pump stations at the end of the 10-year capital project plan and assumes improvements defined in Table 30-4 have been implemented in the timeline identified.

30.7. 1 Asset Scoring

The trigger and asset scoring shown in Tables 30-5 and 30-6 are based on the methodology developed in Section 4, Long Term Resource Planning. These values are used with the parabolic depreciation curves from Section 4 to estimate the remaining useful life of each asset group. Table 30-5 includes the current estimated remaining useful life prior to implementation of the capital improvement projects.

Table 30-5
Current Estimated Remaining Useful Life

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	2	1	0	-	2	10-15
Telemetry System	2	1	0	-	2	5-10
Generator	3	1	0	-	3	5-10
Rotating Assembly	3	5	0	-	5	0-5

Table 30-6 includes project estimated remaining useful life when the recommended projects provided in Table 30-4 are complete. Upon completion of the recommended projects the estimated remaining life of most of the asset groups will increase significantly. The pump station structure asset group will remain the same since the recommended projects do not include a significant rehabilitation or replacement of the structure.

Table 30-6
Estimated Remaining Useful Life Following Capital Improvement Project Implementation

	Trigger Scores					
	Condition	**Obsolescence**	**Call Outs**	**Capacity**	**Asset Score**	**Est. Remain Life (years)**
Pump Station Structure	1	1	0	-	1	30-35
Electrical System	1	1	0	-	1	15-20
Telemetry System	1	1	0	-	1	10-15
Generator	0	0	0	-	0	40
Rotating Assembly	0	0	0	-	0	30

30.7. 2 Rehabilitation/Replacement Schedule Cost Planning

Figure 30-1 graphically represents the rehabilitation and replacement cost projections for Station 1 over the next 75 years. Estimated cost summaries for the short term period, effectively years 2015 to 2026 are included in the Appendix. Estimated costs for the longer term period, effectively years 2027 to 2089, are based on the values from Section 4, Long Term Resource Planning. Table 30-7 shows highlighted values taken from Section 4 to show the estimated rehabilitation costs based on the complexity and size of this pump station. Table 30-8 shows highlighted values taken from Section 4 representing the estimated replacement costs based on the complexity and size of this pump station.

Table 30-7
Asset Group Life Cycle Rehabilitation Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low	→			High
Pump Station Stucture	Structure repair/recoating Bypass pumping Ancillary components	$30,000 $15,000 $10,000	$40,000 $20,000 $15,000	$50,000 $25,000 $20,000	$60,000 $30,000 $25,000	$70,000 $35,000 $30,000
Electrical System	N/A	N/A	N/A	N/A	N/A	N/A
Telemetry System	N/A	N/A	N/A	N/A	N/A	N/A
Generator	Motor rebuild Ancillary components	$10,000 $5,000	$15,000 $10,000	$20,000 $15,000	$25,000 $20,000	$30,000 $25,000
Rotating Assembly	Pump wet end rebuild Motor rewind	$5,000 $5,000	$8,000 $8,000	$11,000 $11,000	$14,000 $14,000	$17,000 $17,000

Table 30-8
Asset Group Life Cycle Replacement Costs

Asset Group	Replacement Component	Estimated Complexity/Size Cost Range				
		Low →				High
Pump Station Structure	Structure(s)	$150,000	$250,000	$350,000	$450,000	$550,000
	Site piping	$50,000	$75,000	$100,000	$125,000	$150,000
	Bypass pumping	$20,000	$30,000	$40,000	$50,000	$60,000
	Dewatering	$10,000	$20,000	$30,000	$40,000	$50,000
	Site landscaping/restoration	$10,000	$20,000	$30,000	$40,000	$50,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Electrical System	Main service and disconnect	$15,000	$20,000	$25,000	$30,000	$35,000
	Transfer switch	$5,000	$10,000	$15,000	$20,000	$25,000
	HVAC/lighting	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$20,000	$30,000	$40,000	$50,000
Telemetry System	Panel/RTU/Modem	$45,000	$50,000	$55,000	$60,000	$65,000
	Instruments	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$10,000	$15,000	$20,000	$25,000	$30,000
Generator	Generator	$50,000	$60,000	$70,000	$80,000	$90,000
	Ancillary components	$10,000	$10,000	$10,000	$10,000	$10,000
Rotating Assembly	Pumps	$5,000	$10,000	$15,000	$20,000	$25,000
	Motors	$5,000	$10,000	$15,000	$20,000	$25,000
	Starters	$5,000	$10,000	$15,000	$20,000	$25,000
	Cables	$5,000	$7,000	$9,000	$11,000	$13,000
	Station Pipe/Valves	$5,000	$10,000	$15,000	$20,000	$25,000
	Ancillary components	$5,000	$5,000	$5,000	$5,000	$5,000

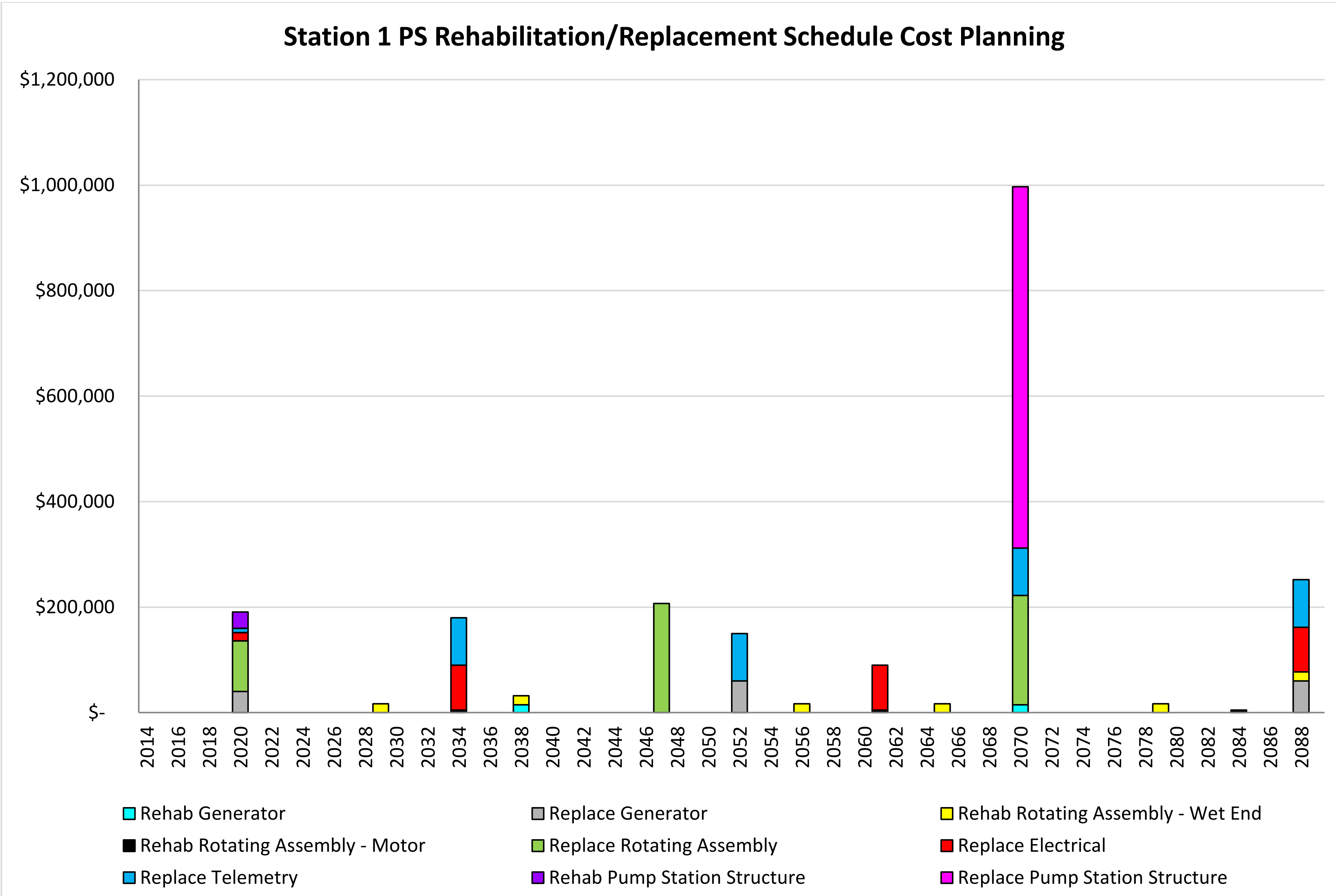


Figure 30-1: 75-year cost planning

Note:

1. Cost planning is based on the evaluation of this station only. Prioritization of capital expenditures is discussed and reflected in Sections 3 and 4.

SECTION 31 – PREVIOUSLY EVALUATED STATIONS

31.1 Introduction

The initial phase of the Wastewater Pump Station Evaluation project, which included seven stations, was completed by another consulting engineering firm, HDR. This evaluation effort was compiled into a report dated November 2013. As part of the second phase scope of work, MSA was responsible for reviewing the project recommendations and costs for consistency with the 26 stations evaluated as part of this second phase.

The seven station were visited to review the project recommendations with observed site conditions. Recommendations differed in several areas generally due to the following reasons: a change in conditions since the previous evaluation, an alternative approach to meeting the end goal (vetted with City staff), and elimination of some items that were considered non-critical or ancillary project components as part of this second phase of evaluations.

31.2 Previously Evaluated Pump Stations

The following table is a summary of the previously evaluated pump stations. The station configuration, listed capacity and last upgrade are identified in Table 31–1. It is also noted if City staff have indicated the station has experience a condition of all pumps running, indicating a loss of redundancy at the station.

Table 31-1
Phase One Pump Stations

Station Name	Configuration	Listed Capacity	Last Upgrade	Reported Loss of Redundancy
Newport Lift	Wet well/dry pit	360 gpm	1988	Yes
Newport Pump	Wet well/dry pit	695 gpm	1990	Yes
Palisades	Wet well/dry pit	165 gpm	1995	No
Parkers	Wet well/dry pit	425 gpm	1987	Yes
Medina	Wet well/dry pit	350 gpm	1989	Yes
Fairweather	Wet well/dry pit	325 gpm	1988	Yes
Cedar Terrace	Suction lift	200 gpm	1985	No

The following pages include a comparison of recommended projects and costs for each of the seven stations. MSA project recommendations and costs were entered into the overall capital improvement plan.

31.2.1 Newport Lift Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Equipment removal requires removal of HVAC ductwork	Agree with HDR assessment	Relocate HVAC ductwork	Extracting equipment is extremely rare. Recommend no change.	Low	N/A	$9,000	$0
Wet well ladder, electrical conduit, and lighting fixture corroding	Wet well not entered as part of this project, but HDR assessment seems reasonable based on observations from the ground surface.	Repair or replace	Agree with HDR recommendation	Low	Include with next near-term project	$14,000	$14,000
Inadequate water service size for washdown purposes.	Not evaluated to this level (no testing)	Provide 1" water service, RPBP, and HotBox	Crews have successfully been washing down this station with current service size. Recommend no project	Low	N/A	$9,000	$0
No water service for washdown purposes at Generator	Washdown of generator vault is not a common activity	Provide 1" water service, RPBP, and HotBox	Recommend no project at this time.	Low	N/A	$9,000	$0
Bottom of dry well helical stairs rusting	Agree with HDR assessment	Power tool clean to SSPC-SP3 and coat with industrial epoxy.	Agree with HDR recommendation	Low	Include with next near-term project	$1,000	$1,000
Potable water RPBP in dry well entry	Not considered a deficiency	Provide a 120-volt circuit to a new, above-grade HotBox to power the heat tracing	Appear to double-count recommended project - recommendation addressed above	Low	N/A	$4,000	$0
KM pump starter control panel is obsolete	Agree with HDR assessment	Replace KM pump starter control panel	Agree with HDR recommendation	Medium	2018-2022	$10,000	$10,000
Generator sump floods	Agree with assessment	Lower sump area	Agree with HDR recommendation	Low	Include with next near-term project	$12,000	$12,000
Corroded generator battery terminals	Appears to have been addressed	Wire brush	No project necessary	Low	N/A	$1,000	$0
Potential inadequate clearances associated with wet well ladder	Wet well not investigated to this level of detail	Measure clearances	N/A	High	Evaluate during next major project.		N/A
Electrical equipment does not meet NEC rating for area classification.	Agree with HDR assessment	Replace electrical equipment	Recommend modifying ventilation to declassify dry well instead of replacing	Medium	Include with next near-term project	$70,000	$20,000
Dry well dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure	Do not track dehumidifiers in capital improvement project planning	Low	N/A	$3,000	$0
No dehumidifier in generator vault	Humidifier found in generator vault	Provide	No project necessary	Low	N/A	$3,000	$0
Generator ATS is old	ATS shows signs of previous short circuiting and modifications have been made w/o UL label	Replace	Agree with HDR recommendation	Low	2020-2025	$10,000	$10,000
Pumps have a reduced pumping capacity	No pump testing was completed. Reported loss of redundancy	Replace wet end parts	Likely nearing time to replace pumps, motors, starters, cables, and piping modifications. Confirm station capacity needs before initiating project	Medium	2015-2018	$15,000	$50,000
Existing dry well can is 50 years old	Structural integrity of metal dry well structure (can) is unknown. City actively monitors impressed current	Hire Consultant to review cathodic protection	Agree with HDR recommendation, but also recommend measuring thickness of remaining steel (ultrasonic testing)	Medium	Include with next near-term project		$10,000
					Subtotal	$170,000	$127,000
					Tax (9.5%)	$16,150	$12,065
					Subtotal	$186,150	$139,065
					ELA (35%)	$65,153	$48,673
					Subtotal	$251,303	$187,738
					Contingency (30%)	$75,391	$56,321
					Total	**$327,000**	**$244,000**

31.2.2 Newport Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Generator frame sloped	Vault appears to be sloped, not generator frame	Shim generator frame	Shim genset and hire geotech to investigate potential settlement issue	Low	2015-2018	8,000	$18,000
Water leakage above disconnect switch	None noticed - appears to have been addressed with pressure grout, but tarp is still in place	Caulk cracks and annular space of penetrations	Confirm issue still exists	Medium	N/A	5,000	$0
KM pump starter control panel is obsolete	Agree with HDR assessment	Replace KM pump starter control panel	Agree with HDR recommendation	Medium	2020-2025	10,000	$10,000
Potential inadequate clearances associated with wet well ladder	Wet well not investigated to this level of detail	Measure clearances	N/A	High	Evaluate during next major project.		$0
Shared exhaust between generator and generator vault	Agree with HDR assessment	Provide separate generator exhaust outlet	Agree with HDR recommendation	Medium	Include with next near-term project	15,000	$15,000
Conduit and wet well lighting fixture is corroded	Agree with HDR assessment	Replace	Agree with HDR recommendation	Low	Include with next near-term project	5,000	$5,000
Electrical equipment does not meet NEC rating for area classification.	Agree with HDR assessment	Replace electrical equipment	Recommend modifying ventilation to declassify dry well instead of replacing	Medium	Include with next near-term project	70,000	$20,000
Pumps have a reduced pumping capacity	No pump testing was completed. Reported loss of redundancy	Replace wet end parts	Likely nearing time to replace pumps, motors, starters, cables, and piping modifications. Confirm station capacity needs before initiating project	Medium	2015-2018	18,000	$50,000
Dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure.	Do not track dehumidifiers in capital improvement project planning	Low	N/A	3,000	$0
-	Inadequate electrical clearance between pump starters and Pump	N/A	Move equipment to achieve clearances	N/A	Include with next near-term project	N/A	$5,000
					Subtotal	$134,000	$123,000
					Tax (9.5%)	$12,730	$11,685
					Subtotal	$146,730	$134,685
					ELA (35%)	$51,356	$47,140
					Subtotal	$198,086	$181,825
					Contingency (30%)	$59,426	$54,547
					Total	**$258,000**	**$236,000**

31.2.3 Palisades Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Bottom grate on Man Lift flexes and is not secure	Issue not observed	Provide thicker bottom grate on Man Lift and secure	Incorporate HDR recommendation	Low	Include with next near-term project	$5,000	$5,000
Tenants in adjacent apartments have direct access to PS site	Security is similar to most other City pump stations. Trip/fall safety issue at this location, however.	Install barrier on upper portion of rockery	Fence entire site to avoid public safety issue	Medium	Include with next near-term project	$9,000	$10,000
Earth timber retaining wall is slanting (3%)	Appears to be minor tilt of wall	Monitor and when slant is 6%, hire a Consultant to perform a more detailed review and design	Unknown if wall tilt occurred during construction or subsequently. Hire geotechnical engineer to explore issue when/if concern arises.	Low	Geotech evaluation with next major project		$5,000
Incoming power is 3-wire with no neutral	Agree with HDR assessment	Install neutral wire to comply with PSE service requirements	Agree with HDR recommendation	Medium	Include with next near-term project	$12,000	$12,000
Inadequate water service size for washdown purposes.	Not evaluated to this level (no testing)	Provide 1" water service, RPBP, and HotBox	Crews have successfully been washing down this station with current service size. Recommend no project.	Low	N/A	$9,000	$0
Wet well seepage	Issue not observed, but root intrusion near surface indicates this is likely still an issue	Sandblast existing coating, pressure grout and seal cracks and joints, coat	Agree with HDR recommendation - coat only	Medium	Include with next near-term project	$62,000	$62,000
Potential inadequate clearances associated with wet well ladder	Wet well not investigated to this level of detail	Measure clearances	N/A	High	Evaluate during next major project.		N/A
Damaged conduits in dry well	Issue not observed	Replace	N/A	Medium	N/A	$10,000	$0
Inadequate clearance in front of 120/240V panelboard	Agree with HDR assessment	Relocate 120/240V panelboard	Agree with HDR recommendation, but recommend moving all electrical gear out of dry well during PS rehab project	Medium	Include with next near-term project	$10,000	$45,000
Electrical equipment does not meet NEC rating for area classification.	Agree with HDR assessment	Replace electrical equipment	Relocate electrical equipment out of dry well as part of PS rehab project	Medium	Include with next near-term project	$70,000	$20,000
Existing dry well can is 45 years old	Structural integrity of metal dry well structure (can) is unknown. City actively monitors impressed current	Hire Consultant to review cathodic protection	Agree with HDR recommendation, but also recommend measuring thickness of remaining steel (ultrasonic testing)	Medium	Include with next near-term project		$5,000
Dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure.	Do not track dehumidifiers in capital improvement project planning	Low	N/A	3,000	0
Inadequate records of Annual L&I Inspections	Issue has been resolved.	Have Annual L&I Inspections completed and have maintenance performed as necessary	N/A	Medium	N/A	$6,000	$0
Pumps will reach the end of their life expectancy in about 7 years	Pumps seemed to both run smoothly during visit.	Replace pumps	Pump replacement will trigger motor and likely piping and EI&C replacement/modifications as well. Recommend monitoring call outs and O&M expenses to trigger project	Low	2020-2025	$15,000	$50,000
					Subtotal	$211,000	$214,000
					Tax (9.5%)	$20,045	$20,330
					Subtotal	$231,045	$234,330
					ELA (35%)	$80,866	$82,016
					Subtotal	$311,911	$316,346
					Contingency (30%)	$93,573	$94,904
					Total	**$405,000**	**$411,000**

31.2.4 Parkers Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Tiles are falling off the walls in the wet well	Wet well not entered as part of this project, but HDR assessment seems reasonable based on observations from the ground surface.	Replace tiles	Consider replacement of tiles with an applied coating system.	High	2023-2027	$90,000	$90,000
Corroded HR and grating in wet well	Wet well not entered as part of this project, but HDR assessment seems reasonable based on observations from the ground surface.	Inspect	Agree with HDR recommendation	High	Include with next near-term project		$10,000
Inadequate water service size for washdown purposes.	Not evaluated to this level (no testing)	Provide 1" water service, RPBP, and HotBox	Crews have successfully been washing down this station with current service size. Recommend no project	Low	N/A	$20,000	$0
Standby generator nameplate missing	No standby generator at this site. Voltage nameplate on generator receptacle is in place.	Add nameplate with voltage and instructions	Recommend no project at this time.	Medium	N/A	$1,000	$0
Conduit and wet well lighting fixture is corroded	Not observed from surface	Replace	N/A	Low	N/A	$5,000	$5,000
Electrical equipment does not meet NEC rating for area classification.	Agree with HDR assessment	Replace electrical equipment	Recommend modifying ventilation to declassify dry well instead of replacing	Medium	Include with next near-term project	$70,000	$20,000
Dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure	Do not track dehumidifiers in capital improvement project planning	Low	N/A	$3,000	$0
Equipment removal is difficult	Beam is offset from centerline of pumps, which makes removal challenging and a potential safety issue. Agree with HDR assessment	Relocate the structural beam	Agree with HDR recommendation	Low	2015-2018	$6,000	$10,000
-	Reported loss of pump redundancy.	N/A	Likely nearing time to replace pumps, motors, starters, cables, and piping modifications. Confirm station capacity needs before initiating project	N/A	2015-2018	-	$80,000
					Subtotal	$195,000	$215,000
					Tax (9.5%)	$18,525	$20,425
					Subtotal	$213,525	$235,425
					ELA (35%)	$74,734	$82,399
					Subtotal	$288,259	$317,824
					Contingency (30%)	$86,478	$95,347
					Total	**$375,000**	**$413,000**

31.2.5 Medina Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Wheel chair access obstruction	Access appears adequate when service truck is parked to the side of the access road	Review realigning wheel chair access	No project recommended at this time	Medium	N/A		$0
Inadequate water service size for washdown purposes.	Not evaluated to this level (no testing)	Provide 1" water service, RPBP, and HotBox	Crews have successfully been washing down this station with current service size. Recommend no project.	Low	N/A	$9,000	$0
Corroded wet well platform and grating	Wet well not entered as part of this project, but HDR assessment seems reasonable based on observations from the ground surface.	Replace	N/A	Low	Evaluate during next major project	$79,000	$79,000
Potential inadequate clearances associated with wet well ladder	Wet well not investigated to this level of detail	Measure clearances	N/A	High	Evaluate during next major project		$0
No dehumidifier in generator vault	Agree with HDR assessment	Provide	Agree with HDR recommendation	Low	Include with next near-term project	$3,000	$3,000
Electrical equipment does not meet NEC rating for area classification	Agree with HDR assessment	Replace electrical equipment	Recommend modifying ventilation to declassify dry well instead of replacing	Medium	Include with next near-term project	$70,000	$20,000
Paco 52-49513-X46D60 model has been placed into an "Aftermarket" status	Agree with HDR assessment. Reported loss of redundancy.	Hire Consultant to design replacement of Paco pumps and piping. Replace existing Paco pumps and piping.	Agree with HDR recommendation. Confirm station capacity needs before initiating project.	High Medium	2015-2018	$30,000	$50,000
Dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure	Do not track dehumidifiers in capital improvement project planning	Low	N/A	$3,000	$0
					Subtotal	$194,000	$152,000
					Tax (9.5%)	$18,430	$14,440
					Subtotal	$212,430	$166,440
					ELA (35%)	$74,351	$58,254
					Subtotal	$286,781	$224,694
					Contingency (30%)	$86,034	$67,408
					Total	**$373,000**	**$292,000**

31.2.6 Fairweather Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Pump #1 air locks	Issue not observed during site visit but reported by staff as occurring during wet weather flows	Hire Consultant to investigate the issue further	Agree with HDR recommendation	Medium	2015-2018		$10,000
Wet well coating is starting to fail	Wet well not investigated to this level of detail	Sandblast and apply coating	N/A	Low		$17,000	$17,000
Standby generator nameplate missing	No standby generator at this site. Voltage nameplate on generator receptacle is in place.	Add nameplate with voltage and instructions	Recommend no project at this time.	Medium	N/A	$1,000	$0
Shared exhaust between generator and generator vault	Agree with HDR assessment	Provide separate generator exhaust outlet	Agree with HDR recommendation	Medium	Include with next near-term project	$15,000	$15,000
Fuel fill station high-alarm does not activate in time to prevent spill	Issue not observed during site visit but staff report this statement is still accurate	Revise fuel alarm level	Agree with HDR recommendation, but believe this can be accomplished by City staff.	Medium	N/A	$3,000	$0
Potential inadequate clearances associated with wet well ladder	Wet well not investigated to this level of detail	Measure clearances	N/A	High	Evaluate during next major project		N/A
Standing water in dry well fan vault	Issue not observed during site visit	Remove standing water and seal cover opening	Small vault - restricts maintenance access. Consider replacing vault entirely as part of next major project	Low	Include with next near-term project	$2,000	$10,000
Electrical equipment does not meet NEC rating for area classification.	Agree with HDR assessment	Replace electrical equipment	Recommend modifying ventilation to declassify dry well instead of replacing	Medium	Include with next near-term project	$70,000	$20,000
Inadequate space in front of Siemens MultiRanger and Simatic Panel per NEC	Agree with HDR assessment	Relocate panel	Agree with HDR recommendation	High	Include with next near-term project	$4,000	$4,000
KM pump starter control panel is obsolete	Agree with HDR assessment	Replace KM pump starter control panel	Agree with HDR recommendation	Medium	2018-2022	$10,000	$10,000
Pumps have reached the end of their life expectancy	Pumps appear to be older but still seem to be operating smoothly. Reported loss of redundancy.	Replace pumps	Likely nearing time to replace pumps, motors, starters, cables, and piping modifications. Confirm station capacity needs before initiating project	Medium	2015-2018	$15,000	$70,000
Generator vault does not have a dehumidifier	Agree with HDR assessment	Provide	Agree with HDR recommendation	Low	Include with next near-term project	3,000	3,000
The dry well dehumidifier has reached the end of its life expectancy	non-critical	Replace dehumidifier upon failure	Do not track dehumidifiers in capital improvement project planning	Low	N/A	$3,000	$0
					Subtotal	$143,000	$159,000
					Tax (9.5%)	$13,585	$15,105
					Subtotal	$156,585	$174,105
					ELA (35%)	$54,805	$60,937
					Subtotal	$211,390	$235,042
					Contingency (30%)	$63,417	$70,513
					Total	**$275,000**	**$306,000**

31.2.7 Cedar Terrace Pump Station

HDR Deficiency	MSA Deficiency Comment(s)	HDR Recommendation	MSA Recommendation	HDR Criticality Level	MSA Timing	HDR Cost Est.	MSA Cost Est.
Moss on electrical panel structure roof	Agree with HDR assessment	Remove moss and treat wood roof	Agree with HDR recommendation - perform as part of O&M visit	Low	N/A	$1,000	$0
Inadequate water service size for washdown purposes	Not evaluated to this level (no testing)	Provide 1" water service, RPBP, and HotBox	Crews have successfully been washing down this station with current service size. Recommend no project.	Low	N/A	$9,000	$0
Electrical service incompatibility with pumping equipment	Agree with HDR assessment	Replace current PSE transformer with a transformer that matches pump requirements. Measure the running motor voltage and amperes in the field	No project recommended. 208V power is okay due to minimal current draw (5-6 amps observed on installed gauges). Motors rated for 10-11 amps and okay with 480V power.	Medium Medium	N/A	$50,000	$0
Electrical service equipment is marginally functional; old and not protected from weather	Service equipment is old and nearing the end of its useful life.	Replace service equipment with installation similar to Palisades	Replace service equipment with installation similar to Palisades	Medium	2023-2027	$20,000	$20,000
Pump motor starter control panel has exceeded its expected life expectancy	Agree with age-based assessment.	Replace pump motor starter control panel	Replace as part of major rehab project.	Medium	2020-2025	$10,000	$10,000
Standby generator nameplate missing	No standby generator at this site. Generator receptacle has been relocated but label is still at old location.	Add nameplate with voltage and instructions	Relocate old label to new generator receptacle.	Medium	2015-2018	$1,000	$0
Inadequate site lighting for safety	Issue not observed during site visit	Provide site lighting	Most City pump stations do not have site lighting. Consider incorporating into major rehab project.	Low	Include with next near-term project	$5,000	$5,000
No explosion-proof lighting in wet well	Wet well not investigated to this level of detail	Provide explosion-proof wet well lighting	Upgrade to City standard	Medium	Include with next near-term project	$3,000	$3,000
Time consuming to disconnect pump needs to be removed	Issue not discussed or observed during site visit.	Provide quick-disconnect plugs/receptacles	No project recommended. Pumps are rarely removed from service. Not a safety issue.	Low	N/A	$5,000	$0
Hydromatic Model 40MPC is slowly being discontinued	Agree with HDR assessment	Hire Consultant to design replacement of Hydromatic pumps and piping. Replace existing Hydromatic pumps and piping	Agree with HDR recommendation. Confirm station capacity needs before initiating project.	High Medium	2020-2025	$30,000	$50,000
					Subtotal	$134,000	$88,000
					Tax (9.5%)	$12,730	$8,360
					Subtotal	$146,730	$96,360
					ELA (35%)	$51,356	$33,726
					Subtotal	$198,086	$130,086
					Contingency (30%)	$59,426	$39,026
					Total	**$258,000**	**$169,000**

SECTION 32 –COST PLANNING FOR REMAINING 13 STATIONS

32.1 Authorization

Murray, Smith & Associates, Inc. (MSA) was authorized by the City of Bellevue (City) to perform additional work to develop cost planning for the remaining 13 pump stations that were not field evaluated in the first or second phase of the Wastewater Pump Station Evaluation project. These stations have recently been or are currently being rehabilitated or replaced.

32.2 Introduction

The City owns and operates 46 wastewater pump and flush stations. Twenty six of the stations were evaluated by MSA under this second phase of the project and seven were previously evaluated by another consultant in Phase 1. The capital improvement projects and 75-year project costs for those seven stations were discussed and updated Section 31 of this report.

The remaining 13 stations discussed in this section were not field evaluated as part of this project or any other project since they have been or are currently being rehabilitated or replaced. Table 32-1 below identifies the station name, configuration, listed capacity and year of the last upgrade. It is also noted if City staff have indicated the station has experienced a condition of all pumps running, indicating a loss of redundancy at the station.

Table 32-1
Remaining 13 Pump Stations

Station Name	Configuration	Listed Capacity	Original Construction/Last Upgrade	Reported Loss of Redundancy
Lake Heights	Submersible	240 gpm	1948/in process	No
Bellefield	Wet well/Dry pit	2,850 gpm	1982/in process	No
Midlakes	Wet well/Dry pit	1,600 gpm	1968/in process	No
Emerald Ridge	Submersible	560 gpm	1982/2012	No
Flush Station 1	Self-Priming	240 gpm	Early 60s/2004	N/A
Flush Station 2	Self-Priming	240 gpm	Early 60s/2004	N/A
Flush Station 3	Dry Pit	240 gpm	Early 60s/1999	N/A
Flush Station 4	Self-Priming	240 gpm	Early 60s/2004	N/A
Flush Station 5	Self-Priming	240 gpm	1955/2012	N/A
Flush Station 6	Self-Priming	240 gpm	Mid 60s/2004	N/A
Flush Station 7	Self-Priming	240 gpm	Mid 60s/2004	N/A
Flush Station 8	Self-Priming	240 gpm	Mid 60s/2004	N/A
Flush Station 9	Submersible	375 gpm	1975/2001	N/A

The projects and costs for the remaining 13 stations were incorporated in the capital improvement projects and 75-year planning horizon to reflect all of City's wastewater pump and flush stations. A discussion of the project and associated costs for the 13 stations are provided in this section.

32.3 Rehabilitation and Replacement Cost Development

A range of rehabilitation and replacement costs were developed for the 26 field-evaluated stations based on each station's complexity and size and presented in Section 4 of this report. The more significant complexity and size of Bellefield and Midlakes are not represented within the range of costs developed for the 26 field-evaluated stations due to their significantly greater capacities and other specialty considerations. Therefore costs identified for these two pump stations are based on bid tab provided by the City for the 2014 Bellefield replacement project and the Midlakes project cost estimate from the City's capital improvement budget.

The rehabilitation and replacement costs for the 11 remaining stations were based on each station's estimated complexity and size. These costs are consistent with the costs established for the original 26 pump stations provided in Tables 4-4 and 4-5 in Section 4 of this report. The assumptions surrounding each of these facilities were vetted with City staff in a meeting on February 6, 2015.

In addition to the typical mechanical, electrical, and structural improvement costs typical of wastewater pump stations, flush station costs added the replacement of the intake piping that extends into the lake. Some intake piping deterioration issues have been observed, but they have not yet been replaced due to the minor impacts realized at the flush stations.

The length of the flush station intake piping assumes the intake end must be at a water depth of 20 feet. This minimum depth/location criteria is based on comments the City has received from the Department of Fish and Wildlife. Measurements from the National Oceanic and Atmospheric Administration's Nautical Chart for Lake Washington (2012) were used to determine the length of intake piping from the shore to the required depth for flush stations 1-8. Measurements to determine the length of suction piping for Flush 9 and 10 were taken from the Lake Sammamish Bathymetric map from King County. To account for intake piping within the land area to the station, an additional 20 linear feet was added to the total intake piping length.

32.4 Basis of Rehabilitation and Replacement Projects

Rehabilitation and replacement projects for a given station were based on the station's configuration, capacity and the year of the last upgrade. The following tables show the recommended rehabilitation and replacement projects for the 13 stations.

32.4.1 Lake Heights

Lake Heights pump station was installed in 1948 and is in the process of being significantly rehabilitated. It is a submersible pump station with a listed capacity of 240 gpm. Since this station is currently being upgraded, there are little improvement projects within the capital improvement projects time frame. The recommended projects for Lake Heights is provided in the table below.

Table 32-2
Lake Heights Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
LH-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2023-2026	$5,000

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.2 Bellefield

Bellefield pump station was installed in 1982 and is in the process of being replaced. It is a wet well/dry pit station with a listed capacity of 2,850 gpm. Since this station is currently being replaced, there are few improvement projects within the capital improvement projects time frame. The recommended projects for Bellefield are provided in the table below.

Table 32-3
Bellefield Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
BF-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$116,000

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.3 Midlakes

Midlakes pump station was installed in 1968 and is in the process of being replaced. It is a wet well/dry pit station with a listed capacity of 1,600 gpm. Since this station is currently being replaced, there are few improvement projects within the capital improvement projects time frame. The recommended projects for Midlakes are provided in the table below.

Table 32-4
Midlakes Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
ML-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$69,000

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.4 Emerald Ridge

Emerald Ridge pump station was installed in 1982 and was significantly rehabilitated in 2012. It is a submersible station with a listed capacity of 560 gpm. Since this station was recently upgraded, there are few improvement projects within the capital improvement projects time frame. The recommended projects for Emerald Ridge are provided in the table below.

Table 32-5
Emerald Ridge Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
ER-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$5,000
ER-2	Motor degrading based on perceived age	Rewind motor	2023-2026	$5,000

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.5 Flush Station #1

Flush Station #1 was installed in the early 60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #1 are provided in the table below.

Table 32-6
Flush Station #1 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F1-1	Motor degrading based on perceived age	Rewind motor	2018-2022	$5,000
F1-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F1-3	Intake piping degrading based on perceived age (installed in the early 60s)	Replace intake piping (~900 LF)	2023-2026	$630,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.6 Flush Station #2

Flush Station #2 was installed in the early 60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #2 are provided in the table below.

Table 32-7
Flush Station #2 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F2-1	Motor degrading based on perceived age	Rewind motor	2018-2022	$5,000
F2-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F2-3	Intake piping degrading based on perceived age (installed in the early 60s)	Replace intake piping (~2,100 LF)	2023-2026	$1,230,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.7 Flush Station #3

Flush Station #3 was installed in the early 60s and was significantly rehabilitated in 1999. The assets are located in a dry pit with a listed capacity of 240 gpm. Since this station was upgraded in the late 90s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #3 are provided in the table below.

Table 32-8
Flush Station #3 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F3-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2015-2018	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F3-2	Intake piping degrading based on perceived age (installed in the early 60s)	Replace intake piping (~180 LF)	2023-2026	$300,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.8 Flush Station #4

Flush Station #4 was installed in the early 60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #4 are provided in the table below.

Table 32-9
Flush Station #4 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F4-1	Motor degrading based on perceived age	Rewind motor	2018-2022	$5,000
F4-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F4-3	Intake piping degrading based on perceived age (installed in the early 60s)	Replace intake piping (~210 LF)	2023-2026	$285,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.9 Flush Station #5

Flush Station #5 was installed in 1955 and was significantly rehabilitated in 2012. It is a self-priming station with a listed capacity of 240 gpm. Since this station was recently upgraded, there are little improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping that was installed with the station in 1955. The recommended projects for Flush Station #5 are provided in the table below.

Table 32-10
Flush Station #5 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost$^{(1)(2)(3)}$
F5-1	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	\$5,000
F5-2	Intake piping degrading based on perceived age (installed in 1955)	Replace intake piping (~225 LF)	2023-2026	\$122,500

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.10 Flush Station #6

Flush Station #6 was installed in the mid-60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #6 are provided in the table below.

Table 32-11
Flush Station #6 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F6-1	Motor degrading based on perceived age	Rewind motor	2018-2022	$5,000
F6-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F6-3	Intake piping degrading based on perceived age (installed in the mid-60s)	Replace intake piping (~100 LF)	2023-2026	$232,500
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.11 Flush Station #7

Flush Station #7 was installed in the mid-60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #7 are provided in the table below.

Table 32-12
Flush Station #7 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F7-1	Motor degrading based on perceived age	Rewind motor	2018-2022	$5,000
F7-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F7-3	Intake piping degrading based on perceived age (installed in the mid-60s)	Replace intake piping (~90 LF)	2023-2026	$225,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.12 Flush Station #8

Flush Station #8 was installed in the mid-60s and was significantly rehabilitated in 2004. It is a self-priming station with a listed capacity of 240 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #8 are provided in the table below.

Table 32-13
Flush Station #8 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F8-1	Motor degrading based on perceived age	Rewind motor	2018-2022	\$5,000
F8-2	Wet end of pump degrading based on perceived age	Replace wet end of pump	2020-2025	\$75,000
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F8-3	Intake piping degrading based on perceived age	Replace intake piping (~600 LF)	2023-2026	\$480,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.4.13 Flush Station #9

Flush Station #9 was installed in the 1975 and was significantly rehabilitated in 2001. It is a submersible station with a listed capacity of 375 gpm. Since this station was upgraded in the early 2000s, the condition of some assets are degrading based on perceived age and there are significant improvement projects within the capital improvement projects time frame. The most notable project for this station is the replacement of the intake piping and the rehabilitation and replacement of major assets within this facility. The recommended projects for Flush Station #9 are provided in the table below.

Table 32-14
Flush Station #9 Summary of Improvement Project Recommendations

Project ID Number	Deficiency Description	Recommendation	Timing (years)	Planning Level Cost(1)(2)(3)
F9-1	Motor degrading based on perceived age	Rewind motor	2015-2018	$80,000
	Wet end of pump degrading based on perceived age	Replace wet end of pump		
	Telemetry degrading based on perceived age	Replace telemetry equipment		
F9-2	Intake piping degrading based on perceived age (installed in 1975)	Replace intake piping (~300 LF)	2023-2026	$330,000
	Pumps, motors and motor drivers are degrading based on perceived age	Replace pumps, motors and motor drivers		
	Structure degrading based on perceived age	Rehabilitate structure		
	Electrical degrading based on perceived age	Replace electrical equipment		

Note:
1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Itemized project costs are included in Appendix A of this report.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.

32.5 Capital Improvement Projects

The timing of the capital improvement projects for the 13 pump stations were based on the year of the station's last upgrade and the assumed age of assets within the facility. This perceived age is consistent with the remaining life curves from Figure 4-1 in Section 4 of this report. Since most of these stations were recently upgraded in the early 2000s or are being upgraded within the next few years, there are few recommended projects within the capital improvement projects timeframe for these 13 pump stations that are not already accounted for in the City's Capital Investment Plan (6-year).

Significant additions to the capital improvement projects are the flush station intake piping replacement projects. The intake piping was installed the 1960s. Though the intake piping is trending toward the end of its useful life and should be considered for replacement in the near future, the lower priority of the flush stations pushes the projects to the 2025 and 2026 timeframe.

The following table is a summary of the projects for the 13 pump stations based on the time frame presented in the tables above.

Table 32-15
Capital Improvement Projects for Remaining 13 Pump Stations Prior to Prioritization

Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
Flush Station 1	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$630,000
Flush Station 2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
Flush Station 3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
Flush Station 4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$285,000
Flush Station 5	-	-	-	-	-	-	$5,000	-	-	-	-	$122,500
Flush Station 6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$232,500
Flush Station 7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$225,000
Flush Station 8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$480,000
Flush Station 9	-	-	$80,000	-	-	-	-	-	-	-	-	$330,000
TOTAL	**$0**	**$6,822,000**	**$155,000**	**$30,000**	**$0**	**$0**	**$10,000**	**$450,000**	**$190,000**	**$300,000**	**$5,000**	**$3,535,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements.
4. Prioritization of projects are shown in Section 3 to account for budgetary limitations.

32.5 75-year Planning Horizon

The intervals for improvement projects are consistent with the long term resource planning discussed in Section 4 of this report. The following table is a summary of the 75-year planning horizon for the 13 additional pump stations.

Table 32-16
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Lake Heights	-	$659,000	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	$3,874,000	-	-	-	-	-	-	$116,000	-	-	-
Midlakes	-	$2,289,000	-	-	-	-	-	-	$69,000	-	-	-
Emerald Ridge	-	-	-	-	-	-	$5,000	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	$75,000	-	-	$630,000	-
Flush #2	-	-	-	$5,000	-	-	-	$75,000	-	-	-	$1,230,000
Flush #3	-	-	$75,000	-	-	-	-	-	-	$300,000	-	-
Flush #4	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #5	-	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #6	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #7	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #8	-	-	-	$5,000	-	-	-	$75,000	-	-	-	-
Flush #9	-	-	$80,000	-	-	-	-	-	-	-	-	-
TOTAL	**$0**	**$6,822,000**	**$155,000**	**$30,000**	**$0**	**$0**	**$10,000**	**$450,000**	**$190,000**	**$300,000**	**$635,000**	**$1,230,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table 32-16 Continued
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Lake Heights	-	-	-	$100,000	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	$832,000	-	-	-	-	-	-	-	-	$1,783,000
Midlakes	-	-	-	$367,000	-	-	-	-	-	-	-	-	$1,054,000
Emerald Ridge	-	-	-	$95,000	-	-	-	-	-	-	$219,000	-	-
Flush #1	-	-	-	-	-	-	-	$5,000	-	-	-	-	$75,000
Flush #2	-	-	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	$75,000	-	-	-	-	$5,000	-
Flush #4	$285,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #5	$122,500	-	-	$80,000	-	-	-	-	-	-	$170,000	-	-
Flush #6	$232,500	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #7	$225,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Flush #8	-	$480,000	-	-	-	-	-	-	-	-	$5,000	-	-
Flush #9	-	$330,000	-	-	-	-	-	-	-	-	$75,000	-	-
TOTAL	**$865,000**	**$810,000**	**$0**	**$1,474,000**	**$0**	**$0**	**$75,000**	**$5,000**	**$5,000**	**$15,000**	**$469,000**	**$5,000**	**$2,912,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table 32-16 Continued
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Lake Heights	-	$219,000	-	-	-	-	-	-	$95,000	-	-	-	-
Bellefield	-	-	-	-	-	-	-	-	$503,000	-	-	-	$503,000
Midlakes	-	-	-	-	-	-	-	-	$321,000	-	-	-	-
Emerald Ridge	-	-	-	-	-	-	$95,000	-	-	-	-	$5,000	-
Flush #1	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-	-
Flush #2	$75,000	-	-	-	$5,000	-	-	-	-	-	-	$170,000	-
Flush #3	-	-	$5,000	-	-	-	-	-	-	-	-	$210,000	-
Flush #4	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #5	-	-	-	-	-	-	$80,000	-	-	-	-	-	-
Flush #6	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #7	$75,000	-	-	-	-	$5,000	-	-	-	-	-	-	$170,000
Flush #8	$75,000	-	-	-	-	-	$5,000	-	-	-	-	-	-
Flush #9	-	-	$5,000	-	-	-	$5,000	-	-	-	-	-	-
TOTAL	**$375,000**	**$219,000**	**$10,000**	**$5,000**	**$5,000**	**$15,000**	**$185,000**	**$0**	**$919,000**	**$0**	**$170,000**	**$385,000**	**$1,013,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table 32-16 Continued
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Lake Heights	-	-	$10,000	-	-	-	-	-	-	-	-	-	-
Bellefield	-	-	-	-	$116,000	-	-	-	-	-	-	$2,383,000	-
Midlakes	$69,000	-	-	-	$69,000	-	-	-	-	-	-	$1,283,000	-
Emerald Ridge	-	-	$5,000	-	-	-	-	-	-	$309,000	-	-	-
Flush #1	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000	-
Flush #2	-	-	-	-	-	$75,000	-	-	-	-	-	-	$10,000
Flush #3	-	-	-	-	-	-	-	$5,000	-	-	-	-	$5,000
Flush #4	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #5	-	-	$5,000	-	-	-	-	-	-	$240,000	-	-	-
Flush #6	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #7	-	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #8	$170,000	-	-	-	-	$75,000	-	-	-	-	-	-	-
Flush #9	$240,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
TOTAL	**$479,000**	**$0**	**$20,000**	**$0**	**$260,000**	**$375,000**	**$0**	**$5,000**	**$0**	**$554,000**	**$0**	**$3,676,000**	**$15,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table 32-16 Continued
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078
Lake Heights	$309,000	-	-	-	-	-	-	-	-	$5,000	-	-	-
Bellefield	-	-	-	-	-	-	-	$116,000	-	-	-	-	$116,000
Midlakes	-	-	-	-	-	-	-	$69,000	-	-	-	-	$69,000
Emerald Ridge	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #1	-	-	-	-	-	-	-	-	-	$560,000	-	-	-
Flush #2	-	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #3	-	-	-	$75,000	-	-	-	-	-	-	-	-	$520,000
Flush #4	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #5	-	-	-	-	-	$5,000	-	-	-	-	$5,000	-	-
Flush #6	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #7	$10,000	-	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #8	-	$10,000	-	-	-	-	-	-	-	-	$560,000	-	-
Flush #9	-	$5,000	-	-	-	$75,000	-	-	-	-	-	-	-
TOTAL	**$339,000**	**$15,000**	**$0**	**$75,000**	**$0**	**$85,000**	**$0**	**$185,000**	**$0**	**$565,000**	**$2,810,000**	**$0**	**$705,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

Table 32-16 Continued
75-year Planning Horizon for Remaining 13 Pump Stations

Station Name	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089
Lake Heights	-	$5,000	-	-	-	$95,000	-	-	-	-	-
Bellefield	-	-	-	$503,000	-	-	-	-	-	$387,000	-
Midlakes	-	-	-	$527,000	-	-	-	-	-	-	-
Emerald Ridge	-	$95,000	-	-	-	-	-	-	-	-	-
Flush #1	-	-	-	-	-	$5,000	-	-	-	-	-
Flush #2	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #3	-	-	-	-	-	-	-	-	$75,000	-	-
Flush #4	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #5	-	$75,000	-	-	-	-	-	-	-	-	$380,000
Flush #6	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #7	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #8	-	-	-	-	-	-	$5,000	-	-	-	-
Flush #9	-	$490,000	-	-	-	-	-	-	-	-	$5,000
TOTAL	**$0**	**$665,000**	**$0**	**$1,030,000**	**$0**	**$100,000**	**$25,000**	**$0**	**$75,000**	**$387,000**	**$385,000**

Notes:

1. Cost represented in 2014 dollars. Project costs include construction plus sales tax (9.5%), ELA (Engineering, Legal and Administration) costs (35%) and contingency (30%).
2. Project cost contingency indicative of an AACE estimate class 4 with an expected accuracy range of -30% to +50%.
3. Costs are inclusive of work needed to maintain existing service levels and do not include any other desired improvements. Timing of projects have been prioritized based on Section 3 discussions.

APPENDIX A

Yarrow Point Project Cost Estimate

Project ID YP-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Exhaust Fan/Unclassify Dry Pit	1	LS	$4,000	$5,000	$3,600	$13,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$82,000	$0	$32,800	$115,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace conduit and meter base	1	LS	$2,000	$0	$800	$3,000
Replace panelboard	1	LS	$1,500	$0	$600	$2,000
Replace fused disconnect	1	LS	$1,500	$0	$600	$2,000
Replace telephone network interface	1	LS	$500	$0	$200	$1,000
Field Instruments and sensors	1	LS	$0	$0	$0	$0
Conduit and wire	1	LS	$0	$0	$0	$0
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$196,000
Tax (9.5%)						$18,620
Subtotal						$215,000
ELA[3] (35%)						$75,250
Subtotal						$291,000
Contingency[4] (30%)						$87,300
Total						$379,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation costs consist of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Cozy Cove Project Cost Estimate

Project ID CC-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Repair service cabinet	1	LS	$2,000	$0	$800	$3,000
Relocate vent	1	LS	$2,000	$2,000	$1,600	$6,000
Exhaust Fan/Unclassify Dry Pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$89,000	$0	$35,600	$125,000
Replace motor starters and cables	3	EA	$3,000	$0	$1,200	$12,000
Replace dry pit centrifugal pump	3	EA	$5,000	$10,000	$6,000	$63,000
Replace standby generator	1	LS	$24,000	$0	$9,600	$34,000
Electrical clearance rework	1	LS	$15,000	$0	$6,000	$21,000
Panelboard replacement & dry transformer	1	LS	$3,000	$0	$1,200	$4,000
Remote control pendant	1	LS	$1,500	$0	$600	$2,000
Replace primary and backup level controls	1	LS	$3,500	$0	$1,400	$5,000
Replace manual transfer switch	1	LS	$2,500	$0	$1,000	$4,000
Conduit and wire	1	LS	$0	$0	$0	$0
Subtotal						$304,000
Tax (9.5%)						$28,880
Subtotal						$332,880
ELA[3] (35%)						$116,508
Subtotal						$449,388
Contingency[4] (30%)						$134,816
Total						$585,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation costs consist of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Evergreen East Project Cost Estimate

Project ID EE-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Exhaust Fan/Unclassify Dry Pit	1	LS	$2,200	$5,000	$2,880	$10,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$82,000	$0	$32,800	$115,000
Replace vertical, centrifugal pump	2	EA	$4,000	$10,000	$5,600	$20,000
Electric clearance rework	1	LS	$10,000	$0	$4,000	$14,000
Motor cord and receptacle replacement	1	LS	$2,000	$0	$800	$3,000
Remote control pendant	1	LS	$1,500	$0	$600	$2,000
Replace primary and back up level controls	1	LS	$3,500	$0	$1,400	$5,000
Replace telephone network interface	1	LS	$1,000	$0	$400	$1,000
Conduit and wire	1	LS	$3,000	$0	$1,200	$4,000
Subtotal						$179,000
Tax (9.5%)						$17,005
Subtotal						$196,005
ELA[3] (35%)						$68,602
Subtotal						$264,607
Contingency[4] (30%)						$79,382
Total						$344,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation costs consist of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Grange Project Cost Estimate

Project ID G-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Exhaust Fan/Unclassify Dry Pit	1	LS	$2,200	$5,000	$2,880	$10,000
Install automatic primer (drain)	1	LS	$2,000	$0	$800	$3,000
Replace vertical, centrifugal pump	2	EA	$4,000	$10,000	$5,600	$20,000
Motor cord and receptacle replacement	1	LS	$2,000	$0	$800	$3,000
Replace motor starters	1	LS	$5,000	$0	$2,000	$7,000
Recoat interior of dry pit	1	LS	$1,500	$0	$600	$2,000
Replace sound proof/insulation material	1	LS	$2,000	$0	$800	$3,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Replace meter base	1	LS	$2,000	$0	$800	$3,000
Replace service rated disconnect	1	LS	$3,000	$0	$1,200	$4,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Remote control pendant	1	LS	$1,500	$0	$600	$2,000
Replace primary and back up level indicators	1	LS	$3,500	$0	$1,400	$5,000
Replace telephone network interface	1	LS	$1,000	$0	$400	$1,000
Replace manual transfer switch	1	LS	$3,000	$0	$1,200	$4,000
Replace auto transfer switch	1	LS	$6,000	$0	$2,400	$8,000
Conduit and wire	1	LS	$3,000	$0	$1,200	$4,000
Replace 60 KW Genset	1	LS	$24,000	$0	$9,600	$34,000
Subtotal						$121,000
Tax (9.5%)						$11,495
Subtotal						$133,000
ELA[3] (35%)						$46,550
Subtotal						$180,000
Contingency[4] (30%)						$54,000
Total						$234,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. The Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Wilburton Project Cost Estimate

Project ID W-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Replace meter base	1	LS	$2,000	$0	$800	$3,000
Convert to submersible station	1	LS	$75,000	$30,000	$42,000	$147,000
Replace service rated disconnect	1	LS	$3,000	$0	$1,200	$4,000
Replace motor starters	1	LS	$3,000	$0	$1,200	$4,000
Replace primary and backup level indicators	1	LS	$3,500	$0	$1,400	$5,000
Replace telephone network interface	1	LS	$1,000	$0	$400	$1,000
Replace manual transfer switch	1	LS	$3,000	$0	$1,200	$4,000
Conduit and wire	1	LS	$3,000	$0	$1,200	$4,000
Replace generator receptacle	1	LS	$2,000	$0	$800	$3,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Subtotal						$185,000
Tax (9.5%)						$17,575
Subtotal						$203,000
ELA[3] (35%)						$71,050
Subtotal						$275,000
Contingency[4] (30%)						$82,500
Total						$358,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 18 Project Cost Estimates

Project ID S18-1

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Install railing	1	LS	$5,000	$0	$2,000	$7,000
ISR relay cabinet and add vent fan	1	LS	$3,000	$0	$1,200	$4,000
Subtotal						$11,000
Tax (9.5%)						$1,045
Subtotal						$12,045
ELA(3) (35%)						$4,216
Subtotal						$16,261
Contingency(4) (30%)						$4,878
Total						$22,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID S18-2

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Add classified lighting in valve vault	1	LS	$2,000	$0	$800	$3,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Subtotal						$62,000
Tax (9.5%)						$5,890
Subtotal						$67,890
ELA(3) (35%)						$23,762
Subtotal						$91,652
Contingency(4) (30%)						$27,495
Total						$120,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Hunts Point Project Cost Estimate

Project ID HP-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[(1)]**	**Installation[(2)]**	**Complete Unit Price**
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$75,000	$0	$30,000	$105,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Replace city-owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace service entrance disconnect equip.	1	LS	$2,000	$0	$800	$3,000
Subtotal						$194,000
Tax (9.5%)						$18,430
Subtotal						$212,430
ELA[(3)] (35%)						$74,351
Subtotal						$286,781
Contingency[(4)] (30%)						$86,034
Total						$373,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Evergreen West Project Cost Estimate

Project ID EW-1

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$75,000	$0	$30,000	$105,000
Replace motor starters and cables	2	EA	$1,500	$0	$600	$4,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Isolate intrinsically safe relays	1	LS	$1,500	$0	$600	$2,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Subtotal						$183,000
Tax (9.5%)						$17,385
Subtotal						$200,385
ELA(3) (35%)						$70,135
Subtotal						$270,520
Contingency(4) (30%)						$81,156
Total						$352,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Lake Crest Project Cost Estimate

Project ID LC-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace blower vault parts to meet code	1	LS	$3,500	$0	$1,400	$5,000
Recoat interior of wet well	1	LS	$71,500	$0	$28,600	$100,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Isolate intrinsically safe relays	1	LS	$1,500	$0	$600	$2,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Replace service entrance disconnect equip	1	LS	$1,500	$0	$600	$2,000
Replace standby power phase monitor	1	LS	$500	$0	$200	$1,000
Subtotal						$187,000
Tax (9.5%)						$17,765
Subtotal						$204,765
ELA[3] (35%)						$71,668
Subtotal						$276,433
Contingency[4] (30%)						$82,930
Total						$360,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Killarney Project Cost Estimates

Project ID K-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Correct power/control panel clearance issue	1	LS	$5,000	$5,000	$4,000	$14,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Isolate intrinsically safe relays	1	LS	$1,500	$0	$600	$2,000
Repair bottom of service entrance cabinet	1	LS	$2,000	$0	$800	$3,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$94,000
Tax (9.5%)						$8,930
Subtotal						$102,930
ELA[3] (35%)						$36,026
Subtotal						$138,956
Contingency[4] (30%)						$41,687
Total						$181,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID K-2

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Recoat interior of wet well	1	LS	$75,000	$0	$30,000	$105,000
Replace primary and backup level indicators	1	EA	$2,500	$0	$1,000	$4,000
Replace standby power phase monitor	1	EA	$500	$0	$200	$1,500
Subtotal						$110,500
Tax (9.5%)						$10,498
Subtotal						$120,998
ELA[3] (35%)						$42,349
Subtotal						$163,347
Contingency[4] (30%)						$49,004
Total						$213,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Meydenbauer Project Cost Estimate

Project ID M-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Recoat interior of wet well	1	LS	$68,000	$0	$27,200	$95,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Isolate intrinsically safe relays	1	LS	$1,500	$0	$600	$2,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Repair bottom of service entrance cabinet	1	LS	$2,000	$0	$800	$3,000
Replace city-owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace primary & standby phase monitors	1	LS	$500	$0	$200	$1,000
Subtotal						$178,000
Tax (9.5%)						$16,910
Subtotal						$194,910
ELA[3] (35%)						$68,219
Subtotal						$263,129
Contingency[4] (30%)						$78,939
Total						$343,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Bagley Project Cost Estimates

Project ID B-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Isolate intrinsically safe relays	1	LS	$1,500	$0	$600	$2,000
Repair bottom of service entrance cabinet	1	LS	$2,000	$0	$800	$3,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$80,000
Tax (9.5%)						$7,600
Subtotal						$87,600
ELA[3] (35%)						$30,660
Subtotal						$118,260
Contingency[4] (30%)						$35,478
Total						$154,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID B-2

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Recoat interior of wet well	1	LS	$75,000	$0	$30,000	$105,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Subtotal						$109,000
Tax (9.5%)						$10,355
Subtotal						$119,355
ELA[3] (35%)						$41,774
Subtotal						$161,129
Contingency[4] (30%)						$48,339
Total						$210,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Pleasure Point Project Cost Estimates

Project ID PP-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Repair bottom of service entrance cabinet	1	LS	$2,000	$0	$800	$3,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$78,000
Tax (9.5%)						$7,410
Subtotal						$85,410
ELA[3] (35%)						$29,894
Subtotal						$115,304
Contingency[4] (30%)						$34,591
Total						$150,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID PP-2

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Recoat interior of wet well	1	LS	$75,000	$0	$30,000	$105,000
Replace standby power phase monitor	1	LS	$0	$0	$0	$0
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Subtotal						$109,000
Tax (9.5%)						$10,355
Subtotal						$119,355
ELA[3] (35%)						$41,774
Subtotal						$161,129
Contingency[4] (30%)						$48,339
Total						$210,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Kimberlee Park Project Cost Estimate

Project ID KP-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work(1)**	**Installation(2)**	**Complete Unit Price**
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Replace motor starters and cables	2	EA	$10,000	$0	$4,000	$28,000
Replace dry pit centrifugal pump	2	EA	$10,000	$10,000	$8,000	$56,000
Increase main disc. and service to 200 amp	1	LS	$15,000	$0	$6,000	$21,000
Replace lower level grating/ladder	1	LS	$10,000	$0	$4,000	$14,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Subtotal						$150,000
Tax (9.5%)						$14,250
Subtotal						$164,250
ELA(3) (35%)						$57,488
Subtotal						$221,738
Contingency(4) (30%)						$66,521
Total						$289,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

South Ridge Project Cost Estimate

Project ID S-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Install railing at elevated control structure	1	LS	$2,000	$0	$800	$3,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Correct gen receptacle and exposed wiring	1	LS	$2,000	$0	$800	$3,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Subtotal						$64,000
Tax (9.5%)						$6,080
Subtotal						$70,080
ELA[3] (35%)						$24,528
Subtotal						$94,608
Contingency[4] (30%)						$28,382
Total						$123,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Lakemont Project Cost Estimate

Project ID L-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Isolate intrinsically safe wiring	1	LS	$1,500	$0	$600	$2,000
Seal structure leaks near power/control pnl	1	LS	$2,000	$0	$800	$3,000
Replace utility phase monitor	1	LS	$500	$0	$200	$1,000
Repair wet well PVC liner	1	LS	$75,000	$0	$30,000	$105,000
Replace motor starter and cable	2	EA	$4,000	$0	$1,600	$12,000
Replace submersible pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace service entrance disc equipment	1	LS	$1,500	$0	$600	$2,000
Replace utility owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace dry transformer	1	LS	$2,000	$0	$800	$3,000
Subtotal						$173,000
Tax (9.5%)						$16,435
Subtotal						$189,435
ELA[3] (35%)						$66,302
Subtotal						$255,737
Contingency[4] (30%)						$76,721
Total						$333,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 4 Project Cost Estimates

Project ID S4-1

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Replace beam seat connection	1	LS	$4,000	$0	$0	$4,000
Re-coat rusted portion of pipe	1	LS	$2,000	$0	$0	$2,000
Subtotal						$6,000
Tax (9.5%)						$570
Subtotal						$6,570
ELA(3) (35%)						$2,300
Subtotal						$8,870
Contingency(4) (30%)						$2,661
Total						$12,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID S4-2

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace service entrance disc equipment	1	LS	$1,500	$0	$600	$2,000
Replace utility owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace primary & standby phase monitors	1	LS	$500	$0	$200	$1,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace backup level indicator	1	LS	$1,500	$0	$600	$2,000
Subtotal						$89,000
Tax (9.5%)						$8,455
Subtotal						$97,455
ELA(3) (35%)						$34,109
Subtotal						$131,564
Contingency(4) (30%)						$39,469
Total						$172,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 6 Project Cost Estimate

Project ID S6-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Install seal offs on conduits into wet well	1	LS	$1,000	$0	$400	$1,000
Replace overfilled conduits/wiring	1	LS	$3,000	$0	$1,200	$4,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Replace service entrance disc equipment	1	LS	$1,500	$0	$600	$2,000
Replace city owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace pump cable termination block	1	LS	$3,000	$0	$1,200	$4,000
Replace standby power phase relay	1	LS	$500	$0	$200	$1,000
Replace dry transformer	1	LS	$2,000	$0	$800	$3,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Subtotal						$77,000
Tax (9.5%)						$7,315
Subtotal						$84,315
ELA[3] (35%)						$29,510
Subtotal						$113,825
Contingency[4] (30%)						$34,148
Total						$148,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 7 Project Cost Estimate

Project ID S7-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Replace service entrance disc equipment	1	LS	$1,500	$0	$600	$2,000
Replace city owned meter base	1	LS	$2,000	$0	$800	$3,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Replace standby power phase relay	1	LS	$500	$0	$200	$1,000
Replace dry transformer	1	LS	$2,000	$0	$800	$3,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Subtotal						$71,000
Tax (9.5%)						$6,745
Subtotal						$77,745
ELA[3] (35%)						$27,211
Subtotal						$104,956
Contingency[4] (30%)						$31,487
Total						$137,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Flush 10 Project Cost Estimate

Project ID F10-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Replace motor starters and cables	1	LS	$3,000	$0	$1,200	$4,000
Replace dry pit centrifugal pump	1	LS	$5,000	$5,000	$4,000	$14,000
Replace intake piping	1	LS	$57,000	$0	$0	$57,000
Subtotal						$75,000
Tax (9.5%)						$7,125
Subtotal						$82,125
ELA[3] (35%)						$28,744
Subtotal						$110,869
Contingency[4] (30%)						$33,261
Total						$145,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 19 Project Cost Estimate

Project ID S19-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Replace/relocate cable termination box	1	LS	$7,000	$0	$2,800	$10,000
New level sensor hooks to improve access	1	LS	$500	$0	$200	$1,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$74,000
Tax (9.5%)						$7,030
Subtotal						$81,030
ELA[3] (35%)						$28,361
Subtotal						$109,391
Contingency[4] (30%)						$32,817
Total						$143,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 17 Project Cost Estimate

Project ID S17-1

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starter and cable	2	EA	$3,000	$0	$1,200	$8,000
Replace submersible pump	2	EA	$3,000	$10,000	$5,200	$36,000
Add ventilation fan to power/control cabinet	1	LS	$500	$0	$200	$1,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$60,000
Tax (9.5%)						$5,700
Subtotal						$65,700
ELA(3) (35%)						$22,995
Subtotal						$88,695
Contingency(4) (30%)						$26,609
Total						$116,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 16 Project Cost Estimate

Project ID S16-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Install exhaust fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Relocate control panels for clearance codes	1	LS	$25,000	$0	$10,000	$35,000
Isolate intrinsically safe wiring	1	LS	$0	$0	$0	$0
Replace City owned meter base	1	LS	$2,000	$0	$800	$3,000
Repair dry pit interior coating system	1	LS	$3,500	$0	$1,400	$5,000
Replace primary & standby phase monitors	1	LS	$500	$0	$200	$1,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Install above grade backflow assembly enclosure	1	LS	$3,500	$0	$1,400	$5,000
Subtotal						$134,000
Tax (9.5%)						$12,730
Subtotal						$146,730
ELA[3] (35%)						$51,356
Subtotal						$198,086
Contingency[4] (30%)						$59,426
Total						$258,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 12 Project Cost Estimates

Project ID S12-1

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Remove dead fir tree	1	LS	$5,000	$0	$0	$5,000
Subtotal						$5,000
Tax (9.5%)						$475
Subtotal						$5,475
ELA(3) (35%)						$1,916
Subtotal						$7,391
Contingency(4) (30%)						$2,217
Total						$10,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Project ID S12-2

Item	Quantity	Unit	Unit Cost	Ancillary work(1)	Installation(2)	Complete Unit Price
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starters and cables	4	EA	$20,000	$0	$8,000	$112,000
Replace dry pit centrifugal pump	4	EA	$20,000	$10,000	$12,000	$168,000
Replace City owned meter base & repair CT c	1	LS	$3,000	$0	$1,200	$4,000
Replace service entrance disconnect equip	1	LS	$1,500	$0	$600	$2,000
Replace automatic transfer switch	1	LS	$2,000	$0	$800	$3,000
Replace standby generator	1	LS	$100,000	$0	$40,000	$140,000
Replace dry transformer	1	LS	$2,000	$0	$800	$3,000
Replace telephone network interface box	1	LS	$500	$0	$200	$1,000
Replace backup level indicator	1	LS	$1,500	$0	$600	$2,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Subtotal						$448,000
Tax (9.5%)						$42,560
Subtotal						$490,560
ELA(3) (35%)						$171,696
Subtotal						$662,256
Contingency(4) (30%)						$198,677
Total						$861,000

Note:
1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 2 Project Cost Estimate

Project ID S2-1

Item	**Quantity**	**Unit**	**Unit Cost**	**Ancillary work[1]**	**Installation[2]**	**Complete Unit Price**
Install supply fan/declassify dry pit	1	LS	$4,000	$10,000	$5,600	$20,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace automatic transfer switch	1	LS	$5,000	$0	$2,000	$7,000
Replace standby generator	1	LS	$15,000	$0	$6,000	$21,000
Replace panelboard	1	LS	$2,000	$0	$800	$3,000
Replace standby power phase monitor	1	LS	$500	$0	$200	$1,000
Replace backup level indicator	1	LS	$1,500	$0	$600	$2,000
Subtotal						$114,000
Tax (9.5%)						$10,830
Subtotal						$124,830
ELA[3] (35%)						$43,691
Subtotal						$168,521
Contingency[4] (30%)						$50,556
Total						$220,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

Station 1 Project Cost Estimate

Project ID S1-1

Item	Quantity	Unit	Unit Cost	Ancillary work[1]	Installation[2]	Complete Unit Price
Install supply fan/declassify dry pit	1	LS	$4,000	$0	$1,600	$6,000
Inspect/evaluate wet well for corrosion	1	LS	$10,000	$0	$0	$10,000
Replace motor starters and cables	2	EA	$3,000	$0	$1,200	$8,000
Replace dry pit centrifugal pump	2	EA	$5,000	$10,000	$6,000	$42,000
Replace automatic transfer switch	1	LS	$5,000	$0	$2,000	$7,000
Replace standby generator	1	LS	$15,000	$0	$6,000	$21,000
Replace standby power phase monitor	1	LS	$500	$0	$200	$1,000
Replace primary and backup level indicators	1	LS	$2,500	$0	$1,000	$4,000
Subtotal						$99,000
Tax (9.5%)						$9,405
Subtotal						$108,405
ELA[3] (35%)						$37,942
Subtotal						$146,347
Contingency[4] (30%)						$43,904
Total						$191,000

Note:

1. Where applicable, costs for ancillary work was included based on sound engineering judgment.
2. Where applicable, installation consists of 40% of the unit cost and ancillary work.
3. Engineering, Legal and Administration costs
4. Project cost contingency indicative of an AACE estimate class 4 within the expected accuracy range of -30% to +50%.

APPENDIX B

CITY OF BELLEVUE
WASTEWATER PUMP STATION EVALUATION, PHASE 2
STATION 4
STRUCTURAL EVALUATION

STRUCTURAL

1. PROJECT DESCRIPTION

The objective of this narrative is to summarize the findings of the structural evaluation which was performed at the City of Bellevue, Station 4, located at 16035 SE 9th Street. On September 17, 2014, a representative from CG Engineering met with Clint Emry of the City of Bellevue to observe the structural conditions at Station 4. At that time the existing dry well was accessible for visual observation. Based on that observation, recommendations and related narrative for proposed structural condition improvements will be presented along with approximate construction costs.

2. EXISTING BUILDING

The Station 4 lift station was constructed in the mid to late 1950's. Based on the existing structural drawings, dated March 19, 1956, the main structure was constructed of cast-in-place reinforced concrete. The interior floor was constructed of steel beams and metal grating. The structural materials and members that were observed on site were consistent with the original structural construction drawings.

3. EXISTING CONDITIONS

Based on the site observation, the overall condition of the dry well structure was observed to be solid and sound. There were no signs of significant cracking or settlement and the structural members were observed to be in good condition. There was one beam connection that showed signs of deterioration, and several other issues to consider for future condition improvements. The following are a short list of structural concerns that should be addressed when considering the longevity of the structure.

Deterioration of a Beam Seat Connection – There are two 6" deep steel beams which support the mid-level landing. These steel beams are supported on each end by double angle beam seats that are embedded into the existing concrete walls. Three of the double angle beam seats are in good condition, but the fourth one is deteriorating and has significant corrosion. The existing condition is shown in the photos to follow. The corrosion may have been caused by humidity and wet conditions within the dry well or by water seepage through the concrete wall into the embedded beam seat connection.

Water Leak and High Humidity – The dry well has an internal drainage pipe that carries surface water from the vault lid, down through the dry well and into the sump at the base of the structure. We observed that the internal drainage pipe was leaking and water was dripping through the mid-landing grating, down to the base of the dry well. As a result, the base slab was wet and the dry well was very humid.

Water Intrusion and Efflorescence – Mineral deposits likely caused by water leaching through the concrete walls were observed in select locations. The photos illustrate this condition. These locations can be cleaned and sealed, however the condition may continue. High humidity can also be the cause of efflorescence.

Rusting of Metals – Rust was observed on metals in several locations. The most obvious was the previously mentioned beam seat connection. Rust was also observed on the pump base anchorage plate, and on the 6" cast iron pipe that enters the dry well near the rusted beam connection. The rust is likely attributed to the humid and wet interior environment, but may also be a result of water seepage through the concrete. Stains were observed where the 6" cast iron pipe penetrates the dry well wall, which indicates that the seal may be compromised at that location. Refer to the photos to follow.

4. RECOMMENDATIONS

As previously stated, the structural integrity of the existing dry well was observed to be solid and sound. It is our professional opinion that, although repair and monitoring is recommended, the safety and continued operation of the dry well is not a concern at this time. The following are recommended condition improvements that should be considered in the near future.

- **Fix Water Leak** – It appeared that the internal water drainage pipe leak was due to a faulty tee fitting. We recommend replacement by city maintenance staff.

- **Replacement of Beam Seat Connection** – As described, one of the four beam seat connections has rusted and should be replaced. We recommend a stainless steel angle or bent plate, and stainless steel epoxy anchor rods. Refer to the structural sketch SS-1, that follows this report, for specifics. We also recommend investigation of the wall by city maintenance staff after the existing beam seat is removed and before installation of the new beam seat to determine if water seepage is occurring through the original beam seat wall penetration.

  We estimate that the approximate construction cost for removal of the existing beam seat and installation (and materials) of the new beam seat is approximately $4,000.

- **Re-Coating the Rusted Portion of the 6" Cast Iron Pipe** – As seen in the photos, a portion of the 6" cast iron pipe next to the rusted beam seat connection is also rusting. The rusted section of pipe extends a distance of about 8" from the inside face of the concrete wall. We recommend removal of the surface rust by sanding or grinding. We then recommend applying rust inhibitive epoxy paint as recommended by the cast iron pipe manufacturer or city maintenance staff. We also recommend also recommend future monitoring of this area to determine if water seepage is contributing to this condition.

The construction cost associated with sanding, grinding, and re-coating the 6" cast iron pipe is approximately $2,000.

- **High Humidity / Wet Conditions** – When the water leak is fixed the base slab should dry out and the humidity should drop. We recommend checking the dehumidifier and monitoring the humidity until it stabilizes. We also recommend periodically monitoring the extent of rust on the pump base anchorage plates. At this time we do not recommend remedial action to the pump base anchorage.

5. SUMMARY

We recommend replacement of the rusted beam seat connection and re-coating of the 6" cast iron pipe within a year. The approximate construction cost associated with the recommended structural condition upgrades is approximately $6,000. We do not anticipate that the operation of the lift station would need to be interrupted during the recommended repairs.

The water leak and humid / wet condition should be rectified as soon as possible by the city maintenance staff. We recommend periodic future monitoring of possible water intrusion, efflorescence, and rust.

Photo 1: Beam Seat in Good Condition

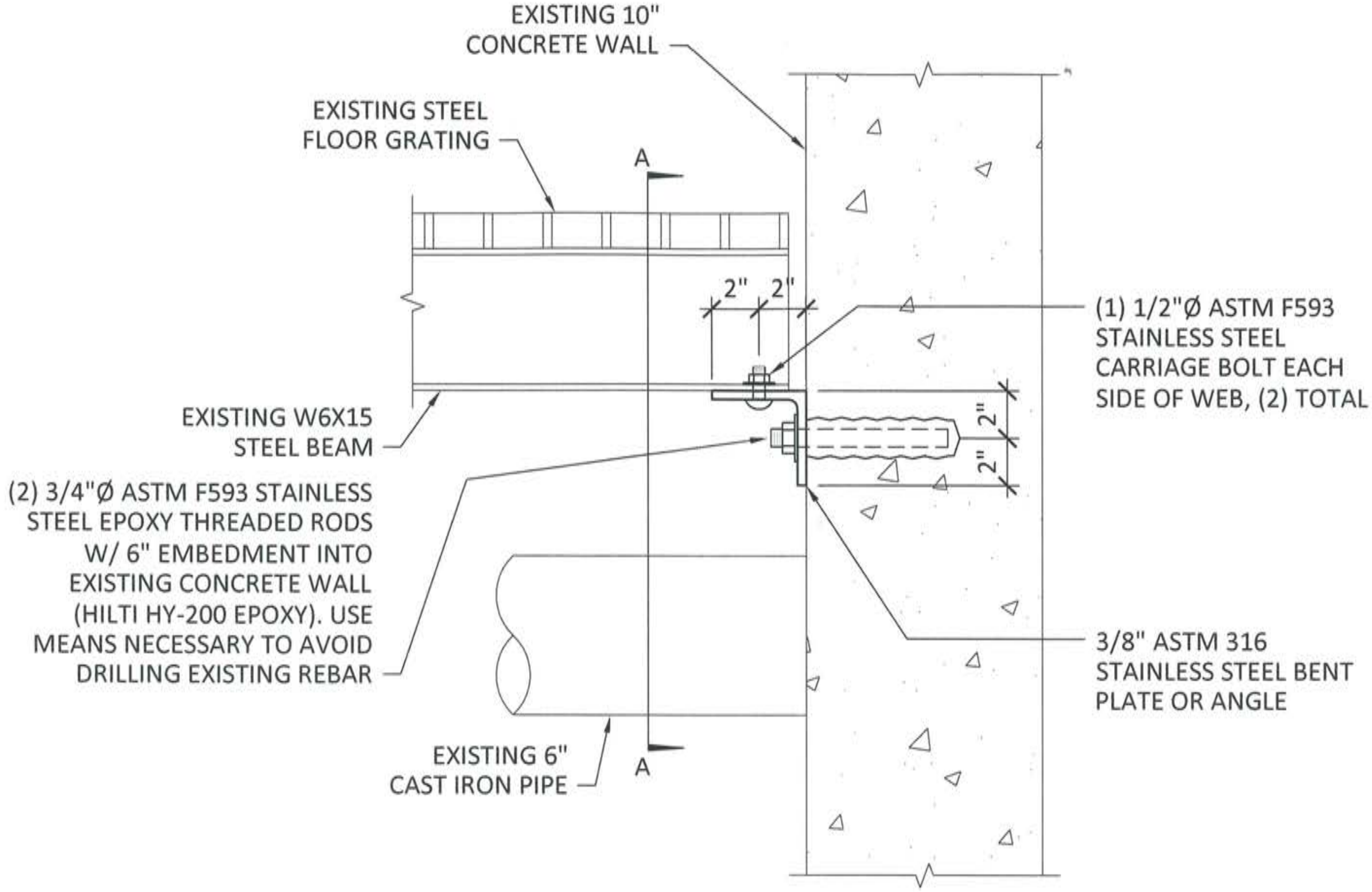
Photo 2: Beam Seat in Need of Replacement & 6” Cast Iron Pipe with Surface Rust

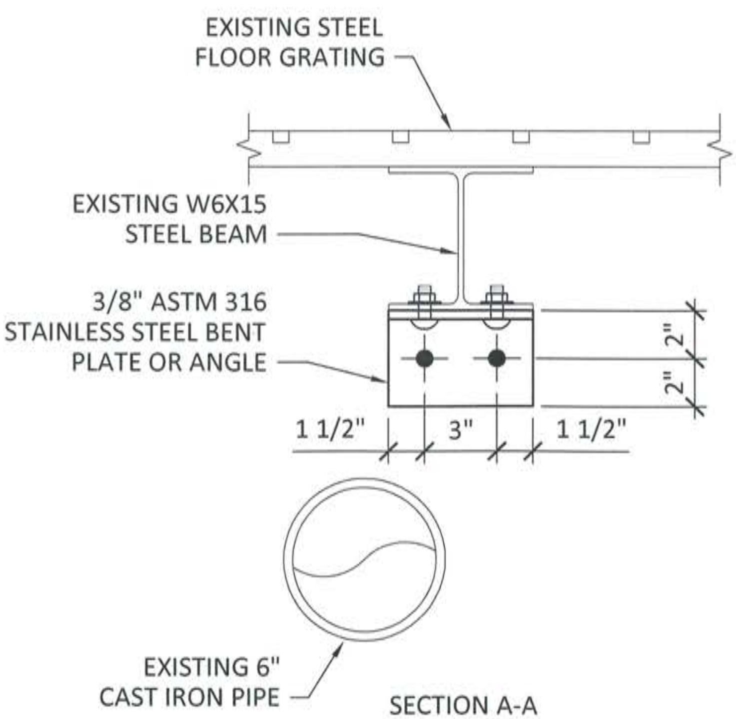
Photo 3: Wet Floor Condition at Sump

Photo 4: Water Leak at Tee Fitting

Photo 5: Rust at Pump Base Anchorage Plate

Photo 6: Efflorescence at Concrete Wall





SECTION A-A

09/25/14

C.G ENGINEERING 250 4TH AVE. S., SUITE 200 EDMONDS, WASHINGTON 98020 PHONE (425) 778-8500 FAX (425) 778-5536	CITY OF BELLEVUE, STATION 4 WASTEWATER PUMP STATION EVALUATION, PHASE 2 16035 SE 9TH STREET	DATE 09/25/14 PROJECT NO. 14215.10 SCALE 1 1/2" = 1'-0"	SHEET
	TITLE BEAM SEAT CONNECTION	DRAWN BY ZOS CHECKED BY JGG APPROVED BY CCC	SS-1

PLOT DATE: 9/25/14 FILE NAME: SS-1

MSA

APPENDIX C

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
1145 Broadway Plaza, Suite 1010 ■ Tacoma, WA 98402-3524 ■ PHONE 253.627.1520 ■ FAX 253.627.1923

TECHNICAL MEMORANDUM

DATE: May 11, 2015

PROJECT: Wastewater Pump Station Evaluation, Phase II

TO: Brandon Cole
City of Bellevue

FROM: Brian M. Casey, P.E.
Thomas J. Perry, P.E.
Murray, Smith & Associates, Inc.

BRIAN M. CASEY
STATE OF WASHINGTON
46632
REGISTERED
PROFESSIONAL ENGINEER
5-11-2015

RE: Pump Station 12 Hydraulic Evaluation

Executive Summary

The City of Bellevue (City) has experienced challenges associated with hydraulic issues at Wastewater Pump Station 12 (Station 12). Murray, Smith & Associates (MSA) was authorized to investigate the hydraulic issues affecting Station 12 as part of some follow-on work from the Wastewater Pump Station Evaluation – Phase 2 Project. The hydraulic/operation issues, field testing results, and recommendations are discussed below.

Pump testing at Station 12 where deterioration within the pump has been observed resulted in several observations:

- The influent drop pipe that was installed during the second half of 2014 to reduce the cascading and air entraining effect appears to have reduced some of the noise and potentially cavitation.
- The suction pipe sizing results in velocities of 12 to 18 feet per second (fps) in the suction piping, which far exceeds the Hydraulic Institute (HI) standard recommendation of 3 to 5 fps.
- The short radius elbows on the suction of the pumps coupled with the high velocities leads to flow separation where the wastewater hits the bottom of the pump impeller at

differing speeds, creating an imbalanced load on the impeller and affecting the wear of the pump bearings, which will contribute to noise and possibly vibration.

- The high velocities and pipe bends likely contribute to pre-rotation of the fluid. When rotating in the same direction as the impeller, pre-rotation can reduce the capacity of the pump.
- While the wet well configuration and suction pipe intake design do not appear to meet HI standards, the wet well water surface elevation did not appear to measurably affect the noise level of the pumps.

It is our opinion the velocities within and configuration of the suction piping are contributing to reduced hydraulic performance and possibly cavitation. In addition, the cavitation damage observed within the pumps may have also been partially caused by entrained air in the wastewater that was more significant prior to the addition of the drop pipe that was added in 2014. However, without the ability to test before and after conditions, this cannot be confirmed.

Recommendations to quickly and inexpensively improve the pumping system in the near term are limited due to the scale of the project required to address the existing hydraulic design issues. The wet well water surface elevation does not appear to affect the pumping system, so adjustments are not recommended. Reducing the pump speed and subsequently the flow could moderately improve the effect of the poor suction piping hydraulics and minimize the imbalanced load on the impellers. However, reducing the pumping rate will require longer duration pumping, increasing power costs and the potential for ragging.

Long term recommendations revolve around replacing the pump and piping configuration to improve the hydraulics. Keys to this include avoiding short radius bends immediately ahead of the pump, eliminating small diameter pipe that results in high suction velocities, and minimizing or avoiding pump operation against a closed valve. Accommodating these changes will require a substantial renovation of the pump station.

Introduction

The City of Bellevue (City) has experienced challenges associated with hydraulic issues at Wastewater Pump Station 12 (Station 12). The configuration of this station is unique for the City, with two sets of two pumps pumping in series for a total of four pumps. Significant pitting within the volute of each pump has been continually observed since the pumps were placed in service in 2004, and the City has reportedly replaced the volutes and impellers three times. During a site visit on June 23, 2014, a team from Murray, Smith & Associates (MSA) performed a high level evaluation and confirmed the noise during pump operation and observed the deterioration within the volutes of pumps 2A and 2B.

As a follow-up to that evaluation, the City requested that MSA perform a more in-depth pumping system evaluation to determine the cause(s) of the pump deterioration. In addition to the same MSA staff from the original testing, our team was supported by Doug Schneider of Brown and Caldwell (BC) for his experience with trouble-shooting series pumping systems. This memorandum has been prepared in association with Mr. Schneider. Additionally, Zach Weeks of PumpTech, Inc. supported the on-site testing and provided a tachometer to assist with measurements. The findings of this evaluation are discussed below.

Background

Station 12 was originally constructed in 1963 and utilized only two pumps that operated in parallel. The first pump station renovation occurred in 1988 when the system was converted over to series pumping where one pump pumps into another to achieve the total pumping head requirements. In 2004, the second renovation was completed, which maintained the series pumping configuration and initiated the hydraulic issues.

From a wastewater collection system perspective, Station 12 receives flow from the surrounding area as well as four upstream pump stations. In order of flow, the upstream stations are: Station 19, Station 18, Station 17, Station 16, and then Station 12.

Station 12 Physical Description

As mentioned above, Station 12 has two sets of pumps operating in series, meaning that pump B discharges directly into the suction of pump A, as shown schematically in Figure 1. What Figure 1 does not show are the sudden transitions into and out the pumps, which can be seen in the attached design drawings.

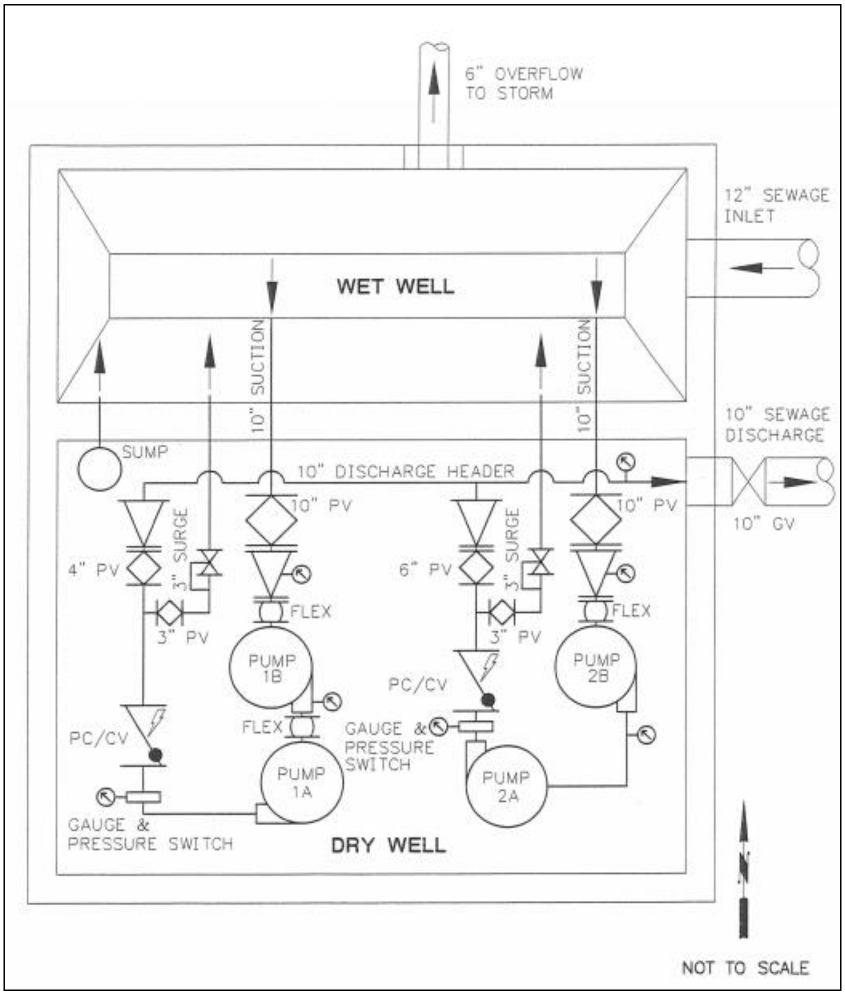


Figure 1 – Schematic view of the Station 12 pumping system

While pumping systems 1 and 2 are similar in physical configurations, there are slight differences and this evaluation focused on pumping system 2 as it was reportedly more problematic. Due to questions relating to pump performance, it is worth noting that all piping beyond the pump suction and discharge flanges is not typically part of a pump manufacturer's design. Fittings on the suction and discharge piping have the potential to negatively affect the hydraulic performance of a pump.

The suction piping from the wet well to pump 2B reduces from a ten-inch diameter to a six-inch diameter, then flows through a flexible fitting prior to reducing to a five-inch diameter and turning upward through a short-radius 90-degree elbow into the suction side of pump 2B. Within the Pump 2B suction plate, the diameter is rapidly reduced from five inches to a four inch opening prior to meeting the impeller.

The discharge piping from pump 2B to pump 2A is all four-inch diameter prior to traveling through a four-inch by five-inch increasing, short radius elbow up into the pump suction plate. The suction plate on pump 2A matches that of pump 2B, rapidly reducing from a five inch diameter opening to four inches.

The discharge piping from pump 2A is also four inches in diameter and flows through an angular pump control valve that opens and closes based on a powered actuator and the hydraulic system pressure. The pump control valve serves as a check valve to prevent flow from reversing direction. After flow is conveyed through the control valve, the pipe size increases to six-inch diameter prior to connecting to the common ten-inch header.

Hypotheses

After observing the wear within the pump volutes on Pump 2A and Pump 2B, erosion due to wastewater constituents such as sand or gravel was ruled out due to the inconsistent pitting. Erosion from wastewater constituents is typically identified by consistently worn areas where velocities are highest, such as the outside of the volute. The remaining likely issues were entrained air and/or cavitation associated with internal piping hydraulics.

Entrained Air – Air is most often entrained in wastewater when turbulent conditions occur in gravity pipes, either through sharp turns or elevation drops that effectively create a plunge pool. Also, the formation of a vortex in a wet well has the potential to draw air from the water surface directly into the pump suction piping.

With no significant turbulence observed upstream of the wet well, the vertical plunge into the wet well and water surface vortexing were identified as potential contributors.

Cavitation – Cavitation occurs when fluid flashes from a liquid to vapor due to low pressure, presenting a gas bubble that then collapses under higher pressure. Cavitation-induced damage is relatively common in pumps where the gas bubble collapses on the surface of a mechanical component, weakening, and ultimately damaging it.

Pressures within a pump are variable, which is why cavitation may occur in some locations but not others. Factors contributing to the pressure variables and cavitation may result from:

- Poor pump design, not following the Hydraulic Institute or similar standards
- Poor pump selection for this installation, operating outside of manufacturer preferred operating range
- Poor piping and hydraulic design, improper piping and pump configuration
- Inadequate net positive suction head available ($NPSH_a$) compared to what is required of the pump ($NPSH_r$).

Testing Plan

To address the potential for entrained air, reducing the wastewater flow drop from the influent pipe into the wet well and increasing the submergence over the influent piping to reduce the potential for vortexing was accomplished by elevating the wet well water surface.

To address the potential for cavitation, reduced speed operation testing was completed, as this would minimize the impeller tip speed and pressure differentials within the pumping system. These tests were not intended to eliminate the issue but rather to look for an increase or decrease in the noise occurring within the pumps, using noise as an indicator of potential pump damage.

Testing plans were developed prior to the field visit to facilitate a logical progression that would best isolate potential causes for identification. The tests performed generally included:

1. Normal operating level, full speed test
2. Normal operating level, low speed test
3. High operating level, full speed test
4. High operating level, low speed test
5. Low operating level, full speed test
6. Low operating level, low speed test

With regard to full and low speed, full speed referred to 100 percent speed (59 Hz, as identified on the VFD) and 1,770 revolutions per minute (rpm) on the pump shaft, as measured by a tachometer. Low speed referred to 85 percent speed (50 Hz, as measured on the VFD) and 1,500 rpm on the pump shaft, as measured by a tachometer. The low speed was identified as a minimum practical speed where the pumps would still be able to pump the wastewater up the hill and avoid the risk of reverse flow or surging near pump shutoff head. The completed testing forms are attached to this technical memorandum.

Findings

NPSH - Using standard calculations to determine NPSH, inadequate NPSH does not appear to be an issue at Station 12. Even with the high suction velocities discussed below, the two feet of submergence at the low pumping level coupled with the 33 feet of atmospheric pressure far outweighs the vapor pressure (less than one foot) and friction losses (maximum of 4 feet estimated at 700 gpm). With roughly 30 feet of $NPSH_a$ and only 12 feet required at 700 gpm, this does not appear to be the issue.

***Pump Capacity* –** Testing during the initial visit in June of 2014 measured the pumping capacity at roughly 550 gpm, far below the design point of 750 gpm. However, the run time data used to calculate the pump capacity was based on pump start-to-pump stop. Due to the operation of the pump control valve, it was discovered during the recent testing that 35 to 45 seconds of pump run time are consumed during startup before the control valve is fully open. Similarly, the pump shutdown sequence reduces the speed of the pumps and initiates the closing of the control valve for a period of 35 to 45 seconds before the pump shuts off.

Pump capacity testing was modified from the initial testing effort, which used pump on, pump off, and level information pulled from City SCADA. First, to improve the accuracy of the pumped volume, clear tubing was installed within the dry well to observe and measure the wet well level. Second, to improve the accuracy of the pump run time, a stop watch was used to track the pump run time only after the pump control valve was completely open and before the shutdown sequence commenced. This revised testing resulted in a measured full speed pump capacity of approximately 700 gpm, much closer to the design point but still diminished which could be a result of pump wear, piping configuration, etc.

Motor Current Draw **–** The motor current was measured for each of the tests. While there was a slightly greater amp draw on the motor for pump 2B than 2A, 46 amps and 44 amps, respectively, roughly 2 amps difference. When an ancillary test was performed for the motors on pumps 1B and 1A, no significant difference was noticed. Given that the pumping system 1 and 2 installations are similar and pumping system 1 did not experience the same discrepancy, the difference in current draw on pumping system 2 could not conclusively be attributed to anything associated with the system hydraulics. The difference in amp draw could be attributed to motor age, condition, quality of manufacturing or other conditions that may be unique to that system.

Pump Speed Output **–** The actual pump shaft speed was compared with the input speed from the VFD to make sure programming had not established 100 percent speed as something significantly different from 60 Hz. In the case of all tests, when the pump was operated at 100 percent speed, this equated to 59 Hz (reasonable given the accuracy of equipment would not significantly affect the output), and the pump shaft speed was measured at 1,770 rpm on both 2B and 2A. Similarly, when the pump was operated at 85 percent speed, this equated to 50 Hz, and the pump shaft speed was measured at 1,500 rpm on both pump 2B and 2A. Therefore, the pump speed was determined to be accurate and a non-factor.

Effect of Wet Well Level **–** The wet well level did not appear to have a measureable effect on the testing performed, as discussed below.

Entrained Air Venting – During the normal wet well level testing, a clear tube was attached to the discharge of pump 2B in an attempt to identify whether entrained air was being pumped. No bubbles were observed and no gas accumulated at the high point in the tubing after it was allowed to sit stagnant.

Wet Well Water Surface – The testing at Station 12 occurred over a two-day period due to the pumps becoming clogged with grease and debris when the wet well level was drawn down for the low level testing on the first day. With the addition of the influent drop pipe in 2014, the wet well is much more quiescent and now captures a significant amount of grease on the water surface. For this reason, no surface observations could be made during the first day of testing.

The majority of the grease was cleaned out of the wet well prior to the second day of testing and the water surface was observed. As mentioned, the influent drop pipe has significantly reduced the turbulence in the wet well, though with its termination above the normal water surface, cascading still occurs. During the low level testing of pumping system 2, which is closer to the influent pipe, no surface swirl or vortexing was observed. During the low level

testing of pumping system 1, surface swirl was observed that ceased once the pumps stopped. However, this swirl was extremely minor and not considered a significant concern.
Noise –The primary indicator to determine if changes in the pumping conditions during the testing would affect the damage to the pumps was noise. For this reason, a simple noise measurement test was performed to measure the relative noise coming from each pumping system. Using an uncalibrated smart phone app, the decibel reading was observed as the wet well level was pumped from a submergence of 5'-10" down to 1'-4"on pump B. Pumping system 2 was measured at approximately 105 dB consistently through the drawdown and decreased to about 100 dB during the pump shutdown sequence. Pumping system 1 was relatively consistent at about 93 dB through the drawdown and pump shutdown sequence.

The consistent measurement of noise as the wet well water surface was lowered when the pumps were operating at full speed, reducing the submergence on the pump, indicates that the wet well water level is not a significant issue within the range tested. The difference between pumping system 1 and pumping system 2 could potentially be attributed to the recent replacement of bearings in pump 1B.

***Effect of Pump System Piping* –** Without detailed physical or computational fluid dynamic (CFD) modeling, an understanding of the hydraulics within the pumping system is based on experience with previous systems. Flow separation and pre-rotation are the two phenomena likely impacting the operation of this station.

Flow Separation – We have analyzed a number of pump stations that have suffered from flow separation and/or suction recirculation. Suction recirculation occurs when the pump is conveying significantly less flow than it is ideally designed for and some water is pulled in and pushed back out on the suction side of the impeller. As this system does not experience the low flow operation, suction recirculation has been ruled out as a likely concern.

Flow separation occurs when the velocity of flow is too high to be able to turn with reasonable velocity uniformity. This creates high velocities against the far side of the elbow as flow separates from the inside of the elbow, creating a reverse flow condition in some cases, as shown in Figure 2.

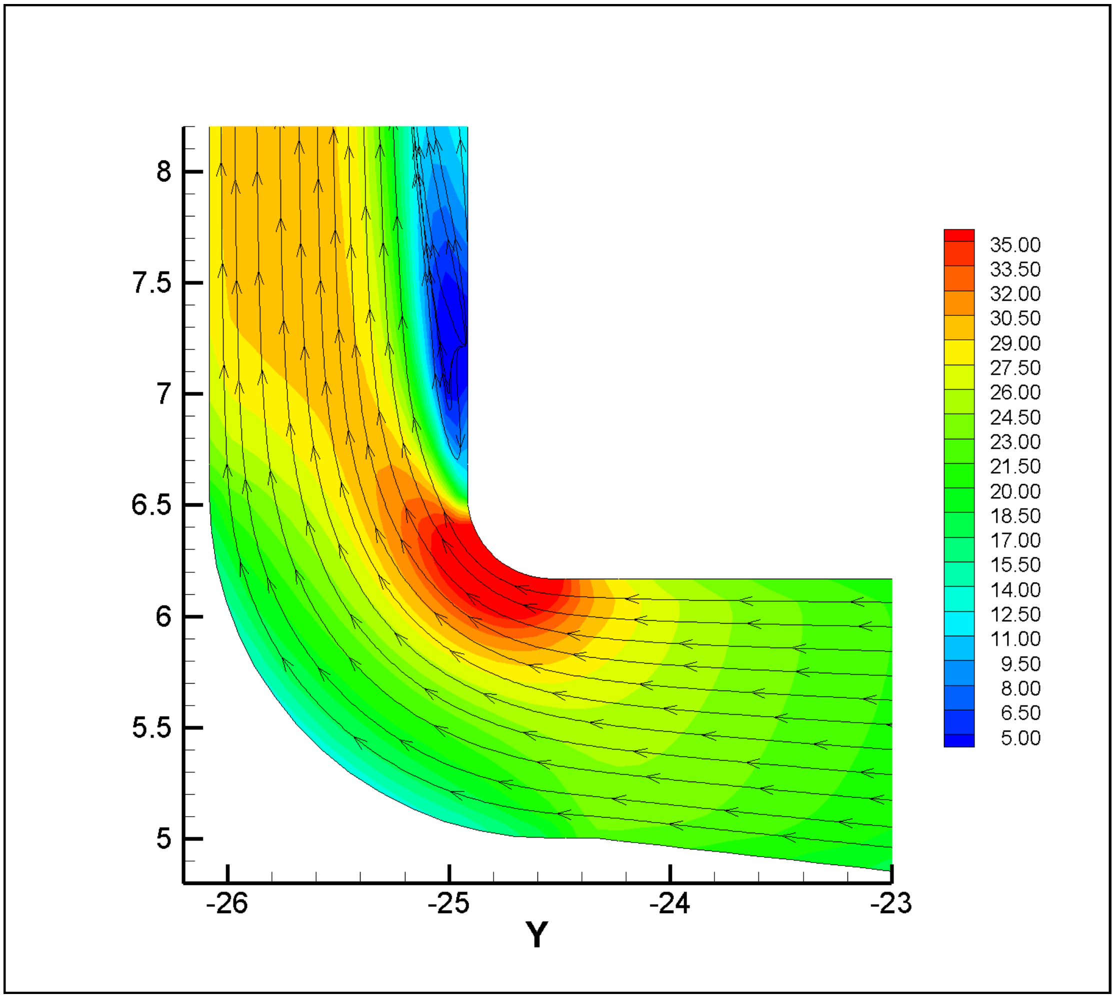


Figure 2 – Example of flow separation occurring through a short radius elbow, similar to the Station 12 configuration

With an average velocity of more than 11 fps on the suction to pump 2B and more than 18 fps on the suction to pump 2A, flow separation is likely occurring. The significant variation in velocity as the flow turns upward into the pump impeller places a higher load on the impeller as it passes the backside of the elbow. This load differential stresses the pump shaft, deflecting it to some extent, resulting in bearing wear. Once bearings begin to wear out, noise becomes prevalent along with other issues. This bearing failure could be contributing to the noise observed in Station 12.

Pre-Rotation – Given the configuration of the piping as flow is discharged from pump 2B and on to 2A, the flow hydraulics will have a tendency to rotate clockwise, the same direction as the pump 2A impeller. This pre-rotation condition effectively prevents the pump 2A impeller from “biting” into the flow stream as the pump was intended. With a diminished “bite” into the flow stream, the pump capacity is consequently diminished as well.

Recommendations

The addition of a drop pipe on the influent sewer in 2014 reduced the cascading effect in the wet well and appears to have reduced the noise in the pumping systems. As testing was not conducted prior to the addition of this feature, this perception cannot be confirmed. However, through continued observation of the inside of the pumps, a reduction in rate of wear would indicate that this is likely.

Regarding other near-term improvements, it is recommended that the pump bearings, particularly in Pump 2B be evaluated for potential replacement. With the imbalanced load on the impeller, it is likely that pump bearings are wearing out more frequently than most of the City's other pumps.

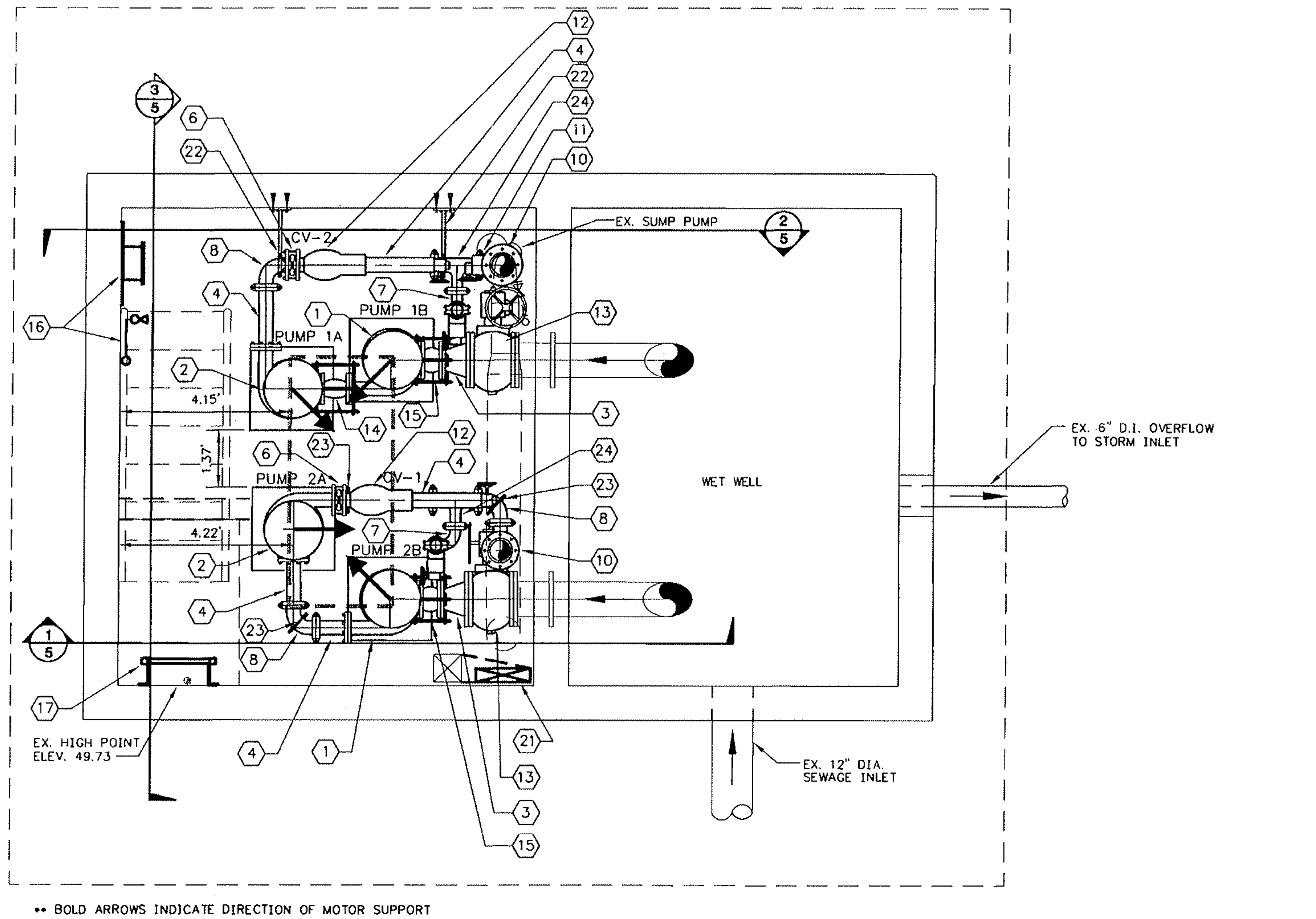
The ultimate solution for this station is to replace the mechanical piping and pumping system to improve the overall hydraulics. The piping should be sized and configured to comply with HI standards to the greatest extent possible given the existing structure. This will almost certainly require the second stage pump to be located on the second level of the station, which will drive structural modifications.

The pumps, given the location on the pump curve at which they are operating, should not be relocated but rather replaced. Replacement of the pumps should also include replacement of the drivers (the VFDs), as they may not be compatible with the new pumps and the electronic system will have exceeded its typical lifespan. Attempting to reuse the VFDs would present a reliability issue. Planning level cost estimate for this future rehabilitation, only including the piping, structural modifications, and driver system is presented in Table 1.

Table 1 | Mechanical System Rehabilitation Cost Estimate

Description	Estimated Cost Range
Mobilization	$10,000 - $20,000
Bypass pumping system	$20,000 - $40,000
Structural modifications	$50,000 - $100,000
Piping	$15,000 - $25,000
Pumps and motors	$100,000 - $120,000
Drivers and wiring	$100,000 - $120,000
Programming/integration	$10,000 - $15,000
Subtotal	**$305,000 - $440,000**
Ancillary allowance (30%)	$92,000 - $132,000
Total	**$397,000 - $572,000**

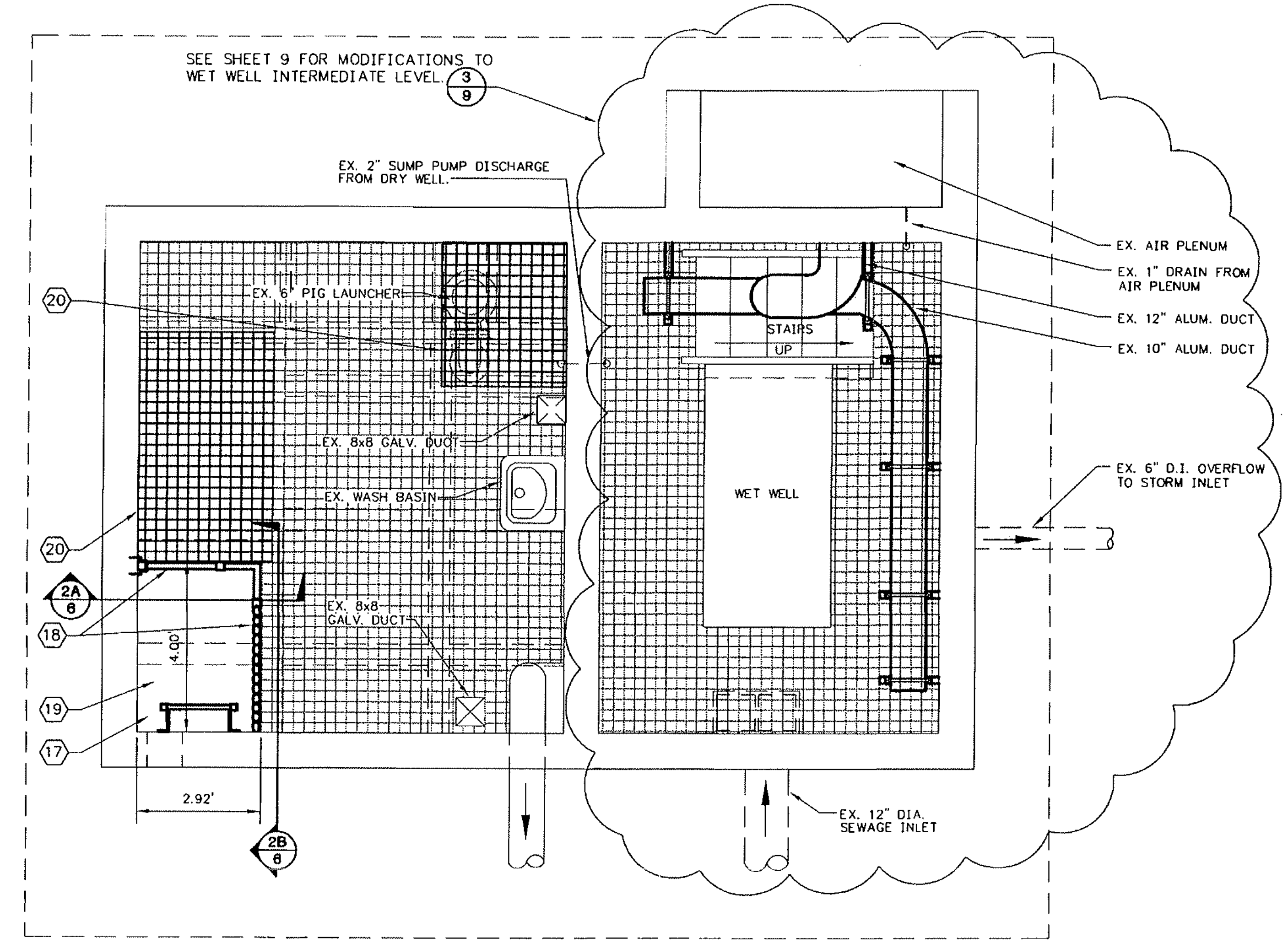
Attachment A - Station 12 Design Drawings



** BOLD ARROWS INDICATE DIRECTION OF MOTOR SUPPORT SIDE ASSEMBLY SLOT ORIENTATION.

1/VAR PLAN - PUMP ROOM (LOWER LEVEL)

SCALE: 1"=2'



2/VAR PLAN - INTERMEDIATE LEVEL

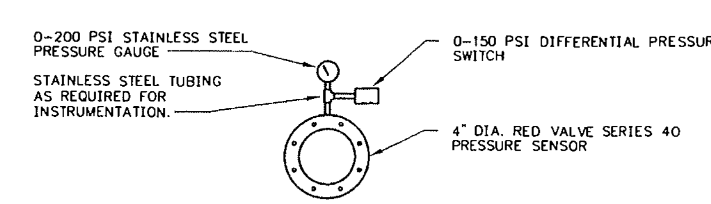
SCALE: 1"=2'

KEY NOTES

1. PUMP CONFIGURATION B W/ 6"x4" REDUCING INLET ELBOW AND 180° INLET/OUTLET CONFIGURATION. SEE SPECIFICATIONS.
2. PUMP CONFIGURATION A W/ 4" INLET ELBOW AND 90° INLET/OUTLET CONFIGURATION. SEE SPECIFICATIONS.
3. 10"x6" FABRICATED STEEL ECCENTRIC REDUCER (FL) (LENGTH=8")
4. 4" GROOVED D.I. SPOOL. VERIFY DIMENSION IN FIELD.
5. 3" GROOVED D.I. SPOOL. VERIFY DIMENSION IN FIELD.
6. 4" DIA. STEEL WAFER STYLE PRESSURE SENSOR WITH BUNA-N SLEEVE, RED VALVE SERIES 40 OR ENGINEER APPROVED EQUAL. PRESSURE SENSOR TO BE EQUIPPED WITH A STAINLESS STEEL 0-200 PSI PRESSURE GAUGE, A 0-150 PSI PRESSURE SWITCH, AND SCREWED CAP PORT FOR TEST GAUGES. SEE DETAIL 3/4
7. 3" 90° GROOVED D.I. SHORT ELBOW
8. 4" 90° GROOVED D.I. SHORT ELBOW
9. 6"x4" GROOVED D.I. ECCENTRIC REDUCER
10. 6"x4" GROOVED D.I. CONCENTRIC REDUCER
11. 4" VIC-PLUG VALVE W/ HAND WHEEL AND MX GEAR BOX INSTALL WITH SEAT TOWARDS PUMPS AND INSURE THAT PLUG ROTATES UP WHEN OPEN.
12. 4" SEWAGE CHECK VALVE (FL), ANGLE PATTERN. SEE SPECIFICATIONS.
13. 10" ECCENTRIC PLUG VALVE (FLxFL) W/ 12" DIA. HAND WHEEL. INSTALL WITH SEAT TOWARDS PUMP AND INSURE THAT PLUG UP WHEN OPEN.
14. 4" DIA. x 8" LENGTH PROCO EXPANSION JOINT W/ 3 PROCO CONTROL RODS.
15. 6" DIA. x 6" LENGTH PROCO SINGLE SPHERE EXPANSION JOINT W/ 3 PROCO CONTROL RODS.
16. RELOCATE EX. HOSE BIB AND RACK TO THIS LOCATION. REPLACE ANY WORN OR DAMAGED PARTS.
17. FIBERGLASS LADDER. SEE DETAIL 1/6
18. FIBERGLASS HANDRAIL W/ STEEL SAFETY CHAIN ACROSS OPENING. SEE DETAIL 2/6
19. OPENING FOR LADDER. REMOVE EXISTING GRATING. SEE STRUCTURAL PLAN.
20. FIBERGLASS GRATING AND SUPPORT MODIFICATIONS. SEE STRUCTURAL PLAN.
21. FABRICATED STAINLESS STEEL DUCT TRANSITION FROM EX. 8x8 DUCT TO 4x16 DUCT. OFFSET 16" CENTER TO CENTER. 4x16 STAINLESS STEEL DUCT TO EXTEND TO 2.0' ABOVE FINISH FLOOR. SEE SECTION. 3/5
22. STAINLESS STEEL ARM PIPE SUPPORT. SEE DETAIL 8/6
23. STANDING PIPE SUPPORT. SEE DETAIL 5/6
24. 4"x3" GROOVED D.I. TEE (HORIZONTAL)

NOTES

1. ALL GROOVED SPOOLS, FITTINGS, AND VALVES SHALL BE CONNECTED TO OTHER SPOOLS, FITTINGS, AND VALVES WITH EITHER STYLE 31 VICTAULIC COUPLING (GROOVExGROOVE) OR STYLE 341 VIC-FLANGE ADAPTER (GROOVExFL) OR APPROVED EQUAL.
2. D.I. PIPE SHALL BE THICKNESS CLASS 53 MIN.
3. ALL HARDWARE SHALL BE STAINLESS STEEL.



3/4 DETAIL - PRESSURE SENSOR

N.T.S.

CALL 72 HOURS BEFORE YOU DIG 1-800-424-5555

REVISED TO CONFORM TO CONSTRUCTION RECORDS
BY MB
CHECKED DV
DATE 12-04

NO.	DATE	BY	APPR.	REVISIONS
1	11/3	MB	DV	LAYOUT REVISED FOR ANGLE VALVE AND PUMPS

CHS
CHS ENGINEERS INC.
12507 BEL-RED ROAD SUITE 101
BELLEVUE, WA 98005-2500
TEL (425) 637-3693 FAX (425) 637-3694

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DAVID R. VOIGT, STATE OF WASHINGTON, 29424, REGISTERED PROFESSIONAL ENGINEER, EXPIRES: 10/11/
SCOTT CHRISTENSEN, STATE OF WASHINGTON, 16677, REGISTERED PROFESSIONAL ENGINEER, EXPIRES: 10/20/

Approved By

DESIGN MANAGER	DATE
CHIEF ENGINEER	DATE
PROJECT ENGINEER	DATE

DV/MB DESIGNED BY	6-03 DATE
MB DRAWN BY	6-03 DATE
SC CHECKED BY	6-03 DATE

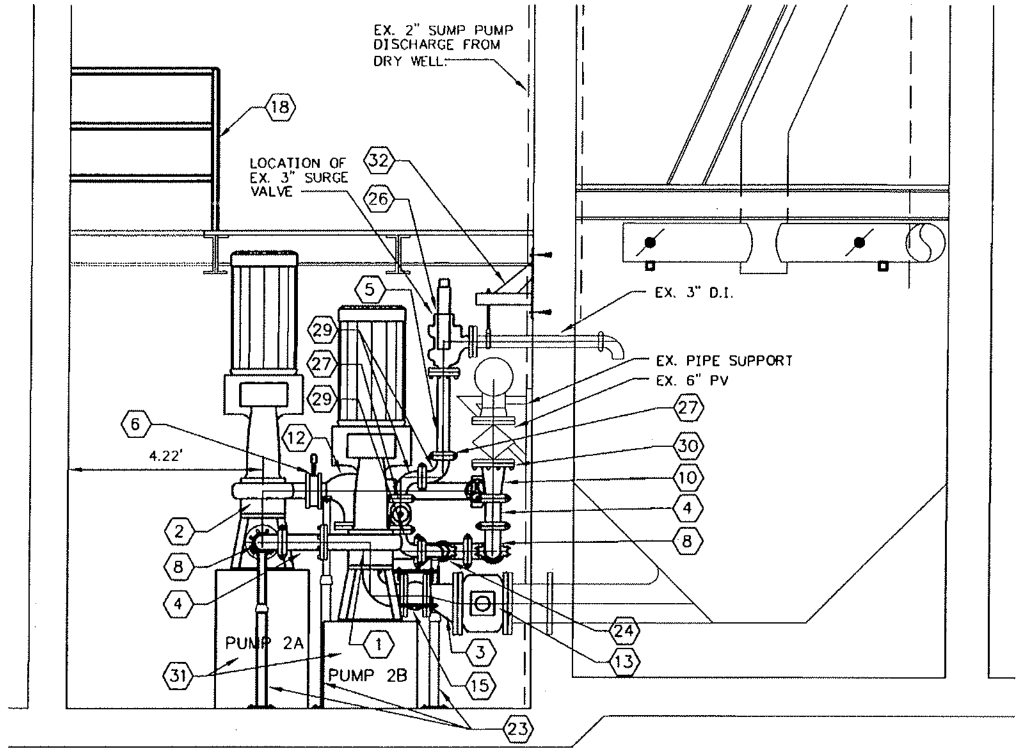
City of Bellevue
Dept. of Public Works & Utilities

PUMP STATION #12
PUMP REPLACEMENT & ODOR ABATEMENT

PUMP REPLACEMENT - LOWER AND INTERMEDIATE LEVEL FLOOR PLANS

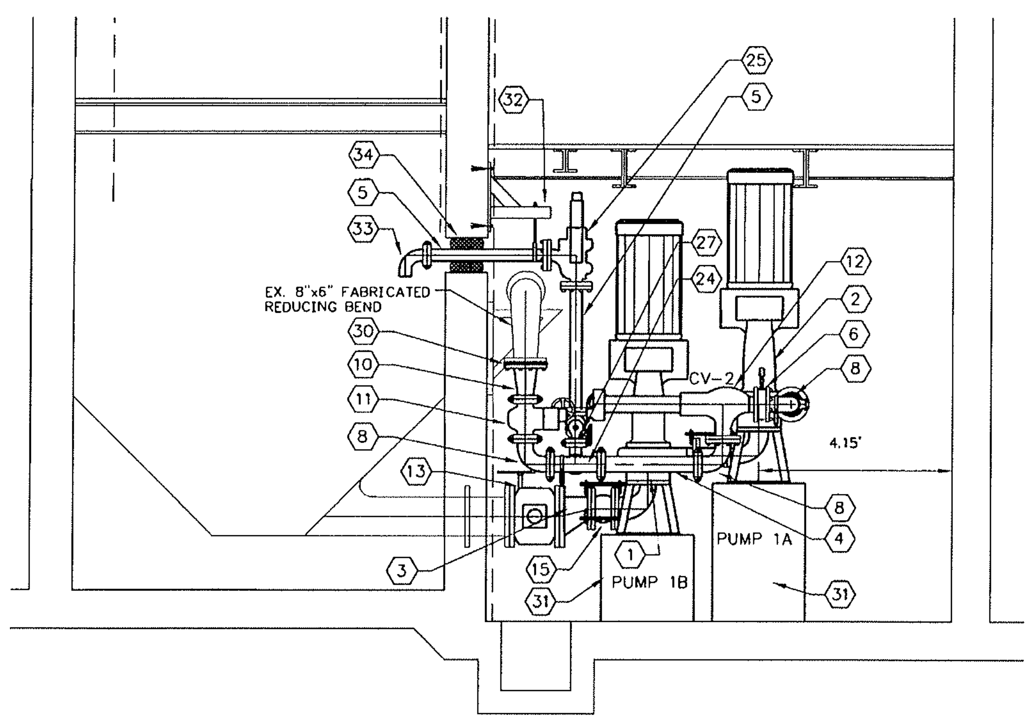
GRID M-8 SECT. 36-25-5 SHT 4 OF 17

22-BELLEVUE\22113-LS12&BAGLEY ODOR\CAD-22113\22113-LS12-PLANS&DETAILS.DWG PLOT 1:1 12-9-04



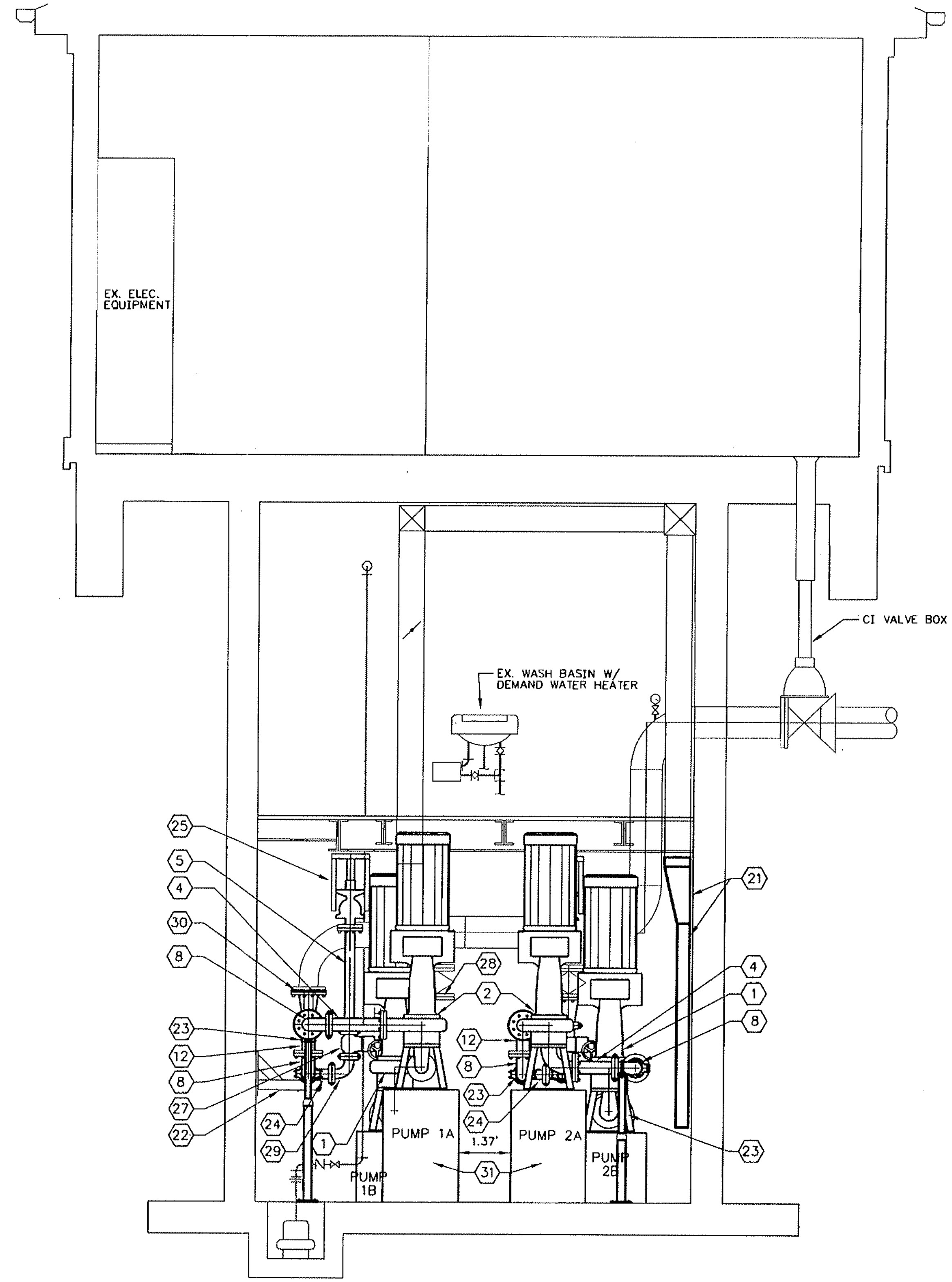
SECTION - PUMPS 1A AND 1B (1/4)

SCALE: 1"=2'



SECTION - PUMPS 2A AND 2B (2/4)

SCALE: 1"=2'



ELEVATION - PUMPS (3/4)

SCALE: 1"=2'

KEY NOTES

SEE SHEET 4 FOR KEY NOTES 1 TO 23.

25. SURGE VALVE TO MATCH EXISTING (GA 625 SEWAGE VALVE).
26. REPLACE EX. SURGE VALVE IN KIND (GA 625 SEWAGE VALVE). CONNECT TO PUMPS 2A AND 2B PIPING.
27. 3" VIC-PLUG VALVE W/ HAND WHEEL AND MX GEAR BOX. SEAT FACES DOWN.
28. 6" D.I. BLIND FLANGE
29. 3" GROOVED 90° BEND
30. 6" D.I. FLANGE SPACER. DETERMINE DIMENSIONS IN FIELD.
31. REINFORCED CONCRETE PUMP PEDESTAL. HEIGHTS VARY, DETERMINE IN FIELD. SEE DETAIL. (3/6)
32. STEEL ARM PIPE SUPPORT, HANGING OPTION. SEE DETAIL (6/6)
33. 3" 90° GROOVED ELBOW
34. CORE DRILL CONC. WALL PENETRATION AND SEAL WITH LINK SEAL MODEL S-316 (STAINLESS STEEL BOLTS AND EPDM RUBBER) OR APPROVED EQUAL.

CALL 72 HOURS BEFORE YOU DIG 1-800-424-5555

REVISED TO CONFORM TO CONSTRUCTION RECORDS

BY MB

CHECKED DV

DATE 12-04

NO.	DATE	BY	APPR.	REVISIONS
1	11/3	MB	DV	LAYOUT REVISED FOR ANGLE VALVE AND PUMPS

CHS
12507 BEL-RED ROAD SUITE 101
BELLEVUE, WA 98005-2500
CHS ENGINEERS INC. TEL (425) 637-3693 FAX (425) 637-3694

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DAVID R. VOIGT — STATE OF WASHINGTON — 29424 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES: 10/11/

SCOTT CHRISTENSEN — STATE OF WASHINGTON — 16577 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES: 10/20/

Approved By

DESIGN MANAGER	DATE	DV/MB DESIGNED BY	6-03 DATE
CHIEF ENGINEER	DATE	MB DRAWN BY	6-03 DATE
PROJECT ENGINEER	DATE	SC CHECKED BY	6-03 DATE

City of Bellevue
Dept. of Public Works & Utilities

PUMP STATION #12
PUMP REPLACEMENT & ODOR ABATEMENT

PUMP REPLACEMENT SECTIONS

GRID M-8 SECT. 36-25-5 SHT 5 OF 17

22-BELLEVUE\22113-LS12&BAGLEY ODOR\CAD-22113\22113-LS12-PLANS&DETAILS.DWG PLOT 1:1 12-9-04

Attachment B - Station 12 Testing Forms

Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 ■ Everett, WA 98201-3566 ■ PHONE 425.252.9003 ■ FAX 425.252.8853

PUMP TESTING PLAN – Normal Wet Well Elevation - Full Speed Test
Allow pumping system to start normally. Start timing and drawdown measurement once pumps hit full speed (measured by tachometer) and check valve is open.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	7.5′	Brian
Pump B Discharge Pressure, psi	64	Brian
Pump A Discharge Pressure, psi	124- glycerin (160 psi)	Brian
Force main discharge pressure, psi	114	Shelby
Pump B tach speed, rpm	1765	Brian
Pump A tach speed, rpm	1765	Brian
VFD input speed, Hz	59	City
Motor B current A/B/C, amps	46.1/46.3/46.5	City
Motor A current A/B/C, amps	44.2/44.0/44.1	City
Drawdown, inches	21	Brian/Shelby
Pump time, min:sec	2:04	Shelby
Fill time, min:sec	18" fill, 7:30	Shelby

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface	Grease	Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise	More than A	Brian
Pump A vibration/noise	Sounds pretty good	Brian

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 ■ Everett, WA 98201-3566 ■ PHONE 425.252.9003 ■ FAX 425.252.8853

PUMP TESTING PLAN – Normal Wet Well Elevation - Low Speed Test
Manual operation of pumps and check valve. Start pumps at 85% speed. Once Pump A discharge pressure exceeds 100-105 psi (static head), open check valve. Adjust pump speed so that pumping system discharge pressure is slightly above static without resulting in an unnecessarily long test (consider influent rate and exceed pumping rate on curve). Start pump testing once speed is constant.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	8′ 0"	Brian
Pump B Discharge Pressure, psi	56	Brian
Pump A Discharge Pressure, psi	105	Brian
Force main discharge pressure, psi	102	Shelby
Pump B tach speed, rpm	1500	Brian
Pump A tach speed, rpm	1500	Brian
VFD input speed, Hz	50	City
Motor B current A/B/C, amps	30.6/30.1/30.5	City
Motor A current A/B/C, amps	28.9/30.0/29.9	City
Drawdown, inches	6	Brian/Shelby
Pump time, min:sec	2:20	Shelby
Fill time, min:sec	5" fill, 3:22	Shelby

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface		Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise	More noise than A	Brian
Pump A vibration/noise		Brian

PUMP TESTING PLAN – High Wet Well Elevation - Full Speed Test
Allow pumping system to start normally. Start timing and drawdown measurement once pumps hit full speed (measured by tachometer) and check valve is open.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	8′-7"	Brian
Pump B Discharge Pressure, psi	64	Brian
Pump A Discharge Pressure, psi	120	Brian
Force main discharge pressure, psi	114	Shelby
Pump B tach speed, rpm	1770	Brian
Pump A tach speed, rpm	1770	Brian
VFD input speed, Hz	59.2	City
Motor B current A/B/C, amps	46.5/46.0/46.7	City
Motor A current A/B/C, amps	43.5/43.5/43.0	City
Drawdown, inches	14	Brian/Shelby
Pump time, min/sec	1:22	Shelby
Fill time, min/sec	12" fill, 5:42	Shelby

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface		Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise		Brian
Pump A vibration/noise		Brian

Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 ■ Everett, WA 98201-3566 ■ PHONE 425.252.9003 ■ FAX 425.252.8853

PUMP TESTING PLAN – High Wet Well Elevation - Low Speed Test
Manual operation of pumps and check valve. Start pumps at 85% speed. Once Pump A discharge pressure exceeds 100-105 psi (static head), open check valve. Adjust pump speed so that pumping system discharge pressure is slightly above static without resulting in an unnecessarily long test (consider influent rate and exceed pumping rate on curve). Start pump testing once speed is constant.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	8′-7"	Brian
Pump B Discharge Pressure, psi	56	Brian
Pump A Discharge Pressure, psi	105	Brian
Force main discharge pressure, psi	102	Shelby
Pump B tach speed, rpm	1500	Brian
Pump A tach speed, rpm	1500	Brian
VFD input speed, Hz	50.24	City
Motor B current A/B/C, amps	30.1/30.8/31.0	City
Motor A current A/B/C, amps	29.3/30.0/29.5	City
Drawdown, inches	7	Brian/Shelby
Pump time, min/sec	3:37	Shelby
Fill time, min/sec	9" fill, 5:26	Shelby

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface		Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise	Little to no cav noticed- maybe bearing	Brian
Pump A vibration/noise	No cav noticed	Brian

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 ■ Everett, WA 98201-3566 ■ PHONE 425.252.9003 ■ FAX 425.252.8853

PUMP TESTING PLAN – Low Wet Well Elevation - Full Speed Test
Allow pumping system to start normally. Start timing and drawdown measurement once pumps hit full speed (measured by tachometer) and check valve is open.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	6′ 3"	Brian
Pump B Discharge Pressure, psi	Approximately 40- plugged	Brian
Pump A Discharge Pressure, psi	120	Brian
Force main discharge pressure, psi	114	Brian
Pump B tach speed, rpm		Brian
Pump A tach speed, rpm		Brian
VFD input speed, Hz	59.24	City
Motor B current A/B/C, amps	44.6/45/45	City
Motor A current A/B/C, amps	42.6/42.6/42.7	City
Drawdown, inches	22	Brian
Pump time, min/sec	2:34	Brian
Fill time, min/sec	18" fill, 6:20	Brian

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface	Turbulent-no vortexing observed	Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise	Constant 105 db 102-106 db	Brian
Pump A vibration/noise	Constant 105 db 102-106 db	Brian

MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
2707 Colby Avenue, Suite 1110 ■ Everett, WA 98201-3566 ■ PHONE 425.252.9003 ■ FAX 425.252.8853

PUMP TESTING PLAN – Low Wet Well Elevation - Low Speed Test
Manual operation of pumps and check valve. Start pumps at 85% speed. Once Pump A discharge pressure exceeds 100-105 psi (static head), open check valve. Adjust pump speed so that pumping system discharge pressure is slightly above static without resulting in an unnecessarily long test (consider influent rate and exceed pumping rate on curve). Start pump testing once speed is constant.

Quantitative Items – TEST A

	Measurement	Responsible Individual
Suction Level (ft above floor)	6′ 7"	Brian
Pump B Discharge Pressure, psi	Bad	Brian
Pump A Discharge Pressure, psi	105	Brian
Force main discharge pressure, psi	102	Brian
Pump B tach speed, rpm		Brian
Pump A tach speed, rpm		Brian
VFD input speed, Hz	50.25	City
Motor B current A/B/C, amps	30/30.3/30.5	City
Motor A current A/B/C, amps	29.2/30/30	City
Drawdown, inches	6	Brian
Pump time, min/sec	6:15	Brian
Fill time, min/sec	12" fill, 4:59	Brian

Qualitative Considerations – TEST B

	Observation	Responsible Individual
Wet Well Surface		Brian
Pump B vent tube discharge		Brian
Pump A vent tube discharge		Brian
Pump B vibration/noise	90-95 db	Brian
Pump A vibration/noise	90-95 db	Brian

APPENDIX B ENVIRONMENTAL IMPACT STATEMENT

LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT PLAN

SEPA Final Environmental Impact Statement

Prepared for
City of Bellevue

June 2024

LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT PLAN

SEPA Final Environmental Impact Statement

Prepared for
City of Bellevue

June 2024

2801 Alaskan Way
Suite 200
Seattle, WA 98121
206.789.9658
esassoc.com

Atlanta	Palm Beach County	San Diego
Bend	Pasadena	San Francisco
Irvine	Pensacola	San Jose
Los Angeles	Petaluma	Sarasota
Mobile	Portland	Seattle
Oakland	Rancho Cucamonga	Tampa
Orlando	Sacramento	Thousand Oaks

D201901003.02

OUR COMMITMENT TO SUSTAINABILITY | ESA helps a variety of public and private sector clients plan and prepare for climate change and emerging regulations that limit GHG emissions. ESA is a registered assessor with the California Climate Action Registry, a Climate Leader, and founding reporter for the Climate Registry. ESA is also a corporate member of the U.S. Green Building Council and the Business Council on Climate Change (BC3). Internally, ESA has adopted a Sustainability Vision and Policy Statement and a plan to reduce waste and energy within our operations. This document was produced using recycled paper.

City of
Bellevue

Post Office Box 90012 ▪ Bellevue, Washington ▪ 98009 9012

June 27, 2024

Lake Washington Wastewater Lake Line Management Plan Final Environmental Impact Statement

Dear Interested Parties:

The City of Bellevue Utilities Department is developing a management plan to identify long-range operational and capital improvement strategies for the future repair, replacement and maintenance of the existing sewer line located underwater or on land adjacent to Lake Washington. The Lake Washington Wastewater Lake Line (LWWLL) system includes approximately 14.6 miles of sewer lines, as well as 15 pump stations and 8 flush stations. Improvements included in the Management Plan to the LWWLL would be located along the shoreline of Lake Washington throughout the following jurisdictions: Bellevue, Beaux Arts, Medina, Hunts Point, Yarrow Point, and unincorporated King County.

The City of Bellevue Development Services Department is the Lead Agency under the State Environmental Policy Act (SEPA) for the proposal and issued a Draft Programmatic (non-project) Environmental Impact Statement (EIS) for the environmental review of the adoption of the Management Plan. Public comments were received on the Draft EIS for 30-day comment period. Comments received are included in Appendix D: Draft EIS Comments and Responses, along with responses to each comment. The EIS has been prepared in accordance with Chapter 197-11 WAC.

The EIS evaluated four alternatives:

- In-Water Alternative
- On-Shore Alternative
- Upland Alternative
- No Action Alternative

Bellevue Utilities Department is reviewing information about the lake line system to develop strategies for future repair, replacement, or maintenance for the six defined Service Areas in the management plan area. Some sections may not require work; others will require repair, replacement, or maintenance. The City will use the LWWLL Management Plan to identify long-range operational and capital improvement strategies for the future repair, replacement, and maintenance of the existing sewer line located underwater or on land adjacent to Lake Washington. In combination with the identification of the preferred alternative (In-Water, Onshore, or Upland Alternative) for future repair and replacement of the aging system, further evaluation and analysis will be performed to determine the best-suited construction method(s) at individual location(s) to implement the operational and capital improvement strategies. Improvements at the pump stations will be evaluated in each Service Area as part of the alternative selection process. The City will select the alternative(s) to be implemented based on several evaluation factors such as environmental, regulatory, social, technical, and cost. Different alternatives may be selected depending on the Service Area.

The Management Plan will be incorporated as an appendix to the City's Wastewater System Plan at the time the Wastewater System Plan is next updated. The current version of the system plan is the Wastewater System Plan adopted by City Council via Resolution 8771 in July 2014 and adopted by King County Council via Ordinance 17968 in February 2015. The plan was approved by the Washington State Department of Ecology (Ecology) in May 2015. At the time of the publication of the Management Plan (expected June 2024), the City expects that updates to the Wastewater System Plan will begin in 2024, followed by the adoption of the Wastewater System Plan (including the Management Plan as an appendix) by City Council.

Implementation of any projects identified in the Management Plan would require a number of permits and approvals from the local jurisdiction prior to construction.

Under SEPA, the Final EIS may be appealed only after the City of Bellevue has taken a specific governmental action, in accordance with RCW 43.21C.075 and WAC 197-11-680. Any appeal of this Final EIS, must wait until action by the City Council to adopt the Management Plan. Notice of the action and specific appeal information will be provided at the time of the action.

The Final and Draft EIS and additional background materials are available for viewing online and can be downloaded from the City's website at https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line.

Thank you for your interest in the Lake Washington Wastewater Lake Line Management Plan.

Sincerely,

Reilly Pittman

Reilly Pittman
Environmental Planning Manager and SEPA Responsible Official
Development Services Department

FACT SHEET

City of Bellevue Lake Line Management Plan SEPA Final Environment Impact Statement

Proposal Title

Lake Washington Wastewater Lake Line (LWWLL) Management Plan (the Management Plan, or the Plan)

Proposed Action

The following alternatives were identified for evaluation in this Programmatic Environmental Impact Statement (EIS):

- In-Water Alternative
- On-Shore Alternative
- Upland Alternative
- No Action Alternative

Location

Improvements included in the Management Plan to the LWWLL would be located along the shoreline of Lake Washington throughout the following jurisdictions (referred to as Service Areas):

- Bellevue
- Beaux Arts
- Medina
- Hunts Point
- Yarrow Point
- King County

Plan Proponent and Lead Agency

City of Bellevue
Bellevue Utilities
450 110th Avenue NE
Bellevue, WA 98004

Project Information / Background Data Contact Person

Angela Chung, PE, LEED-AP
Senior Utilities Engineer
Phone: (425) 452-4320
Email: LkWaLakeLine@bellevuewa.gov

State Environmental Policy Act (SEPA) Lead Agency, Responsible Official, and Contact Information

City of Bellevue Development Services Department
Reilly Pittman, Environmental Planning Manager and SEPA Responsible Official
Development Services Department
Email: LakeLineEIS@bellevuewa.gov

Authors and Principal Contributors to this EIS

This Final Environmental Impact Statement (EIS) has been prepared in coordination with Bellevue Utilities. The following consulting firms provided research and analysis associated with this EIS:

- **Environmental Science Associates (ESA)** – Lead EIS consultant, document preparation; writing of all EIS sections.
- **Carollo Engineers, Inc.** – Lead Management Plan consultant, writing and analysis of the Management Plan.
- **Confluence Environmental Company** – Assisting consultant, writing and preparation of the Management Plan Aquatic Impacts Assessment.
- **Ahern Management Consulting** – Technical consultant for the City of Bellevue.

Date of Issuance of Final EIS

June 27, 2024

Date of Issuance of Draft EIS

April 6, 2023

Due Date of the Draft EIS Comments

Comments were received on the Draft EIS for a 30-day comment period and were required to be postmarked or emailed on or before midnight on May 8, 2023.

Date of the Draft EIS Public Hearing

A virtual public meeting on the Management Plan and a public hearing on the Draft EIS were held simultaneously on Tuesday, April 18, 2023, from 5:00 to 6:00 p.m. on the Zoom platform and made available on the City's website at https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line. Attendees were able to sign up in advance or at the meeting to provide oral comments during the meeting. The meeting was recorded and transcribed, and responses to the comments are provided in this Final EIS as **Appendix D, Draft EIS Comments and Responses**.

The purpose of the public hearing was to provide an opportunity for individuals, agencies, and organizations to review information presented in the Draft EIS and to present oral or written comments on the Draft EIS.

Organization of the Final EIS

The Draft EIS laid the foundation for the initial environmental analysis that was conducted and is a companion document to this Final EIS and is incorporated by reference in accordance with Washington Administrative Code (WAC) 197-11-635. The Draft EIS chapters updated for the Final EIS include Chapter 1, *Introduction & Summary*, Chapter 2, *Description of the Lake Washington Lake Line Management Plan and Alternatives*, and Chapter 8, *References and Source Material*, to account for further development of the Management Plan and comment responses. No further Draft EIS chapters were updated, including any changes to conclusions or the significance of impacts, and are not included in the Final EIS. Two appendices have been included in addition to the Draft EIS appendices. Comments received on the Draft EIS and responses are included as part of this Final EIS in **Appendix D, Draft EIS Comments and Responses**. The **Lake Washington Wastewater Lake Line Management Plan Community Outreach Summary** is included as **Appendix E**. Appendices A through C are included with the Draft EIS and are not reproduced in the Final EIS.

Appeals Process

Under SEPA, the Final EIS may be appealed only after the City of Bellevue has taken a specific governmental action, in accordance with Revised Code of Washington (RCW) 43.21C.075 and WAC 197-11-680. Any appeal of this Final EIS, the non-project proposal, will be considered along with an appeal of the City Council's adoption of the Management Plan, per WAC 197-11-680 (3)(iii). Further, any appeal of the SEPA determination made with the project decision, in this case City Council adoption of this Final EIS via the approval of the Management Plan, must be filed within 14 days after the notice of the decision (City Council approval) under RCW 36.70B.130.

Document Availability

The Final and Draft EISs and additional background materials are available for viewing online and can be downloaded from the City's website at https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line.

Selection of a Preferred Alternative

The City of Bellevue and the Management Plan team reviewed information about the lake line system to develop strategies for the future repair, replacement, or maintenance for the six defined Service Areas in the Management Planning area. Some sections may not require work; others will require repair, replacement, or maintenance. The City may use the Lake Washington Wastewater Lake Line Management Plan to identify long-range operational and capital improvement strategies for the future repair, replacement, and maintenance of the existing sewer line located underwater or on land adjacent to Lake Washington. This programmatic environmental analysis, in addition to the Management Plan, will serve as a resource to analyze environmental effects and contribute to identifying improvements needed to repair and/or replace the lake line system. These improvements would likely include different future site-specific projects or alternative(s) in each Service Area. In combination with the identification of the preferred alternative(s) (In-Water, Onshore, or Upland Alternative) for future repair and replacement of the aging system, further evaluation and analysis will be performed to determine the best-suited construction method(s) at individual location(s) to implement the operational and capital improvement strategies.

Improvements at the pump stations will be evaluated in each Service Area as part of the alternative selection process. The City may select the alternative(s) to be implemented based on several evaluation factors such as environmental, regulatory, social, technical, and cost. Different alternatives may be selected depending on the Service Area.

The Management Plan will be incorporated as an appendix to the City's Wastewater System Plan at the time the Wastewater System Plan is next updated. The current version of the system plan is the Wastewater System Plan adopted by City Council via Resolution 8771 in July 2014 and adopted by King County Council via Ordinance 17968 in February 2015. The plan was approved by the Washington State Department of Ecology (Ecology) in May 2015. At the time of the publication of the Management Plan (in June 2024), the City expects that updates to the Wastewater System Plan will begin in 2024, followed by the adoption of the Wastewater System Plan (including the Management Plan as an appendix) by City Council.

The City continued soliciting input on the Management Plan from the public and other interested parties during and following the Draft EIS comment period. Identification of preferred alternatives is expected to occur following release of the Final EIS in mid-2024.

Timing of Additional Environmental Review

The analysis presented in this EIS is programmatic in nature. Programmatic plans typically establish broad policies or guidelines for future actions or projects, potentially affecting various aspects of the environment. The City Council's adoption of the Management Plan is the SEPA action as the approval process involves governmental decision-making that may result in environmental impacts. The EIS has been prepared to disclose probable significant adverse impacts associated with implementation of the Management Plan to repair, replace, and/or maintain the aging Lake Washington wastewater system. As individual improvements are identified in each Service Area, site-specific environmental review will be conducted prior to implementation. Depending on the preferred alternative(s) selected in each Service Area and the amount of time needed to obtain regulatory approval of the Management Plan, some projects and actions may be ready for site-specific environmental review starting in 2025.

Potential Required Approvals or Permits

Because alternatives and construction methods have not been selected for any improvements, it is not possible to present a complete list of approvals and permits that would be required for future improvements. It is possible to identify the most common types of approvals and permits that would generally be required for the types of improvements presented in the Management Plan.

Potential approvals and permits are listed below by jurisdictional agency.

- Federal
  - Section 10 or Section 404 Permit – U.S. Army Corps of Engineers (Corps)
  - Regional General Permits (RGP) or the Nationwide Permit (NWP) Program – Corps (Dredged Material Management Office [DMMO])
  - Endangered Species Act Consultation – National Marine Fisheries Service (NMFS) and/or U.S. Fish and Wildlife Service (USFWS)
- State
  - National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit –Ecology
  - Section 401 Water Quality Certification – Ecology
  - Shoreline Conditional Use Permit, or Variance – Ecology
  - Hydraulic Project Approval (HPA) – Washington Department of Fish and Wildlife (WDFW)
  - Section 106 National Historic Preservation Act – Department of Archaeology and Historic Preservation (DAHP)
  - Executive Order 21-02 Consultation – DAHP
  - Open Water Disposal Site Use Authorization – Washington Department of Natural Resources (WDNR)
- Local Jurisdictions
  - SEPA compliance
  - Environmentally Critical Areas Review/Approval
  - Land Use Permit
  - Shoreline Permit(s)
  - Building and Related Permit(s)
  - Clearing and Grading Permit(s)
  - Right-Of-Way Use Permit(s)
  - Street Use Permit(s)

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CONTENTS

City of Bellevue Lake Line Management Plan SEPA Final Environment Impact Statement

Appendices (Appendices A, B, and C are included with the Draft EIS. Appendices D and E are new and included with the Final EIS)

Figures

Tables

ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
AC	asbestos cement
ADA	Americans with Disabilities Act
AP	Analytic Period
BACT	Best Available Control Technology
BAVMC	Beaux Arts Village Municipal Code
BCC	City of Bellevue Land Use Code
BMPs	best management practices
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	Capital Improvement Plan
CIPP	cured-in-place pipe
City	City of Bellevue
Corps	U.S. Army Corps of Engineers
CSWPPP	Construction Stormwater Pollution Prevention Plan
DAHP	Department of Archaeology and Historic Preservation
dB	decibel(s)
dBA	A-weighted decibels
DMMO	Dredged Material Management Office
DO	dissolved oxygen
DU	dwelling unit
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FHWA	Federal Highway Administration
FMO	foraging, migration, and overwintering
FMR	fire-modified rock
FOG	fats, oils, and grease
FR	Federal Register
GIS	geographic information system
GMA	Growth Management Act
HGL	hydraulic grade line
HPA	Hydraulic Project Approval

Abbreviation	Definition
I&I	infiltration and inflow
I-405	Interstate 405
I-90	Interstate 90
IDP	Inadvertent Discovery Plan
IPaC	Information for Planning and Consultation
KCC	King County Code
L_{eq}	equivalent continuous sound pressure level
LUC	Land Use Code
LWWLL	Lake Washington Wastewater Lake Line
MMC	Medina Municipal Code
MUTCD	Manual on Uniform Traffic Control Devices
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTUs	Nephelometric turbidity units
NWP	Nationwide Permit
O&M	operations and maintenance
OHWM	ordinary high water mark
PHS	Priority Habitats and Species
PM	particulate matter
PM_{10}	particles below 10 microns in diameter
$PM_{2.5}$	fine particles below 2.5 microns in diameter
PS	Pump Station
PSCAA	Puget Sound Clean Air Agency
PSE	Puget Sound Energy
RCW	Revised Code of Washington
RGP	Regional General Permit
RPZ	Residential Parking Zone
RUL	remaining useful life
SCADA	supervisory control and data acquisition
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Office
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SOP	Standard Operating Procedure
SPR	spiral-wound pipe
sq ft	square feet
SR	State Route
TESC	Temporary Erosion and Sediment Control
TMDL	Total Maximum Daily Load
USFWS	U.S. Fish and Wildlife Service

Abbreviation	Definition
UT	ultrasonic thickness
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WHR	Washington Heritage Register
WISAARD	Washington Information System for Architectural and Archeological Records Data
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WTD	Wastewater Treatment Division
YPMC	Yarrow Point Municipal Code

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CHAPTER 1
Introduction & Summary

The City of Bellevue (City) has lake lines in both Lake Washington and Lake Sammamish that are an important part of Bellevue Utilities' wastewater system. The Lake Washington Wastewater Lake Line (LWWLL) system includes approximately 14.6 miles of sewer lines that are either underwater or on land adjacent to Lake Washington, as well as 15 pump stations and eight flush stations. The Lake Sammamish lake lines are not part of this evaluation.

Most of the Lake Washington lake lines were constructed in the 1950s and 1960s to prevent raw sewage from being discharged directly into the lake. Today, this infrastructure serves approximately 1,900 parcels in Bellevue, Beaux Arts, Medina, Hunts Point, Yarrow Point, and unincorporated King County and still plays a crucial role in keeping Lake Washington water clean. However, the pipes and pump/flush stations that constitute the lake line system are aging, and their location creates challenges for repair and replacement. Without advance planning, components of the lake line system may begin to fail, potentially causing a loss of sewer service to residents and risk to the sensitive lake environment. Line failures could result in property damage to individual homes and widespread contamination of Lake Washington.

Bellevue Utilities is developing a Management Plan for the repair, replacement, and maintenance of the aging lake line system. The **Lake Washington Wastewater Lake Line Management Plan** (the Management Plan, or the Plan) will develop and document a long-range approach for the rehabilitation or replacement of the lake lines, including financial and policy components, to guide future capital improvements to the system. The Management Plan will help ensure the City can continue to provide safe and reliable sewer service to the community, protect public health, and support the Lake Washington ecosystem, while responsibly addressing risks and challenges for the City and residents. As part of this process, the City is preparing a non-project, or "programmatic" environmental impact statement (EIS). This programmatic EIS evaluates the environmental impacts associated with the following four alternatives (three Action Alternatives and the No Action Alternative) to replacement and repair of the lake line system as the capital improvements identified in the Management Plan. Alternative details and potential construction methods are further described in Chapter 2, *Description of the Lake Washington Wastewater Lake Line Management Plan and Alternatives*.

1. **In-Water Alternative** – Any permanent system improvements to conveyance system infrastructure (the system of force main pipes, intakes pipes, emergency overflows, and all other components used to collect and move sewage to the treatment plant) would be generally located below the ordinary high water of Lake Washington.
2. **On-Shore Alternative** – Any permanent system improvements to conveyance system infrastructure would be generally located between the residences, parks, commercial properties and/or public spaces, and the ordinary high water of Lake Washington.

3. **Upland Alternative** – Any permanent system improvements to conveyance system infrastructure would be generally located upland of the residences, park, commercial property and/or public space, and/or within the general vicinity of the public right-of-way.
4. **No Action Alternative** – Required by the State Environmental Policy Act (SEPA) – Potential implementation methods include continued wastewater system operational strategies and maintenance of existing infrastructure, cleaning and condition assessments and monitoring, piecemeal repair and replacement (projects one-by-one as needed), emergency actions, and actions that are taken to maintain or limit degradation of the existing system. Strategies and actions would address immediate needs, but would not address long-term degradation of the existing system in a holistic manner. Under the No Action Alternative, the Management Plan would be adopted; however, the Action Alternative(s) would not be implemented.

Note that different areas of the lake line system may have different selected alternatives – multiple alternatives could eventually be selected for the Lake Washington wastewater lake line system. Implementation of the alternative(s) will occur over different planning period horizons. Improvements, including alternative(s) implementation, are expected to be recommended for the near-term, medium-term, and long-term planning periods. Interim actions, including early action projects and emergency planning and actions, are improvements recommended to be implemented in the near-term planning period in tandem with or prior to other system improvements (see Sections 1.11 and 1.12). The alternatives and planning period implementation are described in more detail in Section 2.5 and Section 2.8, respectively.

1.1 What are the objectives of the Management Plan?

The Lake Washington Wastewater Lake Line Management Plan will identify capital improvement and other system improvement strategies to provide a responsible and effective, long-range approach to maintaining operation of the lake line system. Specifically, the Plan will achieve the following objectives:

- Provide a reliable level of service for existing customers for peak flows while minimizing backups or overflows.
- Maintain, rehabilitate, or replace the lake line system infrastructure with system(s) that are reliable, durable, and maintainable while minimizing risk to the environment.
- Minimize new obligations on the homeowner for infrastructure maintenance and minimize impacts on private property.
- Develop operational strategies that can be implemented in a timely fashion to maintain or improve the quality of the existing system without raising the rates to existing customers outside of typical market levels.

1.2 What is a non-project EIS?

SEPA requires agencies to consider the likely environmental consequences of governmental decisions, including decisions on the adoption of plans, policies, or programs, pursuant to Chapter 43.21C Revised Code of Washington [RCW] and the SEPA Rules (Chapter 197-11 Washington Administrative Code [WAC]). The SEPA Rules provide detail for the environmental review process, including the EIS process.

A non-project EIS is being prepared because the Management Plan is not a specific project, but rather a series of potential future improvement strategies to proactively manage the lake line system. A non-project EIS, also known as a programmatic EIS, is prepared to inform planning decisions that provide the basis for later proposed improvement review (WAC 197-11-704). Non-project actions are governmental actions involving decisions on policies, plans, or programs that provide requirements for how the environment can be modified, in this case, standards around how proposed solutions to address the aging lake line system can modify Lake Washington and the surrounding environment, or standards that will govern a series of connected actions through implementation of the Management Plan. Non-project review allows consideration of the "big picture" and will form the basis for subsequent improvement-specific review. The EIS examines the broad plan-level issues related to the general location of alternatives and how combinations of improvements may collectively impact the environment. A non-project EIS differs from a "project-specific" EIS in that it does not focus on specific projects or project locations, design details, or precise footprints of project(s).

1.3 How were the potential impacts of the proposed Lake Washington Wastewater Lake Line Management Plan evaluated?

To evaluate impacts at a programmatic level, certain construction characteristics were used to compare the potential for impacts among the three Action Alternatives (i.e., In-Water, On-Shore, and Upland Alternatives), which could involve larger, more complex construction activities than the No Action Alternative. For the purposes of the impact analyses (Chapter 4 of the Draft EIS), the various construction approaches (i.e., gravity sewer line, vacuum sewer, pipe bursting) were categorized as either open cut construction methods or trenchless construction methods to evaluate the potential impacts on a programmatic level for each potential Action Alternative (see Section 2.6). If the potential impacts from any of the construction methods varied with the Action Alternative, the construction method impacts were reviewed independently for each element of the environment. Improvements to associated system pump stations were also considered as part of each alternative.

Construction impacts were primarily identified based on the following items for each Action Alternative.

- Excavation Quantities. Improvement components requiring a substantial amount of earthwork (excavation) could affect earth, air quality, surface water, traffic, and cultural resources.
- Surface Disturbance. The larger the surface disturbance area of an improvement, the greater the potential for impacts on environmental resources discussed in this EIS.
- Duration. Improvement construction ranges in length from a few months to 2 years in any given location. The longer the duration of construction, the greater the potential for impacts on most of the resources considered in this EIS.

Impacts on environmental resources are documented as either **significant** or **less-than-significant**; a significant adverse impact for most of the resources refers to impacts that are potentially inconsistent with regulatory standards and/or permit requirements that may require extensive mitigation measures or situations that could not be mitigated.

Similar to the potential construction impact analyses, operational impacts were evaluated at a programmatic level for operation and maintenance of the improvements. Operational impacts were analyzed for the Action Alternatives and No Action Alternative.

1.3.1 What impacts and mitigation measures did we identify?

Impacts

The impact analyses accounted for open cut construction methods requiring more surface disturbance for a longer duration than trenchless construction methods. Surface and infrastructure disturbance would generally be more extensive with the Upland Alternative based on the adjacency to residences, parks, commercial properties and/or public spaces, and the location of public right-of-way. As such, construction impacts on environmental resources, including but not limited to, land use, earth and soils, plants and animals, transportation, and cultural resources, would be more extensive and occur over extended periods of time with open cut construction methods under the Upland Alternative than the other Action Alternatives due to the additional excavation, larger equipment and required construction time. Similarly, based on the location of the In-Water Alternative in Lake Washington, construction impacts on surface water resources and fish and aquatic resources would be more prominent than the other Action Alternatives and the No Action Alternative. **Table 1-1** summarizes the identified potential construction and operation impacts, as well as presents an overview of most potential measures that the City could take to reduce or minimize potential impacts associated with the Action Alternatives and No Action Alternative. Potential impacts were described in more detail in Draft EIS Chapter 4, *Impacts*.

Mitigation Measures

Mitigation would primarily be guided by local, state, and federal approvals and permits that would generally be required for the types of improvements presented in the Management Plan (potential individual approvals and permits are listed in the EIS Fact Sheet). Additional solutions and mitigation for impacts could include, but are not limited to, the following (summarized in Table 1-1):

- Avoid private properties to the extent practicable while siting improvements.
- Isolate construction work areas.
- Construct in-water improvements during prescribed in-water work windows for fish protection.
- Comply with existing policies and procedures.
- Proactive coordination with potentially affected utilities and property owners.
- Adhere to permit conditions.

Mitigation measures were described in more detail in Draft EIS Chapter 5, *Mitigation Measures*.

TABLE 1-1
POTENTIAL IMPACTS AND MITIGATION MEASURES BY ENVIRONMENTAL RESOURCE

Resource	Potential Impacts	Potential Significant Impacts	Potential Mitigation Measures
Land Use and Visual Quality	Acquisition of property and easements, incompatibility with surrounding land uses, conflicts with existing plans and policies, changes to views, light and glare	• Action Alternatives – If private property acquisition is necessary.	• Restore disturbed areas. • Maintain access to properties and businesses during construction. • When siting potential new facilities, prioritize in public property and rights-of-way. • Comply with existing land use policy. • Follow federal, state, and local real estate transaction and property management process regulations, where appropriate.
Earth	Erosion, slope failure, unsuitable or excess soils, dewatering and spoils disposal	• No Action Alternative – Risk of system failure, substantial contamination, and geologic risk possible.	• Geologic risk assessment and design improvements to minimize geologic hazards. • Erosion control measures. • Appropriate soils disposal and monitoring of settlement during dewatering.
Air Quality and Odors	Dust, odors, and emissions	Not expected	• Construction specifications and measures to control dust. • Reduce vehicle emissions, idling, and travel distances, and encourage carpooling for employees. • Design facilities to control odors and emissions with regular maintenance.

Resource	Potential Impacts	Potential Significant Impacts	Potential Mitigation Measures
Surface Water Resources	Stormwater and runoff, turbidity, release of pollutants from construction equipment, and sediments	• Action Alternatives – Risk of system failure releasing untreated wastewater could affect water quality. • No Action Alternative – Highest potential risk (out of all the alternatives) of system failure releasing untreated wastewater that could affect water quality.	• Isolate work areas from open water during dewatering. • Implement erosion and sediment control measures. • Use appropriate plans for monitoring and construction activities. • Implement pollution control measures and waste handling measures. • Decontaminate equipment and restore cleared areas. • Isolate the work area to prevent spillage of construction materials and have spill response materials on-site. • Where possible, use non-petroleum based solvents and fluids and fuel construction equipment 50 feet or more from surface waterbodies.
Fish and Aquatic Resources	Potential noise in and near Lake Washington and its tributaries In-Water Alternative – Could disrupt fish species, especially with open cut construction	• No Action Alternative (Construction) – Risk of habitat alterations from emergency repairs and turbidity and dissolved oxygen if in-water work occurs outside of in-water work windows for fish species. • No Action Alternative (Operational) – Risk of large untreated wastewater release.	• Isolate in-water work area. • Work during prescribed in-water work windows for fish protection. • Install anchor logs for habitat complexity and bioengineered shoreline stabilization. • Install a layer of fish mix gravels in areas impacted by open cut construction. • Restore/enhance disturbed riparian vegetation in on-shore and upland areas.
Plants and Animals	Increased Noise and Human Disturbance in Construction Areas	• Action Alternatives (Operational) – If clearing of large areas occurs without complying with land use and shoreline regulations	• Avoid breeding and rearing periods of the sensitive species, if necessary. • Follow permit conditions for construction site runoff. • Retain site vegetation and revegetate. • Comply with National Bald Eagle Management Guidelines. • Implement invasive species control and management.

Resource	Potential Impacts	Potential Significant Impacts	Potential Mitigation Measures
Noise	Noise generated by construction equipment and activities, increased noise levels in residential areas and near sensitive receptors	Not expected	• Encourage noise-reducing measures. • Work within permitted hours and noise levels to reduce nuisance to adjacent residents, adhere to applicable noise regulations. • Use noise-reducing equipment on construction equipment. • Comply with noise levels specified in facility design.
Transportation	Construction truck trips and barge use, construction employee commute trips, road closures and associated traffic, transit, non-motorized impacts, and parking impacts	Not expected	• Coordinate with transportation services, local neighborhoods, property owners (where appropriate), school districts, and departments to minimize disruption with advance notice. • Develop a Traffic Control Plan for work within the right-of-way. • Avoid construction routes at congested intersections. • Maintain access for private roads and pedestrian and bicycles or detours, as applicable. • Provide off-street parking at staging areas for construction vehicles and on-site loading areas for material delivery and removal. • Prioritize ridesharing for construction workers, as possible. • Provide traffic detour plans and post standard construction warning signs in advance of construction areas. • Provide access for emergency vehicles at all times. • Repair or restore the roadway right-of-way to its original condition or better. • Perform an evaluation(s) for feasibility of dock construction to support the barge, if necessary.

Resource	Potential Impacts	Potential Significant Impacts	Potential Mitigation Measures
Cultural Resources	Risk of Encountering Archaeological or Cultural Resources; Temporary Visual and/or Auditory Impacts on Historic Built Environmental Resources	• On-Shore Alternative, Upland Alternative, and Pump Station Improvements (Construction) – Likelihood to encounter and/or disturb cultural resources.	• Develop and implement an Inadvertent Discovery Plan (IDP), as appropriate. • Develop an Archaeological Monitoring Plan and conduct on-site observation of excavations by an archaeologist, if determined appropriate. • Potential additional coordination with the Department of Archaeology and Historic Preservation (DAHP), and any Affected Tribes.
Public Utilities	Disruption of Existing Above- and Below-ground Utilities during Construction	• Action Alternatives - Risk of system failure and loss of service and sewer backups. • No Action Alternative – Risk of system failure could cause sewer overflows and interrupt service to customers.	• Coordinate and determine potential conflicts with other utilities and transportation departments to plan for shared construction and to avoid consecutive construction projects (road construction and other underground utilities). • Develop construction sequence plans and coordinate schedules to minimize service disruptions and provide ample advance notice if service disruption is unavoidable. • Utilize temporary pumping to continue service to LWWLL customers, if needed. • Conduct utility locates prior to ground-disturbing activities.

1.3.2 What is the difference between the alternatives?

The difference between the alternatives is primarily related to their implementation location, the technical feasibility of construction methods with each alternative (further detail is provided in Section 2.6), and the location of the associated facilities (i.e., pump and flush stations). The alternatives identified and evaluated in this EIS and their primary differences are described below:

- **In-Water Alternative** – Improvements would generally be located below the ordinary high water mark (OHWM) of Lake Washington; system infrastructure would either be relocated in-water or replaced in-water (see **Figure 1-1**). Potential construction methods include gravity sewer line via open cut construction or trenchless technology, cured in-place pipe, spiral wound pipe, slip lining, pipe bursting, or emerging technologies. Potential impacts would be primarily associated with the in-water environment and adjacent environmental resources.

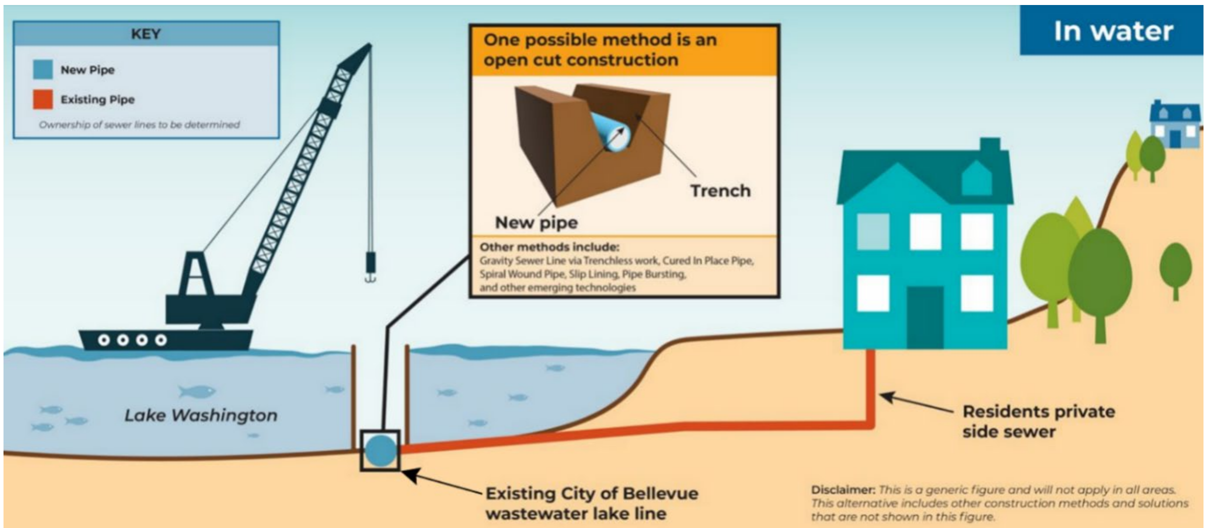

Figure 1-1
In-Water Alternative

- **On-Shore Alternative** – Improvements would generally be located between the residences, parks, commercial properties and/or public spaces, and OHWM of Lake Washington (see **Figure 1-2**). Potential construction methods include gravity sewer line via open cut construction or trenchless technology, or vacuum sewers. Potential impacts would be primarily concentrated on the on-shore area and associated human and environmental resources; however, construction could affect the aquatic environment.

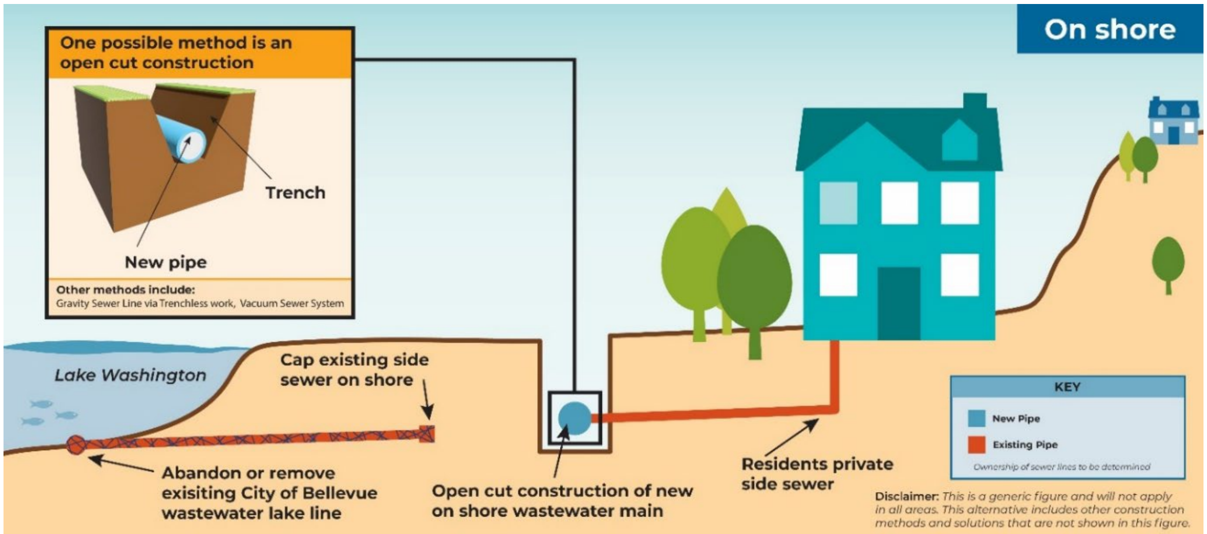

Figure 1-2
On-Shore Alternative

- **Upland Alternative** – Improvements would generally be located upland of the residences, park, commercial property and/or public space, and/or within the general vicinity of the public right-of-way (see **Figure 1-3**). The pump and flush stations connected to the lake line system are also located in the upland area. Potential construction methods include gravity sewer line via open cut construction or trenchless technology, vacuum sewers, or grinder pumps. Potential impacts would primarily be concentrated on the upland area and associated human and environmental resources.

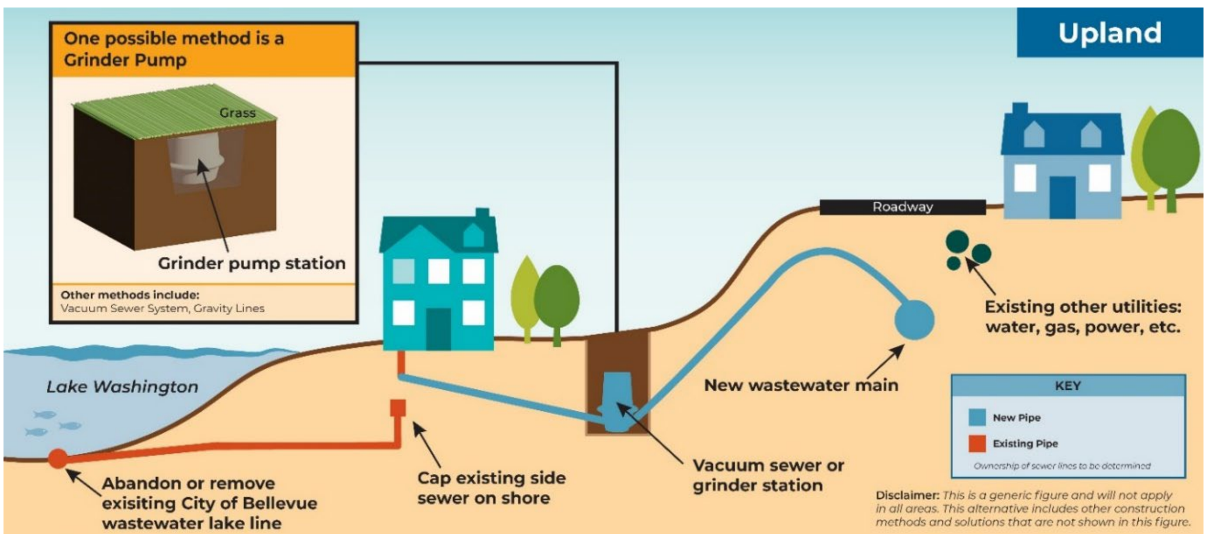

Figure 1-3
Upland Alternative

- **No Action Alternative** – Continuation of existing operational strategies and maintenance of existing infrastructure in place. Methods could include cleaning and condition assessments and monitoring, piecemeal repair and replacement (projects one-by-one), emergency actions, and actions that are taken to maintain or limit short-term degradation. Potential impacts would be concentrated where the existing system is located and could potentially affect the adjacent environmental resources.

1.4 Are there any potential unavoidable adverse impacts?

SEPA defines significant impact as "*a reasonable likelihood of more than a moderate adverse impact on environmental quality*" (WAC 197-11-794). Summarized below are the potential significant unavoidable adverse impacts associated with the Action Alternatives and the No Action Alternative. Refer to Chapter 6, *Significant Unavoidable Adverse Impacts*, for further discussion.

- **Land and Shoreline Use** – Since most of the Lake Washington shoreline is developed for residential use, direct or indirect impacts on the adjacent properties and aquatic habitat during any construction of wastewater system improvements are likely unavoidable. To the extent possible, the City would avoid private property acquisition and displacement of residents or businesses if property is needed for a new facility (e.g., pump station). Significant unavoidable adverse impacts would occur if acquisition of private property or displacement of residents or businesses were required to implement the Plan.
- **Earth Resources** – The No Action Alternative could result in significant impacts on the earth and soils of the Plan area in the future, as the system continues to age, should a system failure occur. The frequency and likelihood of failure of the system as it ages would also increase. Undetected leaks over an extended period could contaminate adjacent soils and increase the potential for erosion.
- **Surface Water Resources** – Although the Management Plan Action Alternatives would reduce the risk of surface water contamination by updating the aging system, the risk of system failure cannot be completely eliminated by any of the alternatives. If a system failure occurred in or near Lake Washington and its tributaries, it would impact water quality by releasing untreated wastewater, which could degrade water quality, impact fish habitat, and create a public health and safety hazard by releasing bacterial and chemical pollutants. The risk of system failure cannot be eliminated and is considered a significant impact. The frequency, likelihood, and potential impact of failure is higher with the No Action Alternative than with any of the Action Alternatives due to the age and condition of the existing system.
- **Fish and Aquatic Resources** – Habitat alterations from emergency repairs, along with turbidity and dissolved oxygen impacts associated with emergency repairs under the No Action Alternative, have the potential to have significant impacts on fish and aquatic resources if unplanned in-water repairs occur outside of the in-water work windows for fish species.
- **Public Utilities** – Impacts from system failure could result in a loss of service for some customers and sewer backups. Although the likelihood of a system failure is low, no mitigation measures could completely eliminate the possibility of an incident or the resulting impacts. Therefore, the result of system failure is considered a significant adverse impact on public utilities. While this impact is present with all alternatives, the No Action Alternative poses a higher risk of failure than any of the Action Alternatives.

1.5 What are the cumulative impacts of the Management Plan?

Cumulative impacts are the effects that may result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. "*Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*" (40 Code of Federal Regulations [CFR] 1508.7). Plan elements could be constructed in areas that may have recently been subject to other construction projects or will be subject to construction of future planned projects. The cumulative impacts associated with the Management Plan relate largely to construction of the Action Alternatives.

The Management Plan could potentially result in cumulative impacts associated with extended construction impacts from Plan improvements that would require long-term construction and may overlap with other construction activities in the Plan area. Long-term construction could contribute to surface water impacts from ongoing runoff based on the location of the existing infrastructure. Proper construction best management practices (BMPs) to control runoff would be implemented.

The long-term effects of construction-related impacts can negatively affect residents, businesses, and those who access or travel to the area, resulting in impacts that range from temporary inconvenience to construction fatigue on residents, businesses, and recreational activities.

Transportation capital projects and neighborhood projects may occur concurrently within the Plan area. Due to the potential extended timeframe of Plan implementation, many major ongoing projects in the Plan area are expected to be completed by the time some of the Plan improvements will be built.

The primary construction impacts related to improvements from the Action Alternatives would include traffic and slowdowns, increased dust and emissions, and construction noise. Many neighborhoods, residents, and workers may experience ongoing construction noise and traffic delays for years from unrelated construction efforts. "Construction fatigue" could be worse in neighborhoods that have seen a high level of construction for other projects in recent years or that would experience extended construction times. Impacts from construction could be offset by deferring construction in areas where construction has occurred under other Plan improvements. To the greatest extent practicable, the City would try to schedule construction projects to minimize neighborhood impacts and reduce overall construction-related impacts in affected communities. The City may need to coordinate closely with the proponents of major projects to minimize the potential for cumulative impacts; however, some level of cumulative impact is likely unavoidable. As appropriate, site-specific mitigation during the review period for each individual improvement would be developed.

The Action Alternative improvements would have long-term benefits to the environment and customers by providing a more reliable level of service and extending the life of the lake line system while minimizing risk to the environment. After construction, the lake line system would be less likely to fail and able to be maintained more efficiently, resulting in a lower risk of environmental contamination from system failures. In addition to protecting water quality in Lake Washington, this would reduce the potential for human health risks associated with potential system failure and provide benefits to existing customers. Cumulative impacts are not expected from the No Action Alternative; however, the No Action

Alternative has the highest probability of minor or major system failure out of all the alternatives, which would threaten environmental conditions.

1.6 What are the areas of concern?

The Lake Washington lake line pipes are deteriorating in many places and are known to be partially filled with debris in places. Without implementation of improvements, potential pipe failures could result in economic, environmental, and social costs, threatening sensitive shoreline habitat, closing beaches, and interrupting wastewater service to homeowners. As with all major infrastructure improvements and construction, there will be difficult decisions and areas of concern associated with implementation of the Plan. Improvements to extend the useful life of the lake line system may require a significant commitment of funding to construct major infrastructure projects or programs. Concerned parties will likely have questions about the Management Plan regarding funding and prioritization of projects, tradeoffs, and coordination with other projects that may take place concurrently. The timing of strategy or improvement implementation is a potential concern, and a wide range of viewpoints can be expected.

Timing of the construction of system improvements under the In-Water Alternative would also be restricted by the Washington Department of Fish and Wildlife (WDFW) and U.S. Army Corps of Engineers (Corps) established in-water work windows in Lake Washington for fish species. Additionally, construction of system improvements in a highly developed mostly residential setting where limited undeveloped land is available will result in difficult siting decisions that could require short-term or permanent impacts on existing land uses, including the potential for impacts on parks or recreational facilities, private property, or community facilities. These challenging siting decisions will be present particularly in the On-Shore and Upland Alternatives.

Construction-related traffic impacts will be of considerable concern to affected residents and business owners. Some neighborhoods in the Service Areas have been the location of previous major construction projects and may experience additional construction-related impacts as part of implemented alternatives. The City would follow its policies regarding the siting of wastewater system infrastructure and facilities, which give preference for City-owned or other public property and rights-of-way, but there may be concern if private sites are identified.

1.7 How has the public been involved with the development of the Management Plan and the EIS?

Public engagement is an important part of both the Management Plan and SEPA processes. The City has a Lake Washington Lake Line Management Plan website (https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line), where they solicited comments on the Plan via an online survey, email, and phone number. Between July 2022 and December 2023, Bellevue Utilities facilitated virtual public meetings, more than 20 community briefings, several online open houses with accompanying community surveys publications, and a series of in-person community events to collect input from project neighbors and partnering jurisdictions for the Management Plan (see **Appendix E** for the **Lake Washington Wastewater Lake Line Management Plan Community Outreach Summary** [Appendix E is a new appendix included with the Final EIS]). Other engagement efforts included postcard mailings, engagement in communities in eight languages, article publications, social media and website updates and posts, and community poster placement and distribution.

Community feedback included input on the most important consequences to consider in the event of a lake line failure, evaluation factors, and water quality. When asked about the consequences to consider in the event of a lake line failure, the majority of people prioritized the difficulty of repair or replacement of a lake line, the number of customers impacted, and the risk to the environment. In regard to evaluation factors, community members ranked impacts on land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important. Some people shared a desire to maintain Lake Washington's water quality and to protect native habitat. Additional input included a desire for long-term and sustainable solutions to prevent further disruption to Lake Washington and to prioritize the impacts on the community members over the cost of the project (see **Appendix E** for more details).

Consistent with SEPA, the City collected EIS scoping comments through a Lake Washington Sewer Line EIS Online Open House extending from July 11 to August 5, 2022, a virtual public scoping meeting on Tuesday, July 26, 2022, and via email. By the close of the scoping period, the City had received six different comments—two comments were submitted via the Engaging Bellevue comment portal, and four comments were submitted via email. Comments were summarized in a final Scoping Report that identified the major topics and themes contained in the comments, and the scoping summary was posted to the City's website. See **Appendix A** for the Scoping Report (Appendices A through C are included with the Draft EIS but not reproduced in the Final EIS).

Bellevue Utilities also hosted an online open house on the EngagingBellevue.com platform. The online open house was live from Monday, July 11 to Wednesday, August 31, 2023, extending longer than the scoping period. The online open house shared information about the Lake Washington lake line system, why a Management Plan and EIS are needed, and potential alternatives for the aging lake lines.

Public comments were invited on the Draft EIS, and an EIS Online Public Meeting took place to solicit comments on the Draft EIS. All public comments received during the Draft EIS comment period were considered and are addressed, and comment topics are summarized below. Comments on the Draft EIS were received from individuals, government entities, and a local corporation. Comments from individuals focused on the lake line system location related to private property and potential improvement preferences on private property. Government entity and local corporation comments were primarily related to regulations and additional analyses to be followed as the improvements are determined and move into future analyses and requested ongoing coordination. The full comments and responses are included in **Appendix D, Draft EIS Comments and Responses** (Appendix D is a new appendix included with this Final EIS).

1.8 How will the Plan be implemented?

The purpose of the Management Plan is to provide an overarching guidance document for the management of the lake line system, similar to the Wastewater System Plan, Water System Plan, or Emergency Water Supply Master Plan (City of Bellevue 2017a, 2023a). It is intended to be a living document that will change as additional data are collected, future studies and analyses are completed, City budget priorities are identified, and in tandem with changing permitting regulations. As such, the implementation of typical operational and capital improvement strategies will require future phases of analysis at a more project-focused level.

The Management Plan will be incorporated as an appendix to the City's Wastewater System Plan at the time the Wastewater System Plan is next updated. The current version of the system plan is the 2013 Wastewater System Plan, adopted by City Council via Resolution 8771 in July 2014; the King County Council adopted the plan via Ordinance 17968 in February 2015. The Washington State Department of Ecology (Ecology) approved the Plan in May 2015. At the time of the publication, the City expects that updates to the Wastewater System Plan will begin in 2024, followed by the adoption of the Wastewater System Plan (including the Management Plan as an appendix) by City Council. Programmatic plans typically establish broad policies or guidelines for future actions or projects, potentially affecting various aspects of the environment. The City Council's adoption of the Management Plan is the SEPA action as the approval process involves governmental decision-making that may have environmental implications.

The City may need to adopt policies to support the implementation of the Upland, On-Shore, and In-Water Alternatives. Much of the existing lake line system is a legacy system that was installed before the current adopted policies. Policy modifications or additions are required to support the operational and capital improvement strategies, which could include replacement of the lake line system as part of the Service Area preferred alternative(s) (see Section 1.9 of the Final EIS for more details on policy considerations).

The policies allow the City to work toward systematically implementing the Action Alternatives to upgrade the lake line system. A failure or delay in enacting the required supporting legal framework associated with the lake line alternatives, emergency repairs, and continued operation and maintenance make the City more vulnerable to infrastructure failures over time.

Future project-level analyses will occur after the completion of the Management Plan. No new specific capital improvements or projects are planned or proposed to be constructed as a result of adoption of the Plan; however, the purpose of the Plan is to inform and guide the identification, selection, timing, and implementation of future capital improvement projects. While the capital improvement projects are being selected for implementation, the Plan also recommends interim actions (i.e., pump and flush station improvements, emergency repairs, and other system improvements) to be taken. Future repair, replacement, or maintenance activities of the wastewater lake line and associated facilities will require separate project-level environmental review. The future project-level review(s) will inform decision-makers about site-specific, project-level environmental impacts and mitigation.

1.9 What are the policy considerations?

Much of the existing City sewer lake line system was constructed ahead of development of many of the City's policies and codes. The City also has sewer system agreements in place with neighboring communities and King County. A review of these existing City policies, codes, and agreements was needed to identify modifications or additions that would be required to implement each sewer lake line alternative. Refer to Chapter 4 of the Management Plan for further discussion.

1.9.1 In-Water Alternative

Should the City proceed with the In-Water Alternative, additional federal, state, and local permitting efforts would be required to address environmental and aquatic impacts, define associated mitigation measures, and demonstrate that the Plan objectives cannot be achieved by siting the sewer lake line in any other location. For example, federal permits would include a Section 10 and/or Section 404 permit(s) from the Corps for in-water infrastructure, where the premise of the Section 404 program is to not permit discharge of dredged or fill material, including construction dredging activities, if a practicable alternative exists that is less damaging to the aquatic environment. Also, the City may need to update its Shoreline Master Program because the program currently discourages new lake line features and encourages moving new lake line facilities away from the shoreline (utility systems in a shoreline area are subject to Substantial Development Permit(s) or exemption requirements [Bellevue City Code [BCC] 20.25E.030]). Similarly, other communities served by the City's sewer system may need to update their Shoreline Master Programs.

1.9.2 On-Shore Alternative

Since the On-Shore Alternative calls for gravity pipes and force mains proximate to the Lake Washington shoreline, the City may need to update the Shoreline Master Program because of the existing language about encouraging moving new lake line facilities away from the shoreline. The City may need update its ownership and/or easement policies specific to the sewer lake line along shorelines. The City may need to update its Sewer Utility Code (BCC 24.04) to clarify who operates and maintains onshore pipe and laterals and for who pays for restoration and/or protection of structures within utility setbacks. The City may also consider establishing a shoreline buffer within its Sewer Code.

1.9.3 Upland Alternative

To implement the Upland Alternative, the City may need to update its ownership and/or easement policies specific to grinder pumps and force mains. The City may need to update its Sewer Code to:

- Change the type of service from gravity to grinder pumps.
- Specify who owns and operates/maintains upland assets (grinder pumps and force mains).
- Accommodate potential sewer configurations of the Upland Alternative (e.g., more than four properties connected to a private system).
- Allow for the City to maintain private facilities and construct new private facilities, and who obtains permits for their construction.

The City may need to update its ownership and/or easement policies specific to an upland sewer line and update the agreements between private landowners and the City specific to lake lines.

Upland assets would be built in compliance with Ecology Guidelines for Sewer Works Design (Ecology 2023) and City Building Code, with City Building Code to be reviewed to allow for the City to construct new private facilities as mentioned above.

1.9.4 Summary of Policy Considerations

To implement the Management Plan regardless of alternative, the City may need to conduct a detailed public process with specific alternatives identified by location. The City may need to determine financial policies regarding payment structure to fund the Plan. A review of existing City policies, codes, and sewer system agreements in place with neighboring communities and King County occurred in order to identify modifications or additions that would be required to implement each alternative. Regardless of alternative, the City may need to modify the Sewer Utility Code and update the Bellevue Utilities Wastewater System Plan.

In addition to the policy considerations listed above, the following are recommended regardless of alternative:

- Develop Operations & Maintenance (O&M) Standard Operating Procedures (SOPs) specific to the Lake Washington sewer lake line.
- Revise the Bellevue Utilities' Engineering Standards for Sewer (City of Bellevue 2024).
- Revisit the franchise agreement with Yarrow Point regarding the responsibilities for relocation of facilities.

Refer to Chapter 4, *Policy Considerations*, of the Management Plan for further details and descriptions.

1.10 What future project-level analyses will be conducted?

The Management Plan will provide a framework for the City to evaluate options for the repair and/or replacement of segments of the Lake Washington wastewater lake line system. As described in Section 1.2, this non-project EIS is being prepared to provide a basis for later review of improvements and assist in the selection of future improvements based on the Management Plan. As part of the non-project EIS process, the selection of future improvements will be informed by the analysis of potential environmental impacts from implementing the Management Plan alternatives evaluated in the EIS and be tailored to the best improvement at a specific location based on the unique location constraints. Additionally, the future improvement-level environmental analyses can incorporate and expand on the environmental issues identified during the non-project stage for each specific location and improvement type. The results of this non-project EIS will inform future improvement decisions and minimize unforeseen constraints as improvements proceed to the permitting and implementation stage.

1.11 What interim actions could occur?

The Management Plan recommends that the City implement the capital improvements in each Service Area in order of risk-based priority, where the highest risk Service Areas will be improved first for efficiency in system function, design, permitting, and outreach. Service Areas were categorized into the following planning periods for implementation of the capital improvement strategies: near-term, medium-term, and long-term, based on the overall risk score for each Service Area. However, interim improvements, such as pump and flush station improvements, designation of emergency repair funds, and other system improvements, are recommended in all Service Areas while the capital improvements (preferred alternative[s]) are being implemented during the longer planning periods (medium and long-term). Ongoing cleaning and inspection to keep the lake line system functioning is a necessary interim action, in addition to development of a robust Emergency Response Plan and applicable resources to maintain the system and prolong the estimated useful life. Recommended pump and flush station improvements from the 2015 Wastewater Pump Station Evaluation Final Report (MSA 2015) were prioritized for implementation in the near-term planning period and would be implemented based on how large the recommended improvements to the pump and flush stations were, deficiencies occurring during the modeled 25-year storm, in addition to input from City Operations and Maintenance staff for stations with a history of performance deficiencies. See Section 2.8 of the Final EIS for the alternative and implementation period based on prioritization for each Service Area.

It is recognized that it is infeasible to immediately take action on all areas of the lake line system. It is also impossible to predict future failures of the lake line with certainty. As such, prioritization of resources and planning efforts for emergency repairs and continued operations is needed.

1.12 What emergency actions could occur?

Ongoing maintenance of the current lake line system is vital until the new operational and capital improvements strategies are in effect. However, the City may face implementation challenges because of capacity and funding. Future lake line failures are unpredictable, so prioritizing resources for emergencies is key. Recommendations focus on easing the burden of emergency responses, many of which can be handled by City staff. Emergency planning recommended to be implemented in the near-term planning period includes developing an Emergency Response Plan, developing standard details for repair applicable to the continued function or construction of a replacement in-kind system, and creating a roster of contractors for repair and procurement of materials.

The City recognizes the importance of a detailed lake line repair Emergency Response Plan to mitigate the potential environmental and public health impacts associated with such incidents. The ability to swiftly address and rectify sewer overflows is key to maintaining the public's trust of the City as a public utility provider. Having a robust lake line repair Emergency Response Plan in place is essential to minimize potential loss of service and environmental damage.

Delaying improvements to the lake line system presents risks. The inaccessibility and inherent risk of the lake line system has led to previous system failures, which are expected to continue. Mitigation requirements associated with expedited and emergency actions can be significantly higher than a planned action. The threshold between what is considered repair or replacement is largely project-specific, and different regulatory agencies may have differing interpretations. The following are potential considerations to evaluate whether a proposed project is considered a repair or replacement: (1) determining the percentage of the system being replaced, and setting a percentage threshold over which is considered replacement instead of maintenance; (2) examining the location of the system; repair if it remains in the same location (minor deviations may be permitted), replacement if not; and (3) examining the purpose of the system; repair if it serves the same purpose (minor upgrades may be permitted), replacement if not.

1.13 What are the benefits of implementation and disadvantages of delayed implementation?

Per SEPA rules (WAC 197-11-440 (5)(c)(vii)), the benefits and disadvantages of delaying the implementation of the proposal (Plan), as compared with possible approval at this time, were evaluated. Several system issues could occur over time without implementation of the Management Plan. The infrastructure may experience problems such as leaks, blockages, external damage, or failure of the pump and flush stations. The lake line system is especially at risk as various modes of failure can disrupt service for multiple customers. For instance, a mid-line blockage or malfunction at a flush or pump station could affect all customers served by that reach. Sanitary sewer issues (relative to other utility emergencies) are particularly notable due to their potential impact on the environment and public health. Since most of the lake line system is located on private property or in inaccessible areas, both planned and unplanned disturbances could substantially affect residents. Proactive, timely, and regular maintenance is essential to uphold the functionality of the existing and any future replacement lake line system. Implementation of the Management Plan will allow the City to be prepared for unexpected failures, by developing an Emergency Response Plan and securing a dedicated emergency repair fund; gathering additional data and renewing individual assets to provide a more accurate remaining useful life, which could allow for a more gradual fundraising strategy and realistic project delivery approach; and using a programmatic approach to develop a repeatable framework that can be applied to subsequent service areas.

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CHAPTER 2

Description of the Lake Washington Wastewater Lake Line Management Plan and Alternatives

2.1 Location

A portion of the Lake Washington wastewater lake line system is owned and operated by the City of Bellevue, serving customers in multiple jurisdictions. The portions managed by the City of Bellevue are located along the shoreline of Lake Washington within the following areas (see **Figure 2-1**):

- Bellevue
- Beaux Arts
- Medina
- Hunts Point
- Yarrow Point
- King County (unincorporated)

2.2 Overview of the Existing Wastewater Lake Line System

The lake line system includes approximately 14.6 miles of lake lines along the Lake Washington shoreline with 15 pump stations and eight flush stations. The lake lines are sewer pipes that follow the shoreline of Lake Washington underwater and in some cases on land adjacent to the lake. Approximately 9 miles of these pipelines are cast iron, 3 miles are asbestos cement, and 1 mile is unknown and miscellaneous material types. Most of the lake line system was constructed in the 1950s and 1960s. Wastewater enters the lake line through City-owned collectors, pump stations, and numerous private lateral side-sewers that discharge directly to the lake line.

The lake line system relies on pump and flush stations to convey wastewater to the gravity system or King County Wastewater Treatment Division (WTD) regional conveyance system. The City's lake line pump and flush stations are commonly located on the waterfront and on private properties, often resulting in difficult access. Pump and flush stations convey flows through the lake lines and then discharge flow in the upland sewer system.

Sources: System Infrastructure: Carollo Engineers 2022; City Boundaries: WADNR 2022

Bellevue Lake Line EIS

Figure 2-1
Lake Washington Lake Line System Location

In 2016, a preliminary condition assessment showed varying degrees of aging in the lake line pipes and interior pipe linings (Tetra Tech 2016). The current system is an operational challenge, primarily because the system is located under a sensitive lake environment, and in many cases, maintenance access is only available through private property. The flat pipe slopes that have resulted from settlement and changes in the lakebed over time and the lack of pipe access for regular cleaning operations in a sensitive lake environment have made operational maintenance of the current system a challenge. The lake line system pipes are aging in many places, and some locations are known to be partially filled with debris. Since some sewer rehabilitation alternatives require a clean host pipe, cleaning of these lake lines in the future is a priority (if it can be done without risking further damage to aging pipes) if certain rehabilitation alternatives are considered. If the pipeline is kept in the same alignment as it is now, these constraints would likely continue to hinder future O&M. Additionally, components of the lake line system may begin to fail, and without advance planning could cause a loss of service to residents and extensive risk to the water quality and the sensitive lake environment.

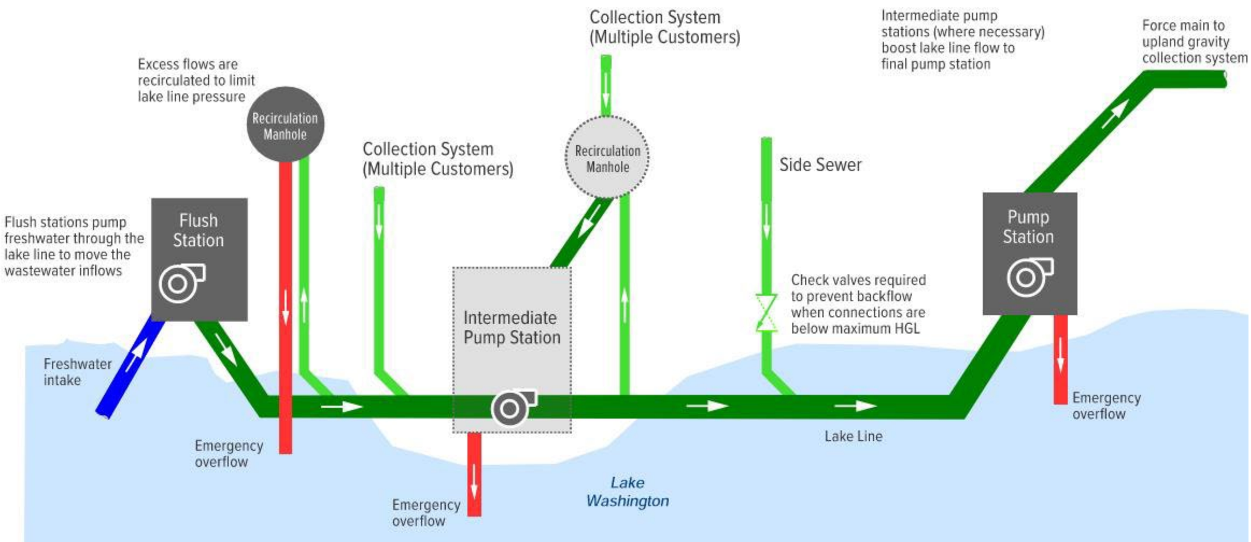
2.2.1 Components of the Lake Line System

Lake line systems require multiple components to function. An overview of the Lake Washington sewer lake line system is shown in Figure 2-1 and system components are summarized below.

- **Flush Stations** – Flush stations that use lake water to “flush” – or assist the movement of sewage – through the lake line. Flush stations are typically run at least once per day on a set schedule, often overnight when sewer flows are lowest to maximize flushing effectiveness.
- **Pump Station (PS)** – Pump stations are used to convey flows from and through the lake line systems and then discharge flow into the upland sewer system.
- **Lake Lines** – Wastewater conveyance pipelines buried near the shoreline in Lake Washington or in some cases on the shoreline. In the 1990s and early 2000s, several capital improvement plan projects placed rock over the most vulnerable locations. The lake lines have unique and complex hydraulics that require different operation from the City’s gravity collection mains and force mains.
- **Lake Line Cleanouts and Maintenance Holes** – Access points to lake lines within Lake Washington that are largely only accessible by boat.
- **Force Mains** – Pressurized pipelines conveying wastewater from pump stations to upland sewer systems.
- **Recirculation Maintenance Holes** – Specialized maintenance holes that protect low-lying customers by limiting the pressure in the lake lines. Once the downstream operating capacity of the lake line is reached, the recirculation returns excess flows to the pump station, rather than forcing additional flow at a higher pressure that may cause backups to low-lying customers downstream.
- **Customer Lateral Side-Sewers** – Pipes that connect from the private customer homes and business lines on land to the Lake Washington lake lines. A portion of lateral side-sewers (5 feet) are located within the City’s sewer easement and are maintained by the City. Many lateral side-sewers serve more than one customer.
- **Gravity Mains** – Publicly owned gravity pipelines conveying wastewater throughout the system. A limited number of gravity mains convey upland flow into the lake lines in Lake Washington.

Figure 2-2 provides a schematic of the operation and function of a typical lake line system. Typical operations are shown on the figure:

- Flows from customers enter the lake line via customer lateral side-sewers and gravity sewers.
- Sustained high flows cause higher pressures in the lake line. These flows may be from a combination of upstream flush and pump stations and infiltration and inflow (I&I) from customer lateral side-sewers and gravity sewers. The pressure is based on the elevation of the recirculation pipe within the recirculation structure and set in relation to the hydraulic gradient data charts. Once the highest pressure/flow is achieved in the lake line, the recirculation back to the wet well will cause the station to overflow due to capacity along with overcoming pumping capacity. See description of recirculation maintenance holes below.
- Recirculation maintenance holes return flow to wet wells to maintain lower lake line pressure. The pressure regulation that occurs is set by the physical open end of pipe elevation of the recirculation pipe within the recirculation maintenance hole.
- At most stations, very high wet well levels caused by excessive inflows are relieved by an overflow to Lake Washington.



*HGL = Hydraulic grade line

Figure 2-2
Typical Lake Line System Operation

2.3 Planning Context

There is potential that components of the lake line will begin to fail, potentially causing a loss of service to residents and risk to the sensitive lake environment, and advanced planning to reduce risk is necessary. Bellevue Utilities is developing the Lake Washington Wastewater Lake Line Management Plan (the Plan) to guide the repair, replacement, and maintenance of the lake line system. The Plan will ensure the City can continue to provide safe and reliable sewer service to the community and protect public health and the sensitive Lake Washington ecosystem.

The Management Plan documents a long-range approach to rehabilitation or replacement of the lake line and connected pump and flush stations. The Plan consists of eight major elements, including Introduction, Existing System, System Alternatives and Other System Improvements, Policy Considerations, Service Area Plans, Financial Considerations, Implementation Plan, and Hydraulic Model. Service Area Plan refers to the multiple capital and other system improvement strategies, including the preferred alternative(s), that are applied to specific components of the system within the Service Area (Chapter 4 of the Management Plan).

2.4 How were the Service Areas developed?

The lake line system has been divided into six "Service Areas" for analysis and planning. The Management Plan team is reviewing information about the lake line system to develop strategies for future repair, replacement, or maintenance in these Service Areas. Some sections may not require work; others will require repair, replacement, or maintenance.

The Service Areas were developed based on sections of the lake line with similar characteristics. A Service Area includes all attributes of the lake line system such as the lake line pipe, pump/flush stations, recirculation maintenance holes, cleanouts and lateral side-sewers, as well as the characteristics of the basin such as parcels/customers, topography and land cover, zoning, critical areas, docks, and bulkheads. Service Areas are used for efficiency or interdependencies of hydraulic function, construction sequencing/methodology, and permitting.

2.4.1 Overview of the Service Areas

The locations of the six Service Areas dividing the Lake Washington sewer lake line system are shown in **Figure 2-3**; the length and pump stations in each Service Area are listed in **Table 2-1**, followed by a description of each Service Area from north to south.

Portions of the shoreline of the Service Areas contain infrastructure to address erosion, including bulkheads. According to a 2001 study, 70 percent of Lake Washington's shoreline was armored with concrete, riprap, sheet pile, or another type of bulkhead (City of Seattle 2013).

Hunts Point and Yarrow Point Service Area

The Hunts Point and Yarrow Point Service Area (approximately 3.2 miles of lake line) covers the entirety of the lake line system in the cities of Hunts Point and Yarrow Point, including a portion of Yarrow Bay and Cozy Cove Bay, and fully encompasses the peninsula of Hunts Point. The Hunts Point and Yarrow Point Service Area spans from approximately 0.15 mile north of Morningside Park following the Lake Washington lake line system to incorporate the system in Hunts Point, ending where Fairweather Bay intersects the peninsula containing Fairweather Place roadway.

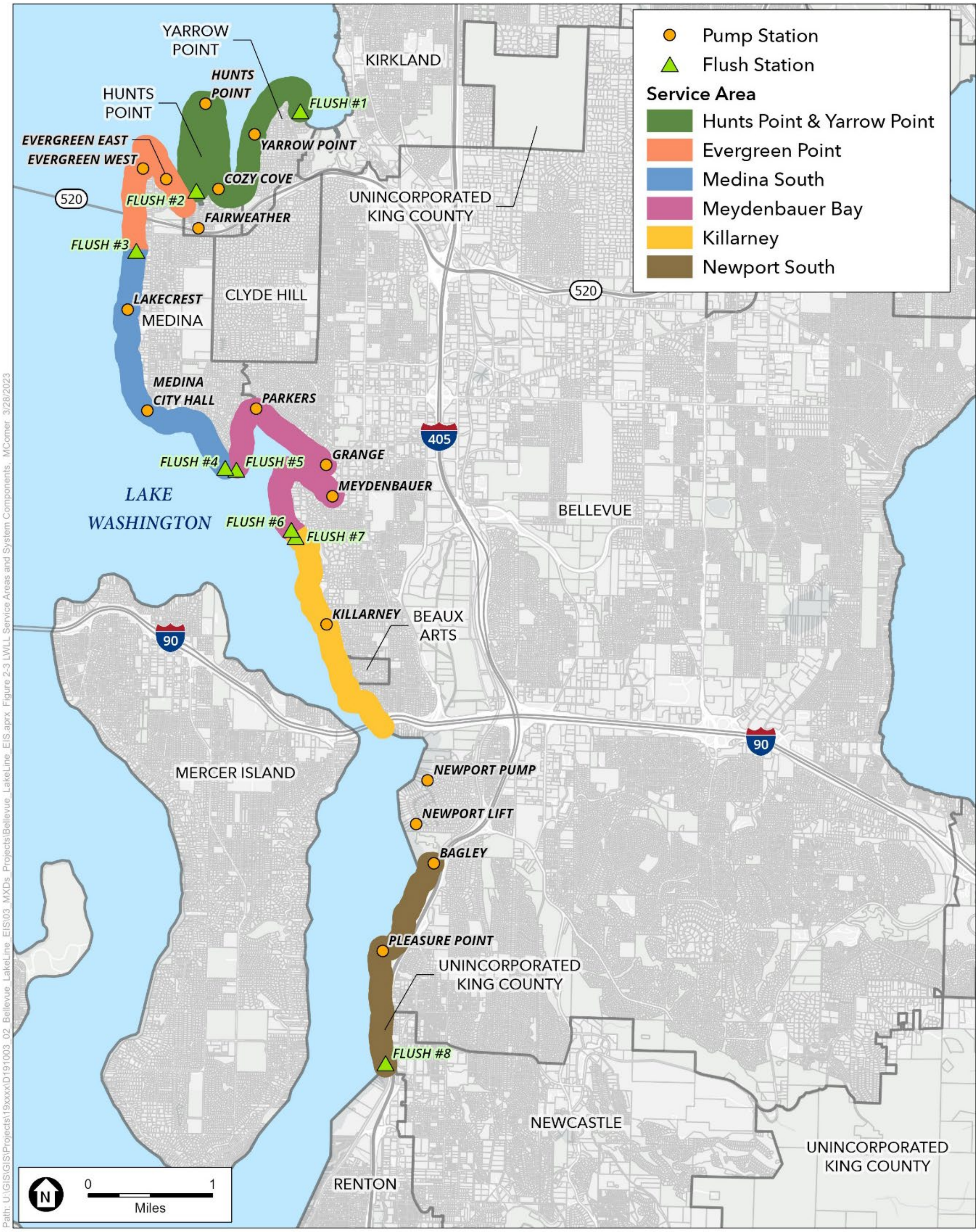
TABLE 2-1
SERVICE AREA LENGTH AND STATIONS

Service Area	Approximate Pipe Length (Linear Feet)[1]	Approximate Parcels Served[1]	Pump and Flush Stations
Hunts Point and Yarrow Point	16,755	587	Flush Station #1 Yarrow Point Pump Station Cozy Cove Pump Station Hunts Point Pump Station Flush Station #2
Evergreen Point	8,423	172	Evergreen East Pump Station Evergreen West Pump Station Fairweather Pump Station Flush Station #3*
Medina South	12,320	213	Flush Station #3* Lakecrest Pump Station Medina City Hall Pump Station Flush Station #4
Meydenbauer Bay	9,082	448	Flush Station #5 Flush Station #6 Parkers Pump Station Grange Pump Station Meydenbauer Pump Station
Killarney	12,965	336	Flush Station #7 Killarney Pump Station
Newport South	10,175	149	Pleasure Point Pump Station Bagley Pump Station Flush Station #8

1. Numbers are approximated based on the best available GIS information and are not confirmed by survey information.
* Note that Flush Station #3 is at Service Area boundaries and is necessary for the operation of the lake line system in both areas.

The Hunts Point and Yarrow Point Service Area serves approximately 587 parcels, which are zoned primarily as residential and contain approximately 154 private docks with interspersed bulkhead infrastructure. The existing zoning in the Hunts Point portion of the Hunts Point and Yarrow Point Service Area is single-family residential on lots ranging from 20,000 to 40,000 square feet (sq ft) (R20 and R40) and public use or town park property (Town of Hunts Point 2007 Zoning Map). Similarly, in the Yarrow Point section, the zoning is Public Uses and single-family residential (R-15). The public use zoning is composed of Road End Beach Park and the Wetherill Nature Preserve (Town of Yarrow Point 2015 Comprehensive Plan).

The Service Area is primarily low-intensity development land cover with some medium intensity developed areas and sparse evergreen and deciduous areas and woody wetlands in Wetherill Nature Preserve. All of the shoreline of the Service Areas is located within a moderate to high liquefaction hazard area. The Hunts Point and Yarrow Point Service Area also contains the following critical areas: a landslide deposit at the northernmost point of Yarrow Point adjacent to Lake Washington, and some steep slopes on the east side of Yarrow Point (see Section 3.2).



Sources: System Infrastructure: Carollo Engineers 2022; City Boundaries: WADNR 2022; Parcels: King County 2022

Bellevue Lake Line EIS

Figure 2-3
Lake Washington Lake Line Service Areas and System Components

Evergreen Point Service Area

The Evergreen Point Service Area (approximately 1.6 miles of lake line) covers a small portion of Hunts Point and the western side of the Fairweather Bay peninsula north of State Route (SR)-520; spans the lake line system into the City of Medina, Evergreen Point, and the portion of the system that intersects SR-520 perpendicularly; and ends approximately 0.4 mile south of SR-520.

The Evergreen Point Service Area serves approximately 172 parcels where the existing zoning is primarily single-family residential and parks and public places, including Lake Lane Park and Fairweather Nature Preserve and Park (Town of Hunts Point 2007 Zoning Map and City of Medina 2018 Official Zoning Map). There are approximately 72 private docks along the shoreline and a City of Medina dock at Lake Lane Park. The land cover in the Service Area is primarily open space and low-intensity development with medium to high-intensity development for SR-520 and interspersed forest cover. The shoreline of the Evergreen Point Service Area is within a moderate to high liquefaction hazard area and contains a small landslide deposit along the shoreline north of NE 24th Street.

Medina South Service Area

The Medina South Service Area (approximately 2.3 miles of lake line) encompasses most of the lake line system in the City of Medina, beginning at the southern terminus of the Evergreen Point Service Area south of SR-520, and extends along the shoreline of Lake Washington following the lake line system to the edge of Groat Point at Meydenbauer Bay and covering about half of the Groat Point peninsula inland.

The Medina South Service Area serves approximately 213 parcels and is zoned primarily as single-family residential and parks and public places, including Medina Beach Park and Viewpoint Park (City of Medina 2018 Official Zoning Map). There are approximately 75 private docks along the shoreline and a City of Medina dock at Viewpoint Park at 84th Avenue NE. The land cover in the Service Area is partially evergreen forest and open space development with areas of low to medium intensity development in the southern portion. The shoreline of the Medina South Service Area is within a moderate to high liquefaction hazard area and also contains the following critical areas: interspersed areas of landslide deposits west of Evergreen Point Road near 73rd Avenue NE and steep slopes along Lake Washington for the span of Evergreen Point Road.

Meydenbauer Bay Service Area

The Meydenbauer Bay Service Area (approximately 2.1 miles of lane line) covers the eastern portion of Groat Point, the lake line system along Meydenbauer Bay and Whalers Cove, and ends approximately where SE Shoreland Drive turns south as it intersects SE Shoreland Place. The Meydenbauer Bay Service Area is located partially in the City of Medina to the west and transitions into the City of Bellevue on the east approximately where Overlake Drive E meets Lake Washington Boulevard NE.

The Meydenbauer Bay Service Area serves approximately 448 parcels, which are zoned primarily as residential, specifically single-family residential in the City of Medina and single- and multi-family residential in the City of Bellevue and contains approximately 92 private docks (City of Medina 2018 Official Zoning Map and City of Bellevue 2015 Comprehensive Plan). Clyde Beach Park and Meydenbauer Bay Beach Park are located in the residential zoned areas as a land use compatible with the low residential density. The land cover in the Service Area is mostly low and medium density with higher intensity development near Downtown Bellevue and interspersed forested areas. The shoreline of the Meydenbauer Bay Service Area is also located within a moderate to high liquefaction hazard area and areas of landslide deposits along Overlake Drive E and SE Shoreland Drive, with steep slopes east of Overlake Drive E and adjacent to SE Shoreland Drive.

Killarney Service Area

The Killarney Service Area (approximately 2.1 miles of lake line) begins at the terminus of the Meydenbauer Bay Service Area south along the lake line system in the City of Bellevue, encompasses the lake line system in Beaux Arts Village, and extends approximately 0.2 mile south of Interstate 90 (I-90).

The Killarney Service Area is zoned primarily as single-family residential and public parks and public spaces, including Chism Beach Park, Burrows Landing Park, Chesterfield Beach Park, and Enatai Beach Park within Bellevue; it serves approximately 336 parcels and contains approximately 93 private docks (City of Bellevue 2015 Comprehensive Plan and Town of Beaux Arts Village 2015 Comprehensive Plan). The portion of the Service Area in the Town of Beaux Arts Village along the shoreline is privately owned by the Western Academy of Beaux Arts (incorporated in 1908) and was designated as Open Space under RCW 84.34 by the Town of Beaux Arts Village in 1972; single-family residential properties are on average more than 150 feet inland from the shoreline.

The land cover in the northern portion of the Service Area is a mix of open space, low-intensity development, evergreen and deciduous forested areas, and evergreen forest along the shore in Beaux Arts Village, with higher intensity development in the southern section near the I-90 bridge. The shoreline of the Killarney Service Area is located within a moderate to high liquefaction hazard area and contains the following critical areas: landslide deposits west of 94th Avenue SE and at Chism Beach Park; location atop the Seattle Fault Zone in the southern section of the Service Area, which puts the area at risk for shallow crustal earthquake and surface rupture; and steep slopes along most of the shoreline.

Newport South Service Area

The northern terminus of the Newport South Service Area (approximately 1.9 miles of lake line) is approximately 1.5 miles south of the southern terminus of the Killarney Service Area. The connecting pipeline between the Killarney Service area and the Newport South Service is located upland (the pipeline is not located in the lake in this segment). Beginning at the southern portion of Newcastle Beach Park, the Newport South Service Area extends following the lake line system in the southern portion of the City of Bellevue into unincorporated King County, parallels Interstate 405 (I-405) to the east and ends approximately 500 feet north of the Virginia Mason Athletic Center in Renton.

The Newport South Service Area serves approximately 149 parcels and within Bellevue is zoned as single-family residential and in King County as residential, with 6 dwelling units per acre (R-6) and contains approximately 98 private docks (City of Bellevue 2015 Comprehensive Plan and King County 2018 iMap). The land cover in the Service Area is mostly low to medium intensity development, which includes the I-405 roadway with some open space developed areas. Similar to the other Service Areas, the shoreline of the Newport South Service Area is also located within a moderate to high liquefaction hazard area, and contains the following critical areas: landslide deposits along Lake Washington Boulevard SE and Hazelwood Lane SE, location atop the Seattle Fault Zone putting area at risk for shallow crustal earthquake and surface rupture, and steep slopes adjacent to I-405.

2.5 EIS Alternatives

The City is considering four different alternatives in the Management Plan. Potential solutions could take place in the lake, on land, and on individual properties. It is important to note that different areas of the system will have different selected alternatives. There will not be one alternative selected for the entire lake line.

Consistent with SEPA, the non-project EIS also evaluates the No Action Alternative, which describes what would occur if the Management Plan Action Alternatives are not implemented and includes potential operational strategies. Development of the Management Plan is also part of the No Action Alternative by identifying strategies for operation and maintenance to consider if the Action Alternatives are not fully implemented.

2.5.1 In-Water Alternative

With the In-Water Alternative, any permanent system improvements to infrastructure would be generally located below the OHWM of Lake Washington (refer to Figure 1-1 for depiction). Depending on system components and conditions, system infrastructure would be relocated in-water or replaced in-water. If an in-water pipeline is decommissioned, the decommissioning would comply with permit conditions, but the pipeline segment would likely be emptied, capped at both ends, and left in place to minimize the risk of contamination or future issues. Removal of the pipeline segment would likely cause more disturbance to the lakebed to remove it than leaving it in place.

Various pipeline replacement technologies and rehabilitation approaches could be used. Implementation methods may include: gravity sewer line via open cut construction, gravity sewer line via trenchless construction, trenchless rehabilitation (cured-in-place pipe [CIPP], spiral-wound pipe [SPR], slip lining, pipe bursting, emerging technologies), new or retrofitted pump/flush stations, and associated improvements. Existing pump/flush stations are located on-shore, and new pump flush stations would be sited either on-shore or in upland areas.

2.5.2 On-Shore Alternative

In the On-Shore Alternative, any permanent system improvements to infrastructure would be generally located between the residence, park, commercial property and/or public space, and the OHWM of Lake Washington. Depending on system components and conditions, system infrastructure would be relocated or replaced on-shore (refer to Figure 1-2 for depiction).

Implementation methods may include: gravity sewer line via open cut construction, gravity sewer line via trenchless construction, a vacuum sewer system, as well as new or retrofitted pump/flush stations and associated improvements. Many of the existing stations have been recommended for upgrades, but verification of flows to each station will be conducted if flows to the station are altered because of improvements to other portions of the lake line.

2.5.3 Upland Alternative

In the Upland Alternative, any permanent system improvements to infrastructure would be generally located upland of the residence, park, commercial property and/or public space, and within the general vicinity of the public right-of-way. Depending on system components and conditions, system infrastructure would be relocated or replaced in the upland area (refer to Figure 1-3 for depiction).

Implementation methods may include: gravity sewer line via open cut or trenchless construction, grinder pump system, vacuum sewer system, new or retrofitted pump/flush stations, and associated improvements. Grinder pump systems and vacuum valve chambers would be located below ground. These components would vary depending on how many houses are connected to the lateral side-sewer line and which type of system is used. In general, the grinder pumps and vacuum valves are roughly 2 to 3 feet in diameter. See Section 2.6 below for a description of these methods.

Associated Facilities

Improvements to associated system pump and flush stations are also considered as part of each alternative. Improvement options range from replacement or upgrade of individual components, significant upgrades (i.e., adding odor control; major repairs that do not require replacement of the structure itself), or complete replacement of the pump/flush station structure. Impact analyses for pump and flush station improvement options are included in Chapter 4 of the Draft EIS, along with the EIS alternatives impact analyses per environmental resource topic.

2.5.4 No Action Alternative

SEPA requires that an EIS "*present a comparison of the environmental impacts of the reasonable alternatives and include the no action alternative*" (WAC 197-11-440 (5)(vi)). The No Action Alternative provides an understanding of what would occur if the Management Plan is not fully implemented. For this EIS, the No Action Alternative is defined as implementation of the same types of operation and maintenance activities that have occurred in the past and that are likely to continue into the future. The No Action Alternative would have no capital improvements. Under the No Action Alternative, the Management Plan would be adopted; however, the Action Alternative(s) would not be implemented.

The operation and maintenance of pump stations and flush stations and associated system infrastructure would continue in the existing locations as before. Maintenance would occur as incremental and uncoordinated repairs and replacements, and the system would not function optimally. The system components will eventually fail after extending the life where feasible by conducting emergency repairs, cleaning, and condition assessments, which could result in system failures and wastewater overflows.

Operational strategies are actions that are taken to maintain or limit degradation of the existing infrastructure. Methods may include review of operations procedures, cleaning and inspection, access improvements (maintenance hole, cleanout installation), data collection, and emergency repairs. They can also include tasks for planning or preparing for capital improvements.

The current and ongoing operational strategies are described below in Section 2.7.1 and 2.7.2.

2.6 Potential Construction Methods for Capital Improvement Strategies

Construction methods would be analyzed for future improvements for feasibility and applicability under each Management Plan Action Alternative, in combination with an evaluation of other factors (as described in Section 2.8), to determine the best strategy or strategies to implement for each Service Area. For the purposes of the impact analyses (Chapter 4 of the Draft EIS), the construction approaches (i.e., gravity sewer line, vacuum sewer, pipe bursting) were categorized as either open cut construction methods or trenchless construction methods to evaluate the potential impacts on a programmatic level for each potential Action Alternative (see **Table 2-2**). The alternative and construction methods selection process will consider and weigh the impact analysis, evaluation factors, and location constraints to determine the best construction method at any given location. More details on the evaluation factors, such as environmental, regulatory, social, technical, and cost, are included in Section 2.8. Various construction methods are described in **Appendix B** (included with the Draft EIS).

TABLE 2-2
ACTION ALTERNATIVES AND CONSTRUCTION APPROACHES AND METHODS

Alternative	Construction Method	Construction Approach
In-Water	Open Cut	Gravity Sewer Line via Open Cut Construction
	Trenchless	Gravity Sewer Line via Trenchless Technology
	Trenchless	Cured In-place Pipe (CIP)
	Trenchless	Spiral Wound Pipe (SPR)
	Trenchless	Slip Lining
	Trenchless	Pipe Bursting
	Trenchless	Emerging Technologies
On-Shore	Open Cut	Gravity Sewer Line via Open Cut Construction
	Open Cut	Vacuum Sewers
	Trenchless	Gravity Sewer Line via Trenchless Technology
Upland	Open Cut / Trenchless	Gravity Sewer Line via Open Cut Construction
	Trenchless	Gravity Sewer Line via Trenchless Technology
	Open Cut / Trenchless	Grinder Pumps
	Open Cut	Vacuum Sewers

2.7 Operational Strategies and Maintenance Proposed in the Management Plan

Operational strategies are actions that would be taken to maintain or limit degradation of the existing infrastructure. During the decision process for individual improvements on segments of the lake line, operational strategies and maintenance efforts may be used in conjunction with the alternatives identified.

2.7.1 Existing Maintenance

Existing maintenance for the lake line infrastructure is outlined in the 2015 City of Bellevue Wastewater System Plan and includes maintenance on the pipelines, flush and pump stations, and maintenance holes. Regular inspection, condition assessments, and cleaning are scheduled for maintenance holes and pipelines to prevent blockages or structural failure. Existing maintenance based on specific system infrastructure components is summarized below.

- **Pump Stations** – All pump stations are maintained on a monthly schedule. Inspection and wet well maintenance are performed during the first 10 business days of each month, and scheduled repairs and maintenance activities are performed during the remainder of the month. Routine minor repairs and cleaning and lubrication of pumps, controls, and pumping equipment are performed at each visit. Wet wells are hosed down until sludge and debris are discharged.
- **Flush Station** – Similar to pump station maintenance, flush stations are checked monthly to see that pumps, motors, dehumidifiers, and the 24-hour clock are working properly. The 24-hour clock controls operation of the flush station. Cell phone communication provides remote control of on/off capabilities of the flush stations.
- **Lake Pipelines** – Lake pipelines, classified as special case pipelines, have limited access, complicating preventive maintenance activities. Lake lines are cleaned primarily on an immediate response basis; some lake lines are on a regular cleaning schedule depending on past observed overflows and/or tendency for sedimentation. Cleanouts are opened and visually inspected for grease buildup.
- **Maintenance Holes** – Inspections are part of an ongoing maintenance hole survey program, and maintenance holes near lakes and other critical area buffers are surveyed more frequently. All maintenance holes are visually inspected for structural defects, system problems, and accessibility, with a goal of visually inspecting one-third of the system annually.

Maintenance on the existing wastewater lake line system includes implementation of emergency repair. Damage to wastewater system components could lead to spills of sewage or the inability of the treatment plant to process waste, allowing it to flow untreated into the local environment. Emergency repair activities are separate from planned repair and existing maintenance planning. Because of the immediate nature of emergencies, the repair options available are limited and focus on reducing the threat to the proper performance of essential wastewater system functions and services. The consequences associated with emergency repairs may be higher than typical maintenance operations since repair options would be limited and the required constrained timeframe.

2.7.2 Operational Strategies

Several actions can be taken to limit degradation of existing infrastructure as the Management Plan is being implemented. Operational strategies specific to the lake line system are categorized as follows and described in **Table 2-3**:

- Operations Procedure Review
- Cleaning and Inspections

- Access Improvements
- Data Collection
- Emergency Repair Planning

TABLE 2-3
OPERATIONAL STRATEGIES

Operational Strategy	Description
Operations Procedure Review	
Review Standard Operating Procedures (SOPs)	• Review the City's catalog of standard operating procedures specific to the lake line. Document and formalize any other routine maintenance tasks completed by staff that are not SOPs. Develop new SOPs where existing procedures are deficient.
Development Review	• Ensure that current standards relevant to the lake line are enforced. This could include permitting and inspection of any new lake line lateral side-sewers, docks, bulkheads, or significant grading activities.
Facility Review	• Develop standard procedures for asset inventories and condition assessments, to uniformly evaluate needed facility improvements.
Cleaning and Inspections	
Cleaning and Inspection	• Continue feasible routine cleaning and inspection of elements critical to lake line function (i.e., removal of debris from flush station and pump intakes, solids removal from pipes, etc.). • Consider purchasing additional or specialized maintenance equipment to expand City's in-house maintenance capabilities. • Evaluate the use of non-traditional cleaning methods (such as ice pigging that uses a two-phase ice and liquid slurry) to prevent further damage to aging pipes. • Inspect existing flush station inlet screens and replace if damaged or missing. • Conduct public outreach to educate customers on the importance of keeping FOG out of the sewer system.
Cleanout Modifications	• Continue work to raise cleanouts above lake surface.
Access Improvements	
Lake Line	• Improve future access and ability to locate lake line. This may include installation of vaults under the docks that can isolate a segment and allow bypass to clean between vaults. • Construct additional maintenance holes or access points near known occurrences of debris accumulation. Maintenance holes and vaults should be designed with sumps or other means of debris collection and removal in mind.
Pump and Flush Station Access	• Reduce public access to pump and flush stations by installing fencing or other barriers to reduce risk of damage or injury. • Construct permanent access for necessary maintenance equipment. • Obtain legal access to all pump and flush stations that currently do not have easements or public rights-of-way that supports how it is regularly accessed. • Coordinate with property owners to maintain existing landscaping around existing cleanouts, pump and flush stations to facilitate O&M access.
Data Collection	
Survey	• Confirm pipe size, material, and location of lake line pipe relative to shoreline. Feasibility of capital improvements depends primarily on location due to permitting restrictions and construction method limitations. • Confirm locations of exposed lake line pipe and monitor as storms may move rocks and expose new areas of pipe that could be subject to damage from nearshore activities.
Overflow Monitoring	• Implement a recirculation maintenance hole and pump station overflow monitoring system for recirculation maintenance holes that is linked to the telemetry/SCADA system.

Operational Strategy	Description
HGL at Cleanouts	• Monitor and log the HGL at cleanouts. This information can be used to identify failures in the lake line system that lead to unusual operating conditions, identify properties at highest risk for overflow damages, and calibration of the lake line system hydraulic model.
I&I Evaluation	• Complete I&I evaluation in areas where leaks are suspected (areas experiencing unusual pump/flush station cycling, previous breaks, visible leaks).
Customer Complaints	• Conduct public outreach to educate customers on what type of issues to report, how to reduce risks of damaging the existing infrastructure, and proper complaint channels. Log complaints in a database that is identifiable by location and relationship to lake line system.
Flush/Pump Station Operation	• Monitor the existing operation of flush and pump stations closely for deviations from typical operating conditions that may be indicative of a failure within the lake line system. This may require purchasing and installing additional monitoring equipment. • Install permanent flow meters downstream of pump stations to measure the combined customer and flushing flows.
Lateral Side-sewer Inventory	• Develop a database of existing lateral side-sewers identifying known parameters such as age, pipe material, location, replacement/repair history, and properties served.
Structure Inventory	• Develop a database of existing structures with the potential to damage the existing lake line or City-owned portion of lateral side-sewers (i.e., bulkheads, docks, landscaping features).
Condition Assessment	• Collect additional pipe assessments at locations near previous evaluations to track pipe degradation over time. • Conduct condition assessments of pump and flush stations that do not have a current evaluation. • Perform UT measurement of the pipe wall (or using other emerging pipe assessment technologies) where feasible and as allowed by permitting constraints. Conduct at regular intervals to validate RUL estimates.
Emergency Repair Planning	
Overflow SOP	• Develop plans to respond to overflows of the lake line system. Plan should identify documentation and reporting procedures, mitigation measures, and cleanup standards.
Pipe Failure SOP	• Develop a plan to respond to failures of the lake line pipe based on pipe size, material, condition, and location.

Abbreviations: SOP = standard operating procedure; FOG = fats, oils, and grease; HGL = hydraulic grade line; SCADA = supervisory control and data acquisition; I&I = infiltration and inflow; UT = ultrasonic thickness; RUL = remaining useful life

2.8 Implementation Approach and Timing

The Lake Washington Wastewater Lake Line Management Plan is intended to be used by the City to identify long-range operational and capital improvement strategies for the future repair, replacement, and maintenance of the existing sewer line located underwater and on land adjacent to Lake Washington. In combination with the identification of the preferred alternative (In-Water, Onshore, or Upland Alternative) for future repair and replacement of the aging system components, further evaluation and analysis will be performed to determine the best-suited construction method(s) at individual location(s) to implement the operational and capital improvement strategies. Improvements at the pump stations will be evaluated in each Service Area as part of the alternative selection process. Several evaluation factors such as environmental, regulatory, social, technical, and cost can be used by the City to select the alternative(s) to be implemented.

Different alternatives may be selected depending on the Service Area. Evaluation factors that will be considered will include the following factors (refer to **Figure 2-4**).

- **Permitting** – Evaluate the effort required to prepare and obtain the necessary permits from local, state, and federal agencies.
- **Environmental Impact** – Evaluate the extent of the impacts on regulated environmental resources (lake, wetland, stream, or associated buffers) and geologic hazards.
- **Right-of-Way and Easement** – Evaluate the extent to which land use rights would need to be acquired or modified to implement the alternative.
- **Performance, O&M** – Evaluate how the location of the lake line system impacts the ease and feasibility of long-term maintenance.
- **Constructability** – Evaluate the technical feasibility and risk associated with constructing the alternative.
- **Cost** – Evaluate the relative total cost of the alternative, including design, construction, mitigation, permitting, and life cycle.
- **Local Community and Stakeholders** – Evaluate the potential various impacts on or challenges to local residents, community groups and stakeholders.

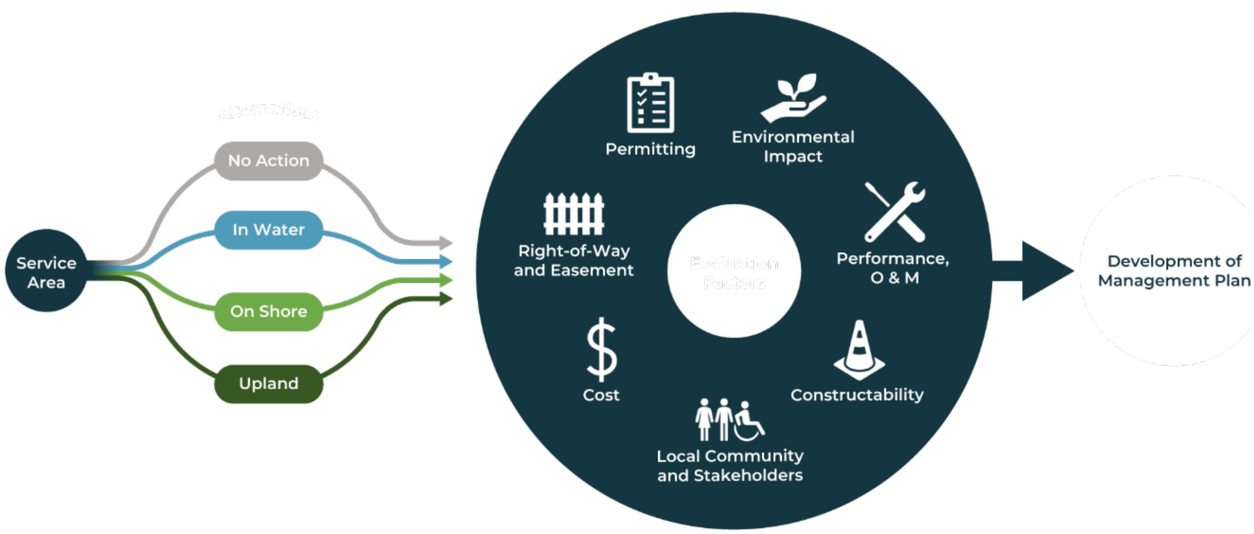


Figure 2-4
Alternatives Evaluation Process

The Management Plan includes risk-based prioritization and recommended capital and other system improvements of the lake line system that are intended to establish location priorities and guide future capital improvements; however, no specific capital projects are planned or proposed to be constructed as a result of the Management Plan. Recommended improvements are expected to be proposed for the near-term, medium-term, and long-term planning periods.

The Management Plan recommends the City implement the capital improvement strategies, preferred alternative(s) in each Service Area, in order of risk-based priority, with the highest risk Service Areas improved first for efficiency in system function, design, permitting, and outreach. The recommended timing for the proposed pump and flush station improvements in a Service Area does not follow the proposed implementation period for the Service Area that was based on the risk ranking of the overall Service Area. Per the 2015 Wastewater Pump Station Evaluation Final Report (MSA 2015), there are still pump and flush station that need improvements, and the interim recommended improvements have been proposed for the medium-term planning implementation period and prioritized for implementation by size of the recommended improvements, stations with a history of performance deficiencies and modeled performance deficiencies. Similarly, interim cleaning and inspection and pipe assessment projects have been split into phases so the City can complete these activities over the near-term planning period.

Only one Service Area, Meydenbauer Bay, has an implementation period for the preferred alternative(s) within the near-term planning period; however, interim actions including pump and flush station improvements, designation of emergency repair funds, and other system improvements are recommended in the same planning period across all Service Areas. Near-term improvements will largely depend on the availability of City resources. Implementation of near-term planning period activities for the Meydenbauer Bay preferred alternative include pump and flush station improvements (beginning with Evergreen Point pump and flush station improvements), cleaning and inspection, emergency planning, data collection and ongoing routine inspections, monitoring, complaint logging, emergency repairs, and public outreach and education.

The Newport South, Hunts Point and Yarrow Point, Killarney, Evergreen Point and Medina South Service Areas have implementation periods within the medium-term planning period, and Medina South Service Area has a recommended long-term implementation (planning) period. The Management Plan outlines the estimated implementation costs by planning period and outlines the typical alternative implementation and planning, which would apply to the Meydenbauer Bay Service Area first of the Service Areas.

2.8.1 Typical Implementation

Implementation of the capital improvement strategies, preferred alternative(s) in each Service Area, will occur in phases. The typical implementation phases will likely include the following: initiation of the capital improvements, a pre-design phase, design phase, and construction. The City can refine this process as the projects from each alternative are implemented in each Service Area. The typical implementation phases of the operational and capital improvement strategies, including the preferred alternative(s), in each Service Area are illustrated in **Figure 2-5**.

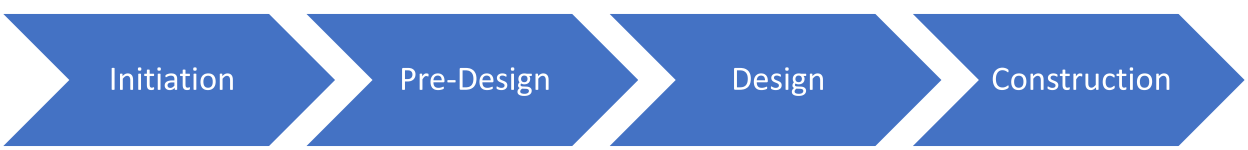


Figure 2-5
Typical Implementation Phases

Initiation steps could include project definition, scoping, preparation of the contractor acquirement, and internal data collection, followed by the pre-design phase. This phase may include conducting a conditions assessment, field data collection, additional analyses and modeling, planning-level cost estimating, and public outreach. During design, the next phase, agreements with agencies and jurisdictions could occur including easement and property acquisition agreements. Permitting, property acquisition, and additional public outreach and project-level cost estimating could occur during this step. The final phase is construction, where the capital improvements are constructed, the portion of the lake line system that was updated is operational, the replaced/existing lake line system portion is abandoned, and lessons learned are documented for future lake line projects. The construction phase may also include actions such as permit compliance and starting new or transitioning City staff to train for O&M of the portion of the lake line that was improved.

The implementation of the operational and capital improvement strategies, including the preferred alternative(s), in a given Service Area would encompass a relatively large geographic project area. As such, it is recommended that the City identify other planned improvements (transportation, other City utilities, major franchise utility projects) in the area to coordinate construction, permitting, and restoration where feasible. In addition to potential cost savings for the City, this can help prevent construction fatigue for residents, workers, and the traveling public in project areas.

CHAPTER 8

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Appendix D
Draft EIS Comments and Responses

APPENDIX D
Draft EIS Comments and Responses

Summary of Comments and Responses on the Draft EIS

This summary includes all comments received on the Draft EIS and responses to each of the comments. The Draft EIS was issued on Thursday April 6, 2023, and included a 30-day comment period, which ended on Monday May 8, 2023. A virtual public meeting on the Management Plan and a virtual public meeting on the Draft EIS was held on Tuesday April 18, 2023, from 6 to 7 p.m. with 12 attendees.

During the Draft EIS comment period, comments were submitted through the EIS comments email address, lakelineeis@bellevuewa.gov, and via phone call to the Project Manager. The Draft EIS received a total of seven comments from individuals and agencies.

This summary includes all of the comments received (by comment number), as organized by comments from individuals and government entities, and the City's responses to the comments received.

Reponses to Comments

No.	Name of Commenter/Comment	Response
Comments from Individuals		
1-1	**Dan Williams** *Hello, and thank you for the April 6 notice in the mail. I'm a resident of 4224 95th Ave NE, Yarrow Point, WA 98004. My question is just whether the Lake Line runs along or through my property. Thank you.*	The property located at 4224 95th Avenue NE, Yarrow Point, WA is adjacent to Lake Washington and may contain infrastructure associated with the lake line system. Refer to your property title information for specifics on lake line infrastructure location. Appendix A in the Management Plan (https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line) contains mapping of infrastructure in the Plan area.
2-1	**Richard Fade** *Hello,* *Thanks for the information on this process and running the public meeting next week.* *I have read the Draft EIS Statement in it's entirety – also the Lake Line Web site.* *The Draft EIS documents a broad range of options with dramatically different impacts on the community and adjacent landowners – but there is no proposed or draft plan. Public may not realistically provide any comment or reaction until such time a proposal is presented, all you are going to get with the information provided is – an understanding you are taking many complex factors under consideration and, fear.* *As a resident with a property adjacent to one of your pump stations (current tax assessment >$12m) I have a keen interest in what you are thinking to do next door to my home?* *Thank you!*	Thank you for your comment. The intent of the Draft Programmatic EIS is to study the potential environmental impacts associated with the potential actions that are included in the Management Plan. A non-project EIS was prepared on the Management Plan because the Plan is not a specific project, but rather a series of potential solutions for the lake line. The EIS was prepared to disclose probable significant adverse impacts associated with implementation of the Management Plan to repair, replace, and/or maintain the aging Lake Washington wastewater system. As such, improvement-specific impacts are not evaluated because they have not been identified at this time. The EIS documents a broad range of options to provide decision-makers and the public with an impartial analysis of the potential environmental impacts associated with implementation of the proposed Management Plan. The improvements selected in individual locations will vary between strategies for future repair, replacement, or maintenance. Some sections may not require work; others will require repair, replacement, or maintenance. Further evaluation and analysis will be performed to determine the best-suited construction method(s) at each individual location to implement the operational and capital improvement strategies. The City will select the alternative(s) to be implemented based on several evaluation factors such as environmental, regulatory, social, technical, and cost (further detailed in Section 2.8 of the Draft and Final EIS). As individual improvements are identified, site-specific environmental review and analyses will be conducted as required prior to implementation, which may include coordination with property owners of affected properties.

No.	Name of Commenter/Comment	Response
3-1	**Richard Fade** *Thank you for your kindness and patience in listening to me today and for explaining the process and many considerations the team evaluating the Lake Line Plan is taking into account. I have two observations I would like to share for your teams consideration. After speaking with you I realized my first comments are relative to an adjacent ongoing project not the Lake Line Project itself – I re-read the EIS and see this listed in the "Public Projects and Actions in the Plan Area" table: S16 Sewer Pump Station Improvements – Cozy Cove, Hunts Point, Evergreen East and West, and Fairweather Pump Stations* *Our property sits immediately adjacent and shares a property line to Evergreen East Pump Station – the existing facility is about 30 ft from the side wall of our home. This underground utility vault / pump station has worked well over the years – it suffers from old age and is in need of updating (some seals no longer function and it is difficult to contain fumes in the summer months when wastewater is not moving efficiently). My comment is – this facility is within public land – at the end of Lake Lane – as such it should be relatively easy to perform whatever excavation and replacement to update this pump station with minimal costs and mitigation. I would think replacing and continuing to operate this pump facility as it is today – updated with new more effective equipment is in the best interest of the City.*	Thank you for your input and feedback on the existing facility adjacent to your property. During the alternatives selection process as part of the Management Plan, the pump and flush stations will be evaluated for improvement options, which may include replacement or upgrade of individual components (such as the underground utility vault and seals), significant upgrades (e.g., adding odor control; major repairs that do not require replacement of the structure itself), or complete replacement of the pump/flush station structure. As noted in the Response to Comment 2-1, the City will consider several factors during the alternative selection process for the pump and flush stations (as detailed in Sections 1.8 and 2.8 of the Draft and Final EIS). The recommendation for the Evergreen East Pump Station in the Evergreen Point Service Area is noted.

3-2	*My second comment is related to the Lake Line Project itself .. I would like to address the future location of any proposed new or replacement line, I realize there is not a "one size fits all" approach which is going to work for every location and that the SEPA goes to great detail to represent the options and consequences of several approaches. In the area of Evergreen Point – specifically on the Fairweather Bay (east) side of the Point (my comment will be more uniformly true for this side of the point as the west side has more varied topography but may experience similar issues).*
	
	I would like to strongly recommend the plan consider various methods to replace the line with the current "In Water" location or "Upland" alternatives as is detailed in the DRAFT EIS
	
	• *The current In Water method has served the community well for decades and is an established easement in the community.*
	• *I do not believe "Alternative 2 On Shore" should be considered for this east side of Evergreen Point and potential the west side as well.*
	    – *Most residents had to install a rock bulkhead as part of the process of establishing a residence – this would mean the path of any pipeline (and easement) would need to move up slope from those bulkheads to be installed – this would put any easement and construction literally at many residents "back door". Hugely disruptive and intrusive.*
	    – *The area has extensive development and landscaping – the cost to rip up and restore these properties, including patios, landscaping, trees, hedges would be significant and prohibitive – especially in light of the fact you have*
		In combination with the identification of the preferred alternative (In-Water, On-Shore, or Upland Alternative) for future repair and replacement of the aging system, further evaluation and analysis will be performed to determine the best-suited construction method(s) at each individual location to implement the operational and capital improvement strategies. The alternative and construction methods selection process in all the Service Areas, including the Evergreen Point Service Area, will consider and weigh the impact analysis, evaluation factors (including impacts on private property owners), and location constraints to determine the best construction method in each location.
		
		As part of the process, the potential impacts on or challenges to local residents, community groups, and stakeholders, including construction impacts on residents and properties, will inform the selection of location-specific improvements to be evaluated. The right-of-way and easement evaluation factor will consider the extent to which land use rights would need to be acquired or modified to implement the alternative and will be a consideration in the selection of improvements when access is required, or existing infrastructure lies on private land. As individual improvements are identified, site-specific environmental review and analyses will be conducted prior to implementation, which may include coordination with property owners of affected properties.

No.	Name of Commenter/Comment	Response
	an existing easement where the pipeline is currently located – in the lake – which has served the community for decades. – *Placing an easement on so many homeowner's property when and easy easement already exists is likely to draw significant opposition from residents.* – *Maintenance / Access can also be a problem with the Onshore Plan – today the pipeline runs offshore in many places but it is also on shore under existing homeowners properties. I have been told in the past 24 months, by a City of Bellevue Wastewater technician – when servicing the pump station next to our home – that in summer when there is significantly less waste water flow – the pipeline stagnates a bit and needs to be stimulated / flushed – in one location in particular which is on the NW side of Evergreen Point which is underground under a residence sidewalk to their dock. The City employee explained to me "it would help us a lot to be able have access there but the City is reluctant to rip up a residence property to provide it .." moving to an Alternative 2 makes access problematic years after the installation and restoration of residents property. I am not making this up – this is an existing problem where the City has an onshore easement under a residents yard today, why would you create more of this?* – *In summary why would the City consider abandoning an existing easement which has worked well for decades in favor of imposing easements (real impact on property values) and significant development hardship on residents adjacent to the Lake?* • *The Upland option should be considered where public right of way can be disturbed to install pipeline and provide access for ongoing maintenance. This is similar to the Alternative 1 in that is an existing easement, controlled by the City – which can be manipulated without minimal impact on residents of Bellevue / Medina / Hunts or Yarrow Point.* *Thank you for considering my points above.*	
4-1	**Meredith Shank** *HI – thanks for the opportunity to comment. I live in Yarrow Point and would like to see the sewer pipe removed from the water where there are too many potential harms to the water, fish and wildlife and our human in and on water recreation. From looking at the EIS, I believe that locating the lake line on land using the trenchless method provides the least harm to the environment and to neighbors over the long term.* *Thank you.*	Thank you for your comments. In combination with the identification of the preferred alternative (In-Water, On-Shore, or Upland Alternative) for future repair and replacement of the aging system, further evaluation and analysis will be performed to determine the best-suited construction method(s) at individual location(s) to implement the operational and capital improvement strategies. The alternative and construction methods selection process in all the Service Areas, including the Service Area containing Yarrow Point, will consider and weigh the impact analysis, evaluation factors (including environmental impact), and location constraints to determine the best construction method in each location. The process will evaluate the extent of the impacts on regulated environmental resources (lake, wetland, stream, or associated buffers) and geologic hazards in the near term and long term and will inform the selection of location-specific improvements. The "Performance, Operations, and Maintenance" Evaluation Factor will evaluate the feasibility of long-term maintenance and potential impacts (factors further detailed in Section 2.8 of the Draft and Final EIS). As individual improvements are identified, site-specific environmental review and analyses will be conducted prior to implementation.

No.	Name of Commenter/Comment	Response
Comments from Government Entities		
5	**Washington Department of Archaeology & Historic Preservation (DAHP)** *Please see the attached letter from the DAHP commenting on the Draft EIS for the Lake Washington Lake Line Management Plan. As outlined in our letter, we agree that all three project alternatives have a high likelihood of impacting archaeological resources. The In Water Alternative is less likely to encounter protected archaeological resources, however, all three alternatives may impact resources. Therefore we agree with the recommendations in the Draft EIS that a cultural resources survey be conducted in advance of ground disturbing activities associated with the project once an alternative is selected.* *One note. The report states that Governor's Executive Order 05-05 will have to be followed if State capital budget funded is used for the project. In the letter we note that the executive order has been updated to Governor's Executive Order 21-02. We recommend the Final EIS be updated to include the updated number.*	Responses to the comments in the attached letter are presented below. The agreement with the potential impacts on archaeological resources under the alternatives is noted. The recommendation to conduct a cultural resources survey before ground-disturbing activities associated with projects is noted and is consistent with Section 5.9, *Measures to Reduce or Eliminate Potential Impacts on Cultural Resources*, of the Draft EIS. The Final EIS will reference the latest executive order number, currently Governor's Executive Order 21-02.

COMMENT	RESPONSE

Comment No. 5

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

April 21, 2023

Reilly Pittman
Planner
City of Bellevue

In future correspondence please refer to:
Project Tracking Code: 2022-12-08376
Property: City of Bellevue _ Lake Washington Wastewater Lake Line Management Plan _ 22-112187-LE
Re: Archaeological Survey Work Requested; Built Environment Assessment of Any Historical Period Buildings/Structures Impacted

Dear Reilly Pittman:

5-1 The Washington State Historic Preservation Officer (SHPO) and Department of Archaeology and Historic Preservation (DAHP) has been provided with documentation regarding the above referenced project. As a result of our review, our professional opinion is that the project area has the potential to contain archaeological resources and has the potential to impact built environment resources.

5-2 We have reviewed the DRAFT EIS Document and agree with the conclusions and recommendations in Section 3.9 Cultural Resources. Specifically, we agree that all three alternatives (In Water, On Shore, and Upland) have the potential to impact protected archaeological resources.

- The In Water alternative, as it is off-shore of the historic shoreline, is most likely to impact submerged resources, such as precontact period dugout canoes and fish weirs, historical period boats and piers, and other sunken resources.
- Both the On Shore and Upland alternatives have the potential to impact precontact period villages, camps, and processing areas, as well as a variety of historical period resources. Although the On Shore and Upland areas are heavily developed in many areas, archaeological sites are often found below roads and historical period construction and are often found during utility replacement projects in urban areas.

5-3 The DAHP recommends that once an alternative is selected, that a professional archaeologist assess the route of the proposed work through subsurface testing, and/or monitoring if testing in advance is not feasible due to hardscaping and existing utilities. If any historical period buildings/structures may be impacted by the project, appropriate Historic Property Inventory Forms (HPIFs) should be completed and reviewed by the DAHP. The DAHP requests the opportunity to review any archaeological survey/monitoring plans and any resulting cultural resource reports and documentation.

5-4 We also recommend consultation with the concerned Tribes' cultural committees and staff regarding cultural resource issues prior to the initiation of ground disturbing activities.

State of Washington • **Department of Archaeology & Historic Preservation**
P.O. Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065
www.dahp.wa.gov

5-1 Comment noted.

5-2 Your comments are noted. The statements regarding the potential impacts from the In-Water Alternative on submerged resources and the On-Shore and Upland Alternatives on precontact period areas, historical period resources, and archaeological sites are consistent with Section 4.9.1 of the Draft EIS.

5-3 The recommendation that a professional archaeologist assess the proposed improvements is noted and is consistent with Section 5.9, *Measures to Reduce or Eliminate Potential Impacts on Cultural Resources*, of the Draft EIS. Potential mitigation measures in the Draft EIS also include preparation and implementation of an Archaeological Monitoring Plan and monitoring of select areas by a professional archaeologist during ground-disturbing activities. The City will continue to coordinate with DAHP as individual improvements are identified and move forward. As appropriate, Historic Property Inventory Forms and archaeological survey/monitoring plans and/or cultural resource reports and documents will be submitted for review.

5-4 The recommendation to consult with concerned Tribes' cultural committees and staff is noted and consistent with the potential measures in Section 5.9, *Measures to Reduce or Eliminate Potential Impacts on Cultural Resources*, of the Draft EIS.

COMMENT	RESPONSE

Comment No. 5

5-5 If any federal funds or permits are associated with this proposal, Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800, must be followed. This is a separate process from both the NEPA and SEPA environmental review processes and requires formal government-to-government consultation with the affected Tribes and the SHPO.

5-6 If State capital budget funding is utilized by the project, then the Governor's Executive Order 21-02 (formerly GEO 05-05) must be followed.

5-7 These comments are based on the information available at the time of this review and on behalf of the SHPO in conformance with Washington State law. Should additional information become available, our assessment may be revised.

Thank you for the opportunity to comment on this project and we look forward to receiving the survey design and any resulting reports and forms. Please ensure that the DAHP Project Number (a.k.a. Project Tracking Code) is shared with any hired cultural resource consultants and is attached to any communications or submitted reports. Should you have any questions, please feel free to contact me.

Sincerely,

Stephanie Jolivette
Local Governments Archaeologist
(360) 628-2755
Stephanie.Jolivette@dahp.wa.gov

State of Washington • **Department of Archaeology & Historic Preservation**
P.O. Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065
www.dahp.wa.gov

5-5 The potential for adherence to Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations, 36 CFR 800, is noted and is consistent with the Fact Sheet for the Draft EIS, which identifies Section 106 as one of the potential consultations and approvals that may be required as individual improvements are identified.

5-6 The Final EIS will reference the latest executive order number, currently Governor's Executive Order 21-02. The latest Governor's Executive Order will be followed if state capital budget funding is utilized for any individual improvements.

5-7 The City will continue to coordinate with DAHP as individual improvements are identified and move forward. The DAHP Project Number (Project Tracking Code: 2022-12-08376) will be attached to any future correspondence with DAHP accordingly.

No.	Name of Commenter/Comment	Response
6	**King County Wastewater Treatment Division** *Attached please find King County Wastewater Treatment Division's comments on the Draft Environmental Impact Statement (DEIS) for the Lake Washington Wastewater Lake Line Management Plan (LWWLL), project 22-112187-LE. Our agency has facilities in the vicinity of the proposed project site.* *Thank you for the opportunity to review and comment on this project.*	Responses to the comments in the attached letter are presented below. Coordination with King County Wastewater Treatment Division (WTD) will be conducted for any proposed improvements or projects located in the vicinity of the listed facilities under the jurisdiction of King County.

COMMENT	RESPONSE

Comment No. 6

King County
Department of Natural Resources and Parks
Wastewater Treatment Division
King Street Center, KSC-NR-5505
201 South Jackson Street
Seattle, WA 98104-3855

May 1, 2023 — sent via email: LakeLineEIS@Bellevuewa.gov
KC OAP Ref No.: 1951

Reilly Pittman
City of Bellevue
450 110th Avenue NE
Bellevue, WA 98004

Dear Reilly Pittman:

6-1 The King County Wastewater Treatment Division (WTD) has received the Draft Environmental Impact Statement (DEIS) for the Lake Washington Wastewater Lake Line Management Plan (LWWLL), project 22-112187-LE, that proposes Bellevue Utilities is developing a management plan to identify long-term operational and capital improvement strategies for the future repair, replacement and maintenance of the 14.6 miles of existing sewer line located underwater or on land adjacent to Lake Washington, as well as 15 pump/lift stations and 8 flush stations, in the cities of Bellevue, Beaux Arts, Medina, Hunts Point, Yarrow Point, and unincorporated King County.

6-2 **King County facilities, the Enatai Interceptor and the Medina Pump Station outfall are located in the LWWLL and DEIS project area. (See enclosed map showing the location of the WTD facility in the project vicinity).**

In order to protect these wastewater facilities, **WTD requires that City of Bellevue submit construction drawings for specific projects identified in the LWWLL management plan/DEIS as they move into implementation,** so that WTD can assess potential impacts. Please send drawings to:

Local Public Agency Program
King County WTD, Engineering and Technical Resources
201 South Jackson Street, KSC-NR-0503
Seattle, WA 98104-3855
(206) 477-5414 / lpa.team@kingcounty.gov

6-3 **King County has permanent easements for sewer lines in the LWWLL and DEIS project area and must be assured the right to maintain and repair the WTD sewer lines.** In the event that the lines must be relocated, a new permanent easement must be provided. Please contact King County regarding this easement, at:

Bill Wilbert
Permitting Compliance and Property Acquisition
King County Wastewater Treatment Division
201 South Jackson Street, KSC-NR-0512

RESPONSE

6-1 Comment noted.

6-2 The City acknowledges that the following King County facilities, the Enatai Interceptor and the Medina Pump Station outfall, are located in the LWWLL Plan area (as shown on the enclosed map). The City will continue to coordinate with King County as individual improvements are identified and implemented, and drawings will be sent to the indicated address, as appropriate.

6-3 King County's permanent easements in the LWWLL Plan area are noted, in addition to the right to maintain and repair the WTD sewer lines. The City will continue to coordinate with King County WTD as individual improvements are identified and implemented and should the need for a new permanent easement arise.

COMMENT	RESPONSE

Comment No. 6

May 1, 2023
Page 2 of 2

6-3 Seattle, WA 98104-3855
(206) 477-5523 / bill.wilbert@kingcounty.gov

Thank you for the opportunity to review and comment on this proposal.

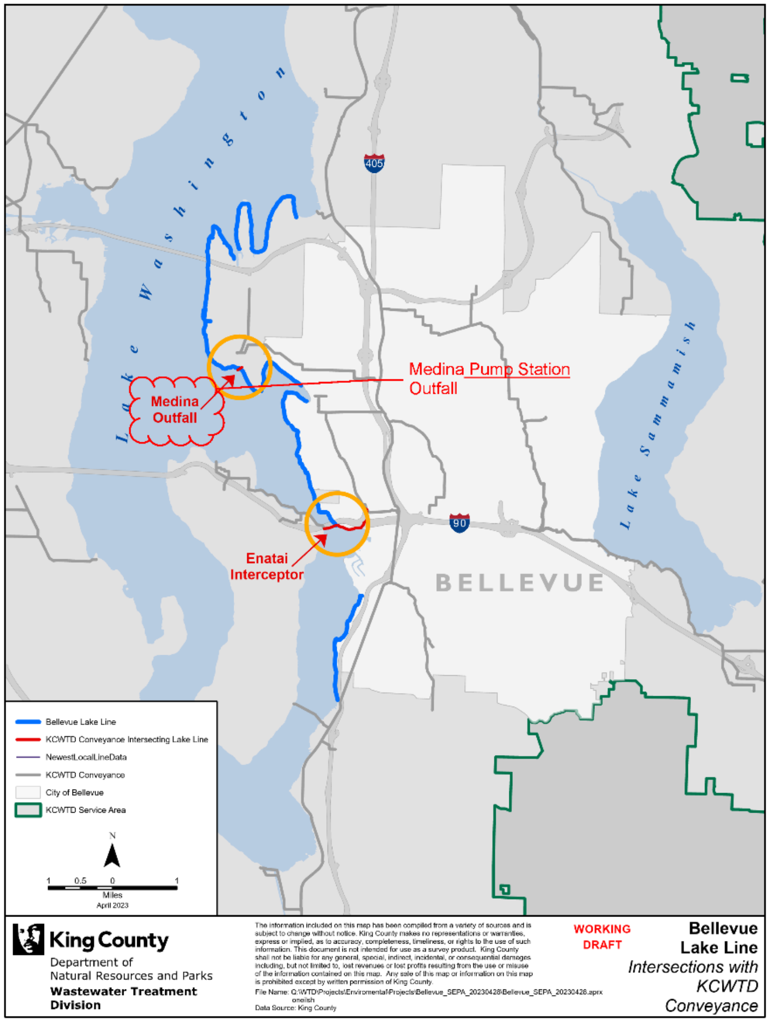
Sincerely,

Rachael Hartman

Rachael Hartman
Environmental Planner

cc: Mark Lampard, Local Public Agency Coordinator
Claire Christian, Permitting Compliance and Property Acquisition

Enclosure

COMMENT	RESPONSE
Comment No. 6 	6-2 See Response to Comment 6-2.

No.	Name of Commenter/Comment	Response
Comments from Corporation		
7	**Western Academy of Beaux Arts Board of Trustees** *Thank you for allowing us submit corrections to the Draft EIS on behalf of the Western Academy of Beaux Arts. We look forward to partnering in the planning for the sewer line upgrade. Attached is a letter with our corrections to the EIS. Please let us know if you have any questions.*	While this letter was received after the comment period had closed, it has been included for reference and factual correction. Coordination with Western Academy of Beaux Arts (WABA) will be conducted for any proposed improvements or projects located in the vicinity of WABA property.

COMMENT	RESPONSE

Comment No. 7

7-1 May 18, 2023

Angela Chung, PE, LEED-AP
Senior Utilities Engineer
City of Bellevue
Bellevue Utilities
450 110th Avenue NE
Bellevue, WA 98004

Sent via email to LkWaLakeLine@bellevuewa.gov

Dear Angela,

7-2 As the **shoreline and tidelands** landowner within the Town of Beaux Arts Village, the Western Academy of Beaux Arts (WABA) would like to offer the following corrections and comments to the Lake Washington Wastewater Lake Line Management Plan SEPA Draft Environmental Impact Statement (EIS).

The City of Bellevue Utilities has an indeterminate wastewater system through WABA property, for which a utility easement will need to be negotiated, regardless of the outcome of your project. WABA has a current unrecorded survey of the sewer pipes along with other of its facilities. As President of the WABA Board of Trustees, our board and I look forward to future discussions on this topic before any right of way plans are completed.

Per Angela Chung's conversation earlier this month with WABA Vice President, Carrie Oliver, we are writing to 1) Provide suggested corrections to the EIS and 2) Offer context on WABA outside of the EIS for your team's background and knowledge.

Corrections To EIS

7-3 Last paragraph on page 2-9 that flows into 2-10.
The Killarney Service Area is zoned primarily as single-family residential and public parks and public spaces, including Chism Beach Park, Burrows Landing Park, Chesterfield Beach Park, and Enatai Beach Park within Bellevue; it serves approximately 336 parcels and contains approximately 93 private docks (City of Bellevue 2015 Comprehensive Plan and Town of Beaux Arts Village 2015 Comprehensive Plan). The portion of the Service Area in the Town of Beaux Arts Village along the shoreline is privately owned by the Western Academy of Beaux Arts (WABA, incorporated in 1908) and was designated as Open Space under RCW 84.34 by the Town in 1972; single-family residential properties are on average over 150-feet inland from the shoreline.

Table 3.1-1
Column 3, Row 5 (Killarney)

- Single family
- Privately owned Open Space adjacent to Single Family Residential.

Responses

7-1 Although this comment was received after the comment period ended on May 8, 2023, it has been included in the comment summary.

7-2 The City acknowledges that WABA is the shoreline and tidelands landowner within the Town of Beaux Arts Village and that a utility easement will need to be negotiated. The City will continue to coordinate with WABA as individual improvements are identified.

7-3 Updates to the last paragraph as noted on pages 2-9 and 2-10 will be made in the Final EIS. No substantial updates to Chapter 3 are required for the Final EIS; as such, the chapter will not be updated; however, the updates to Table 3.1-1 are noted.

COMMENT	RESPONSE
Comment No. 7	7-4 The overview of WABA and its relationship to the Town of Beaux Arts Village has been noted.

7-4

Background on WABA

Outside of the EIS, at Angela's suggestion we wanted to provide a brief overview of WABA and its relationship to the Town of Beaux Arts Village.

The Western Academy of Beaux Arts (WABA) is a non-profit corporation that owns, operates and maintains in trust the 1,100 feet of Lake Washington shoreline in the Town of Beaux Arts Village, Washington. WABA is managed by an elected Board of Trustees and funded through an annual property assessment required by Covenant of all property owners within the unrecorded plat of Beaux Arts Village. This private property, also known as the WABA Beach and Commons area, was established in 1909 for the enjoyment of and use by WABA members and their accompanied guests.

The elected WABA Board of Trustees (Board) is responsible for managing, operating, maintaining, and improving the Corporation's shoreline assets, which include a swim beach and docks, boat moorage for over 55 watercraft, multiple picnic areas, an off-leash dog area, children's play areas, tennis/pickleball courts, private access roads and parking areas, and surrounding woodlands and trails. WABA also owns open spaces on the Town of Beaux Arts Village's northern and southern borders and a few other areas within the Town of Beaux Arts Village. In addition, WABA owns the first class shorelands/tidelands adjacent.

Conservation and celebration of the Arts are WABA's top priorities. Our roughly five-acre waterfront and woodlands contain dozens of old growth, significant, and younger Douglas Fir, Western Cedar, Coast Redwood, and Big Leaf Maples, several of which run just a few feet back from the shoreline. The property is also home to many other trees and native foliage, a pair of nesting Bald Eagles, and a multitude of other wildlife both aquatic and terrestrial.

Some of the conservation efforts we have made over the years include restoration of our shoreline in partnership with the Lake Washington / Cedar / Sammamish Chinook Salmon Recovery Plan and the King Conservation District to support salmon habitat; The Puget Sound Commission to minimize stormwater impacts on Lake Washington; and a years-long Woodlands Restoration Project to ensure the health of our forest and overall flora, which included replacing non-native plants with appropriate native species, removing ailing trees and shrubs, and planting a new generation of protected large and small coniferous and deciduous trees.

We look forward to future discussions regarding a utility easement and your Lake Washington Wastewater Lake Line Management Plan project.

Sincerely,

Jeff Avansino
President, Western Academy of Beaux Arts Board of Trustees
(206) 356-1727
jeff.avansino@gmail.com

Appendix E
Community Outreach Summary

Prepared for:

Prepared by:

Lake Washington Wastewater Lake Line Management Plan

Community Outreach Summary

Spring 2022 – Spring 2024
Development of the Lake Line Management Plan

Table of Contents

Project background

The City of Bellevue’s Lake Lines are a portion of the sewer system located along the shorelines of Lake Washington and Lake Sammamish. The Lake Washington Wastewater Lake Line is the portion of the system that runs through the lake and adjacent to the shoreline of Lake Washington. It includes 14.6 miles of sewer line with 15 pump stations and eight flush stations along the shoreline.

This infrastructure serves more than 1,000 community members in Bellevue and neighboring communities. However, pipes in the lake line system are aging, and the aquatic environment creates challenging conditions for repair and replacement activities. The Lake Washington Sewer Lake Line Management Plan was developed to effectively assess lake line conditions and plan for the management and maintenance of the lake lines. The plan will help ensure the City can continue to provide safe and reliable sewer service to the community. Equally important, it will help us protect public health and the delicate Lake Washington ecosystem.

Report summary

Hearing from community members is a critical part of Bellevue Utilities’ planning and decision-making process. From July 2022 to December 2023, the project team conducted virtual public meetings, provided community briefings, published several online open houses with accompanying community surveys, and hosted a series of in-person community events to collect input from project neighbors and partnering jurisdictions. The project team incorporated community feedback into the management plan alternative analysis and environmental documentation. This report summarizes the Bellevue Utilities’ community outreach efforts and feedback received from the community.

By the numbers

- Engaged 21 community partners for project briefings
- Hosted a virtual public meeting with 12 attendees
- Hosted in-person pop-up events across eight locations
- Engaged communities in eight languages (Simplified Chinese, Traditional Chinese, English, Japanese, Korean, Russian, Spanish, Vietnamese)
- Sent two postcards to 6,342 residents each time
- Hosted two online open houses with 1,200 total visitors throughout the project
- Fielded two community surveys with 27 total respondents
- Published three “It’s Your City” articles
- Posted four social media posts
- Published three website updates
- Distributed 15 posters to nine community locations

Community engagement goals

The project team engaged the community and local partners to:

- Build and maintain public support by sharing how the project will benefit the community.
- Raise awareness of the importance of Lake Washington lake line, as well as the needs, challenges and impacts for lake line rehabilitation and/or replacement.
- Communicate the repercussions to the community and Lake Washington if no action is taken to rehabilitate and/or replace the aging lake line.
- Lay groundwork and develop strong community relationships for future improvement projects that could include planning, design, and construction phases.
- Identify the needs of audiences directly affected by lake line rehabilitation or replacement.
- Share information early and often to ensure transparency and prevent surprises.
- Provide opportunities for public input during key steps of the project and incorporate audience feedback into project decisions.

Informed consent principles

The project team followed guidelines of informed consent to provide clear and transparent communication about the project and opportunities for public involvement. The project team used the following informed consent principles during outreach:

- Be clear about what problem the project is solving and why it is important.
- Establish the City's legitimacy as the right entity to solve the problem, and that it would be irresponsible to not address it.
- Be transparent about who is potentially affected, the problems and opportunities that the solutions solve or address and the benefits to the community of managing the lake line in contrast to not doing anything.
- Provide ample and early opportunities for engagement, while shifting the approach over time to adapt to each phase of the project.
- Be clear and transparent about the decision-making process and share how public feedback will be incorporated into that process.

Priority audiences

The project team prioritized engagement with audiences who will be directly impacted when the projects outlined in this planning effort are implemented. This included people who live, work, or recreate in the project service areas as well as Bellevue Utilities ratepayers. Additionally, the project team engaged community or advocacy groups who may have interest in the lake line system, as well as permitting authorities, and partner jurisdictions who may have decision-making authority on future work.

See **Appendix A** for a detailed list of audiences in the project area.

Community engagement report

The project team engaged community members virtually and in-person. The engagement approach included the following activities:

- **Briefings to local partners:** Between January and March 2023, the project team conducted outreach to local agencies and community groups to share information about the project background and timeline, offer an opportunity for an in-person or virtual project briefing, gather initial impressions, identify concerns, and answer questions. For those interested in the briefing opportunity, the project team prepared a Lake Line 101 presentation to share the project background, Programmatic EIS and Management Plan alternatives, evaluation factors for alternatives, and the evaluation approach before answering questions from participants. See **Appendix B** for a summary of outreach and briefings provided to local partners.
- **Virtual public meeting:** In spring 2023, the project team encouraged community members to participate in the Draft Environmental Impact Statement (DEIS) public comment period. The project team promoted the DEIS comment period by sharing posters at community locations and by hosting a virtual public meeting for community members to ask questions or share testimony. The project team hosted a virtual public meeting via Zoom Webinar on April 18, 2023. The project team shared a brief presentation with the group describing the project and the EIS process. The team then facilitated a public testimony period for attendees. See **Appendix C** for a summary of the virtual public meeting.
- **Online open houses:** To encourage community input, Bellevue Utilities hosted two online open houses on EngagingBellevue.com. The first online open house promoted the DEIS public comment period in spring 2023. The second online open house was to solicit feedback on alternatives analysis in summer/fall 2023. A total of 1,200 participants engaged with both online open houses to learn more about the project and share feedback. See **Appendix D** for more details about the online open houses.
- **Pop-up events:** In September 2023, the project team conducted community outreach in parks, along trails, and at community events near the project service areas. Creating opportunities for engagement at community-centered events and gathering places allowed for those who don't actively seek or lack resources pertaining to City-based projects to stay involved and to share their input. These pop-up events were designed to share information about the project and solicit input on the prioritization factors being used to analyze the project alternatives. See **Appendix E** for a summary of the pop-up events.
- **Community survey:** The team hosted two opportunities to provide feedback via online surveys throughout this project, one for the DEIS public comment period and one during the analysis of potential alternatives. During the alternative selection, the team hosted a community survey on the project website, promoted through community pop-up events and other notifications. Nineteen people responded to the survey. They provided

information about in which services areas they live, work, or play, how they would prioritize consequences of lake line failure, priorities for evaluation criteria for each alternative, how they prefer to be notified about project updates, and any other feedback they wanted to share with the project team. See **Appendix F** for a summary of survey data and **Appendix H** for a full list of comments.

Notifications

The project team encouraged community participation in outreach activities through the following channels:

- Multilingual postcard mailing to people living and working near the project area
- Social media announcements on the City's Facebook and X (Twitter) pages
- Email notices sent to email listserv subscribers
- Announcements on the project website
- Articles in the "It's Your City" quarterly newsletters
- Multilingual flyers distributed to jurisdictional partner and popular gathering spaces near the project area

See **Appendix G** for photo examples of project notifications.

Key themes

For the development of the management plan, we asked communities to provide input to help inform the final recommended alternatives. The project team incorporated themes from the in-person and virtual conversations and online survey data into their analysis. What we learned from the community feedback includes:

- When asked about the most important consequences to consider in the event of a lake line failure, the majority of people prioritized the difficulty of repair or replacement of a lake line, the number of customers impacted, and the risk to the environment. These themes were repeated in comments received throughout the project.
- When asked about the most important evaluation factors for alternative selection, community members ranked impacts to land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important. This echoes the themes mentioned above.
- Some people shared a desire to maintain Lake Washington's water quality and to protect native habitat. Additionally, people expressed desire to implement a long-term and sustainable solution so that service can continue be provided for years to come without further disruption to Lake Washington or personal property. Lastly, people expressed concerns over the cost of the maintenance of the lake lines, but consistently encouraged the project team to prioritize the impacts to the community members over the cost of the project.

- Bellevue Utilities learned that most people engaging with this project lived, worked, or played in the Meydenbauer Bay or Medina South service areas. The team also learned that most people preferred that Bellevue Utilities keeps them informed about this project via emails, postcards, and "It's Your City" articles.

See **Appendix H** for a full list of public comments.

Incorporating public input

The themes reported in this document were used by the project team to verify the EIS scoping and to inform the preferred alternative(s) for the management plan. With the EIS and Management Plan now complete, Bellevue Utilities anticipates formal adoption of the management plan with the next update to the City's Wastewater System Plan, currently anticipated in 2026. The project team is committed to ongoing engagement and will continue to inform the public before data collection, design or construction begins for any service area.

Accessibility

In compliance with Title VI, the City attached accessibility statements to all public materials:

- For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city's ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

정보 Information 情報
Información معلومات
సమాచారం Информация
اطلاعات Thông Tin
सूचना 425-452-6800 資料

Appendix A – Audience spreadsheet

Name	Audience category
Beaux Arts Village Town Clerk	City department or other agency
Bellevue Chamber	Business
Bellevue Christian School – Three Points Elementary	School or childcare facility
Bellevue Parks and Recreation	City department or other agency
Boys & Girls Club of Bellevue	School or childcare facility
City of Bellevue Environmental Services Commission	City department or other agency
City of Bellevue Marinas	Boating facility
City of Clyde Hill	City department or other agency
City of Medina - City Manager's office	City department or other agency
City of Medina - Development Services	City department or other agency
City of Medina - Public Works	City department or other agency
City of Newcastle - City Manager's office	City department or other agency
City of Newcastle - City Manager's office	City department or other agency
City of Newcastle - Public Works	City department or other agency
City of Newcastle - Public Works	City department or other agency
City of Yarrow Point	City department or other agency

Enatai Elementary School	School or childcare facility
First Church-Christ Scientist	Cultural or religious organization
Killarney Circle Pool	Social service
King County	City department or other agency
Medina Elementary School	School or childcare facility
Medina Market	Business
Meydenbauer Bay Yacht Club	Boating facility
New Hope International Church	Cultural or religious organization
Newport Hills Community Club	Neighborhood group
Newport Yacht Club	Boating facility
NW Lifestyle Homes	Business
Old Bellevue Chevron Auto Repair	Business
Overlake Golf & Country Club	Business
Seattle Boat Company – Newport	Boating facility
Seismic Northwest	Business
St. Mary-on-the-Lake Peace & Spirituality Center	Cultural or religious organization
St. Thomas School	School or childcare facility
The Greater Newcastle Chamber of Commerce	Business
The Well Community Church	Cultural or religious organization
Town of Beaux Arts Village	City department or other agency

Town of Beaux Arts Village	City department or other agency
Town of Hunts Point	City department or other agency
US Army Corps of Engineers	City department or other agency
Villaggio on Yarrow Bay	Property owners and tenants
Virginia Mason Athletic Center	Business
Voeller and Associates	Business
Washington State Department of Ecology	City department or other agency
Washington State Department of Fish and Wildlife	City department or other agency
Washington State Department of Transportation	City department or other agency
Wells Medina Nursery	Business
Yarrow Bay Marina	Boating facility
Yarrow Point Town Hall	City department or other agency

Appendix B – Briefing outreach summary

Briefing outreach summary

To offer briefing presentations to community groups, the project team sent 38 outreach emails and conducted six follow up phone calls to 21 community-based organizations, agencies and local jurisdictions, neighborhood groups, chambers of commerce, and parent teacher associations. The team shared project information and details for how to provide input to the project team. Upon request, the project team shared the Lake Line 101 presentation via email or presented it during a briefing.

Generally, contacts shared appreciation for the outreach and participated in information sharing by distributing the email among their colleagues and peers. Few community members shared questions or requested briefings. Some noted the usefulness of the Lake Line 101 presentation and other online resources and committed to following up if questions arise.

Notable Outcomes

- Downtown Bellevue Residents Association requested further coordination to gather information to distribute through their Facebook page and will reconnect with the team as capacity allows.
- The Town of Yarrow Point supported the coordination of a briefing to the Hunts Point, Yarrow Point, and Beaux Arts Town Councils. The project team briefed these audiences during a meeting in spring 2023.
- The Medina Parent Teacher Association supported the project team in distributing a project update blurb in their monthly newsletter.

Outreach log

Name	Response
Bellevue Chamber	Primary contact forwarded the outreach email to colleagues who lead government affairs and communications to share the information among Bellevue Chamber membership.
Bellevue High PTSA	Primary contact shared thanks for the information and committed to reaching out after reviewing resources if any questions arise.
Downtown Bellevue Residents Association	Primary contact responded with interest in further discussion to support drafting a message for the DBRA Facebook page. Next steps pending DBRA capacity.
HOA for The Point on Yarrow Bay	During phone call outreach, primary contact requested an additional email with project information, which the project team sent following the call.
Hunts Point	Primary contact did not respond. However, contacts with the Town of Yarrow Point supported the coordination of briefings with municipalities. See notes in Yarrow Point communications.

Lochleven Community Association	Connected via follow up phone call and sent follow up email with more information. Primary contact shared information among Lochleven commissioners and expressed interest in supporting information sharing on NextDoor.
Medina Parent Teacher Association	Coordinated with primary contact to share project information blurb in the Medina PTA newsletter. Did not share any questions or request a briefing.
Meydenbauer Bay Yacht Club	Primary contact shared thanks, noted that the information provided was sufficient, and expressed interest in future partnership.
Newport Yacht Club and HOA	Primary contact forwarded information along to additional Newport Shores community contacts. None shared questions or briefing requests.
Overlake Golf & Country Club	Connected with primary contact during phone call outreach and gathered email information to share follow up information.
WABA (Town of Beaux Arts)	Primary contact did not respond. However, contacts with the Town of Yarrow Point supported the coordination of briefings with municipalities. See notes in Yarrow Point communications.
Wetherill Nature Preserve	Primary contact shared thanks, sharing positive feedback for the Lake Line 101 presentation, and committed to sharing the information among organization commissioners and following up if any questions arise.
Yarrow Point	Primary contact shared information with the Town Engineer, who offered to coordinate presentations to Hunts Point, Yarrow Point, and Beaux Arts Town Councils. The project team organized a presentation and offered one-off follow ups.

Additionally, the project team conducted outreach to the City of Medina, the Enatai Elementary School PTSA, the Enatai Neighborhood Association, the Fairweather Basin Boat Club, the Meydenhauer Bay Neighbors Association, the Newport Hills Community Club, the Greater Newcastle Chamber of Commerce, and the Vuecrest Community Association, but did not receive responses.

Appendix C – Virtual public meeting summary

Poster distribution summary

To promote the Draft Environmental Impact Statement (DEIS) virtual public meeting and to direct community members to where they can participate in the DEIS public comment period, the project team distributed 15 posters on April 4, 2023, to nine different community gathering spaces, including:

- Beaux Arts Village
- Bellevue Botanical Gardens
- Bellevue City Hall
- Bellevue Library
- Crossroads Community Center
- Hunts Point Town Hall
- Northwest Arts Center
- South Bellevue Community Center
- Yarrow Point Town Hall

The team followed up to provide virtual project materials at two locations: the Crossroads Community Center and the Yarrow Point Town Hall.

Virtual public meeting summary

The project team hosted a virtual public meeting via Zoom Webinar on April 18, 2023. The project team shared a brief presentation with the group describing the project and the EIS process. The team then facilitated a public testimony period for attendees.

Attendance:

<u>Project team</u>

Bellevue: Angela Chung, Reilly Pittman, Elizabeth Stead, Linda De Boldt

Carollo: Lara Kammereck, Cheyenne Thompson

ESA: Lisa Adolfson

PRR: Scott Burns, Conny Garcia Gaitan, Emma Dorazio, Morgan Calder

<u>Community members</u>

Eight people attended the virtual public meeting out of the 18 people who registered.

Q/A:

- Is a combination of these different alternatives also an option? For example, use on shore option in some places and other options in some other areas.
  - Answer: Yes, one alternative might not be feasible in each service area, so the final recommendation might be a combination of alternatives.

Testimony Comments:

- I am not sure what kind of testimony you are looking for.
  - Response from project team: Any comments are good; you can submit written comments by May 8 if you don't have anything to share now.
- In terms of the alternatives provided, I think moving the lines off the lake, instead of inside it, would be safer for the ecosystem in case it breaks. There would be less damage to the lake if they were out of the water. I think there might be an opportunity to combine some of the alternatives, which would be my recommendation. My question is: How do the private side sewers connect to the main line and who is responsible for them when they are clogged? We had a bad experience with our line clogging and backing up, and we were told we were responsible, but the clog was exactly where it joined with the main line. I was told within 5 feet of that junction is the City's responsibility.
  - Response from project team: I would say questions about the system should be directed to Bellevue Utilities, Angela Chung. The EIS is looking for comments on the environmental impact of the alternatives, or comments on the alternatives and the plan itself.
  - Response from project team: We will follow up with you, or you can contact Angela directly!

Links shared with participants during the webinar:

- To download a copy of the DEIS or submit electronic testimony through the survey, please visit: https://www.engagingbellevue.com/lake-washington-line
- Visit the project website: https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line
- View the Lake Line 101 presentation: https://prezi.com/p/edit/l_n1k8xgivgr/
- Email testimony to: LakeLineEIS@bellevuewa.gov

Next Steps

- Bellevue Utilities Project Manager, Angela Chung, followed up via email with the participant who provided testimony during the meeting to answer his outstanding questions.
- PRR posted the public meeting recording to the project website.

- Any public testimony received during the DEIS comment period will be documented as part of the EIS process.

Appendix D – Online open house summaries

Online open house #1

To share information about EIS scoping and accept scoping comments for the management plan, Bellevue Utilities hosted an online open house on the EngagingBellevue.com platform. The online open house was live from July 11, 2023, to August 31, 2023. The online open house shared information about the Lake Washington Lake line system, why a management plan and EIS are needed, and potential solutions for the aging lake lines. Information and graphics for four potential alternatives – a “no action” alternative (emergency repairs and continued maintenance only), an in-water alternative, on shore alternative, and upland alternative – were presented. The online open house was published in English and a summarizing text block of information was provide on the website in Chinese (simplified and traditional), Japanese, Korean, Spanish, Russian, and Vietnamese. Visitors were able to submit scoping comments through an online open house form available in all eight languages. The online open house had a total of 286 visitors during the scoping period and two EIS scoping comments were submitted in English.

Online open house #2

To share information about the alternatives analysis and to solicit feedback for the management plan, Bellevue Utilities hosted an online open house on the EngagingBellevue.com platform. The online open house was live from September 1, 2023, to November 1, 2023. The online open house shared information about the Lake Washington Lake line system, information and graphics for potential alternatives, and the alternative evaluation factors. The main focus of this online open house was to encourage people to take the community survey to provide input on the evaluation factors so the project team could incoporate commuity priorities into the analysis of potential alternatives. The online open house was published in English and a the community survey was available in Chinese (simplified and traditional), Japanese, Korean, Spanish, Russian, and Vietnamese. The online open house had a total of 914 visitors and 19 survey responses were submitted in English.

Appendix E – Community pop-up event summary

Overview

Hearing from community members is a critical part of Bellevue Utilities' planning and decision-making process. In September 2023, the Lake Washington Wastewater Lake Line project team conducted community outreach in parks, along trails, and at community events near the service area. Creating opportunities for engagement at community-centered events and gathering places allows for those who don't actively seek or lack resources pertaining to City-based projects to stay in the know and share their input. These pop-up events were designed to share information about the project and solicit input on the prioritization factors being used to analyze the project alternatives. Residents within the service area were notified of these community events and the community input survey through promotions detailed below.

Goals

- Share information about the project and answer questions
- Collect feedback from the community that will be incorporated into the management plan alternatives recommendation

Promotions

- Postcard mailer sent to residents
- Social media posts
- Listserv emails
- Website updates

Event details

Date	Pop-up location	Impressions	Common questions and comment themes
September 6	Medina Park and Points Loop Trail	24	- Expressed curiosity about what the project is. - Questions about where the service areas are located
September 13	Meydenbauer Bay Park and Wildwood Park	14	- Expressed curiosity about what the project is. - How will this affect me as a rate payer?

			- What happens to private property owners within the service areas?
September 14	Bellevue Farmers Market	63	- Expressed curiosity about what the project is. - How does this impact the environment? How will environmental impacts change based on each alternative? - Expressed concern about property easements. Prioritize that as an evaluation factor.
September 21	Meydenbauer Bay Park and Wildwood Park	6	- Expressed curiosity about what the project is. - Shared that environmental impact is more important than cost.
September 26	Road End Beach	4	- Expressed curiosity about what the project is. - Shared that waterfront property owners are more invested in this project than other ratepayers.

Survey responses and analysis

Community members who were engaged during a pop-up event were provided the option to leave more robust feedback through an online survey. The community survey received 19 responses.

Themes from the survey responses include:

- Prioritization of the difficulty of repair or replacement of a lake line, the number of customers impacted, and the risk to the environment as most important consequences of failure.

- Prioritized evaluation criteria were impacts to land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important.
- Desire to maintain Lake Washington’s water quality and to protect native habitat, desire to implement a long-term and sustainable solution, and prioritization of the impacts to the community members over the cost of the project.
- Most people engaging with this project lived, worked, or played in the Meydenbauer Bay or Medina South service areas.
- Most people preferred that Bellevue Utilities keeps them informed about this project via emails, postcards, and “It’s Your City” articles.

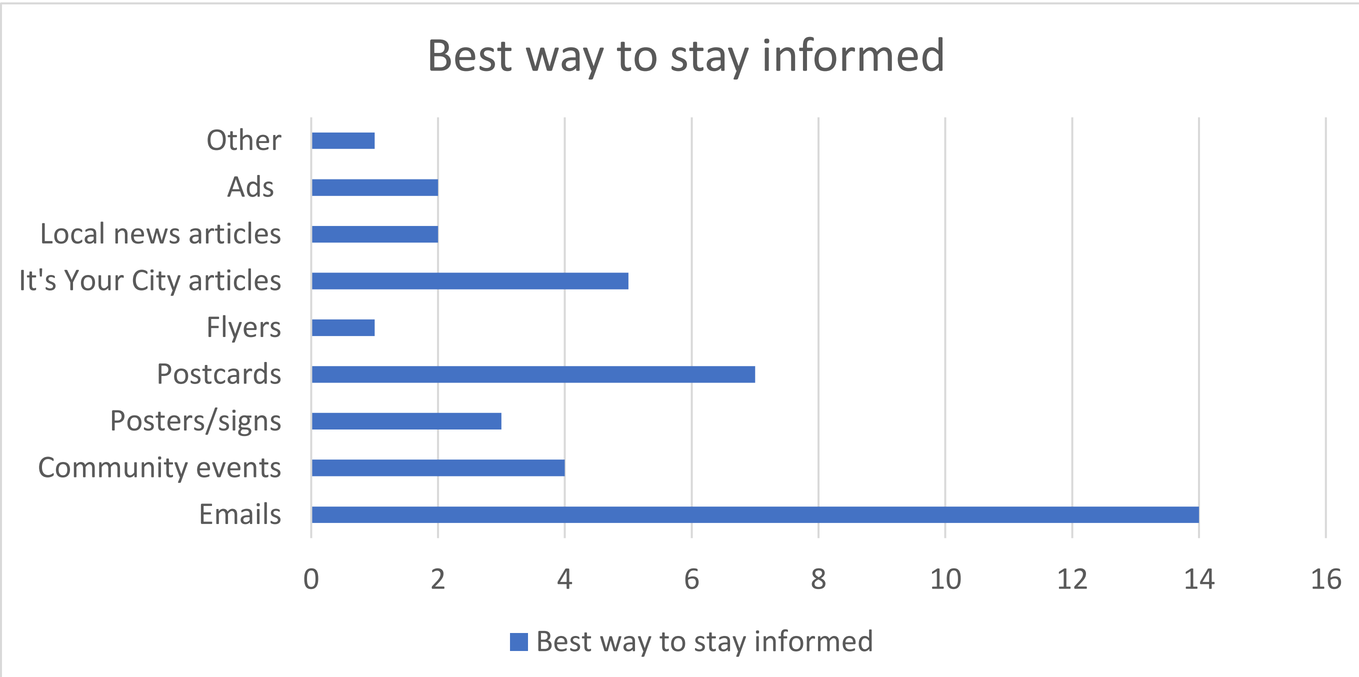
Incorporation of feedback

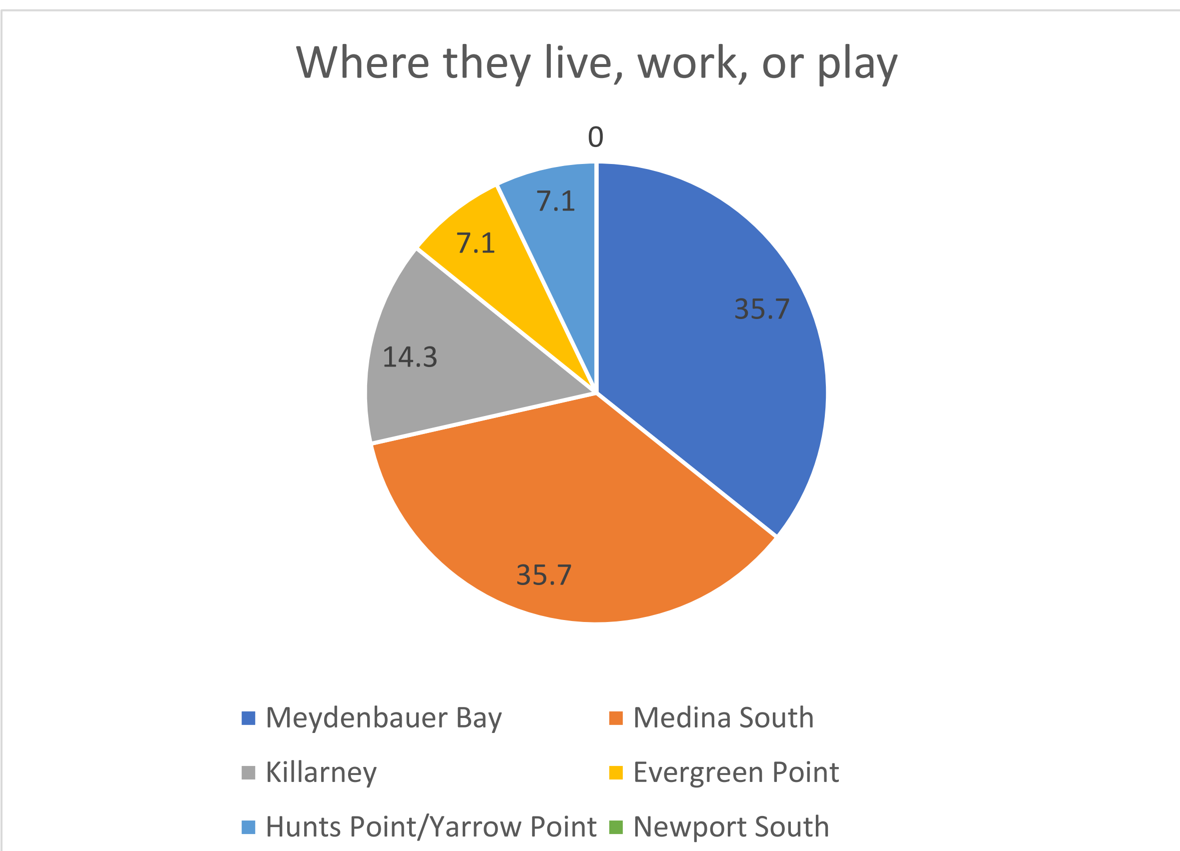
The project team incorporated community feedback into the management plan options analysis and environmental documentation in the following ways:

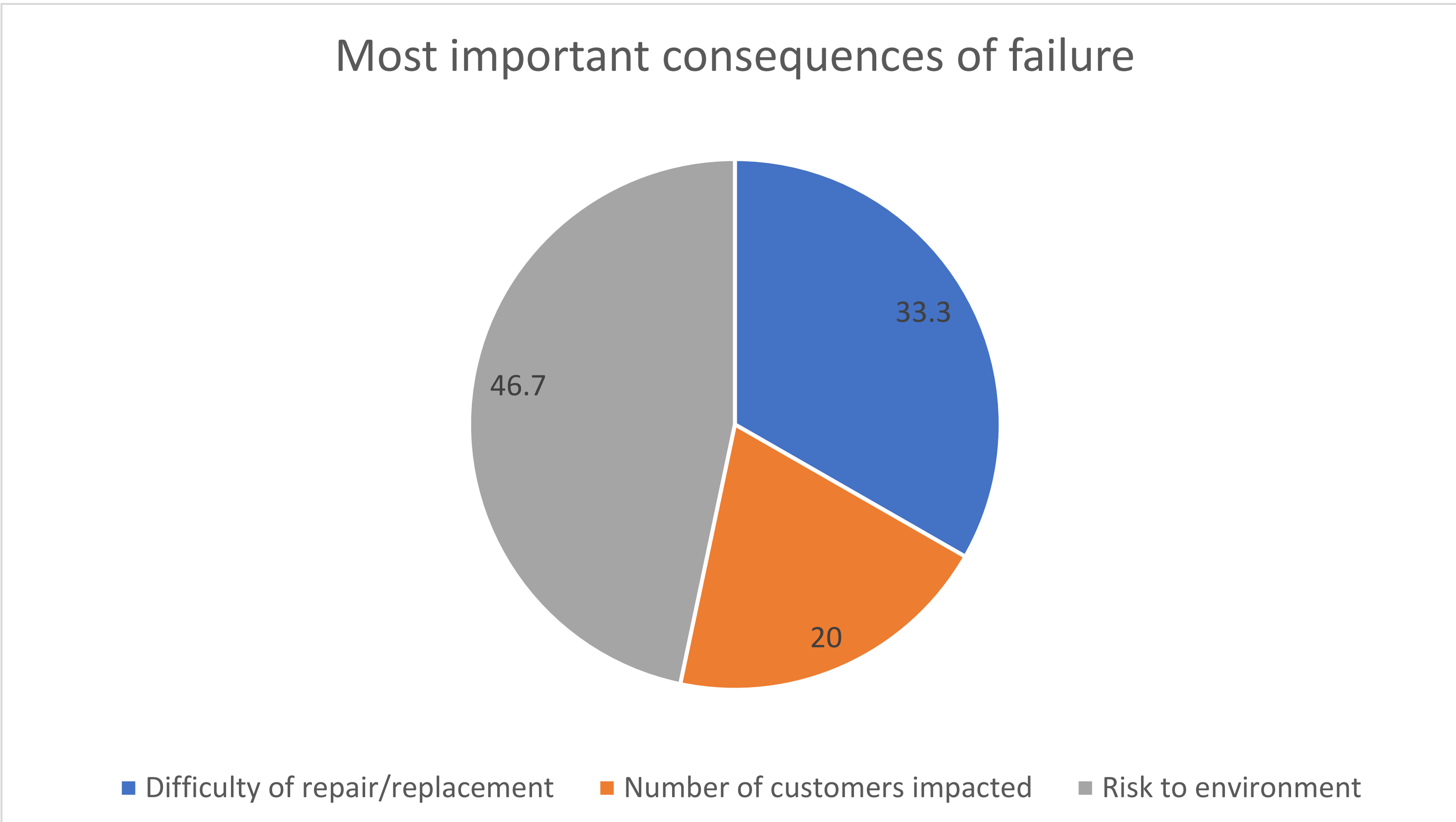
Topic	How we used it
Specifics about each service area	Management plan development and saved for future planning use
Priorities for consequences of failure	Compared to our analysis and assessed different scenarios if community priorities were different than our baseline
Priorities for evaluation criteria	Compared to our analysis and factored into high-level alternative evaluation, and saved for future planning use
How to reach folks	Will be used to prioritize outreach methods during project implementation and saved for future planning use

Appendix F – Survey data

Public comments from community surveys can be viewed in [Appendix H](#).






Most important consequences of failure
33.3
20
46.7
Difficulty of repair/replacement
Number of customers impacted
Risk to environment

Appendix G – Notifications


The City of Bellevue needs your input!

Bellevue Utilities is developing a management plan for the repair, replacement and maintenance of the Lake Washington sewer lake lines, which include 14.6 miles of pipes along the lake's shore. To understand the potential impacts of this plan on the environment, Bellevue Utilities will produce an environmental impact statement (EIS). The project team is currently determining the most important factors to study in the EIS and wants your input.

You're invited!

Join the EIS team for a virtual public meeting to learn more about the plan and the programmatic EIS process, to comment and ask questions about the EIS!

- Tuesday, July 26, 6 – 7 p.m.
- Visit our online open house through August 5 at: engagingbellevue.com/lake-washington-line

Other ways to get involved

Your input is important. If you can't join us at the meeting, or if you would like additional background, you can view the latest information at bellevuewa.gov/lake-washington-line

450 110th Ave. NE
Bellevue, WA 98004

Information 425-452-6800

For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city's ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

UTL 22 Vendor Lake Line B

Example of project postcard


LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT PLAN AND EIS

You're invited!

Join the EIS team for a virtual public meeting to learn more about the plan and the EIS process, comment and ask questions about the EIS!

- Tuesday, July 26, 6-7 p.m.
- Visit our online open house through August 5 at: engagingbellevue.com/lake-washington-line

Bellevue Utilities is developing a management plan for the repair, replacement and maintenance of the Lake Washington sewer lake lines, which include 14.6 miles of pipes along the lake's shore. The plan will help ensure the city can continue to provide safe and reliable wastewater service to the community and help us protect public health and the delicate Lake Washington ecosystem.

To understand the potential impacts of this plan on the environment, Bellevue Utilities will produce an environmental impact statement (EIS). The EIS team is currently determining the most important factors to study and wants your input.

Other ways to get involved

If you can't join us at the meeting, you can still stay updated on latest information at bellevuewa.gov/lake-washington-line

Questions?

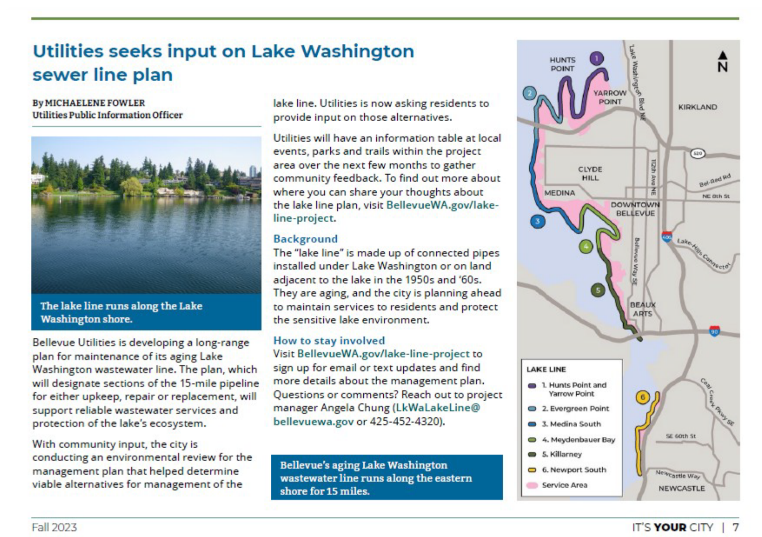
For more information about the EIS, email LakeLineEIS@bellevuewa.gov

For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city's ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

Information 425-452-6800

UTL 22 Vendor Lake Line A

Example of project poster


Utilities seeks input on Lake Washington sewer line plan

By MICHAELENE FOWLER
Utilities Public Information Officer

The lake line runs along the Lake Washington shore.

Bellevue Utilities is developing a long-range plan for maintenance of its aging Lake Washington wastewater line. The plan, which will designate sections of the 15-mile pipeline for either upkeep, repair or replacement, will support reliable wastewater services and protection of the lake's ecosystem.

With community input, the city is conducting an environmental review for the management plan that helped determine viable alternatives for management of the lake line. Utilities is now asking residents to provide input on those alternatives.

Utilities will have an information table at local events, parks and trails within the project area over the next few months to gather community feedback. To find out more about where you can share your thoughts about the lake line plan, visit BellevueWA.gov/lake-line-project.

Background

The "lake line" is made up of connected pipes installed under Lake Washington or on land adjacent to the lake in the 1950s and '60s. They are aging, and the city is planning ahead to maintain services to residents and protect the sensitive lake environment.

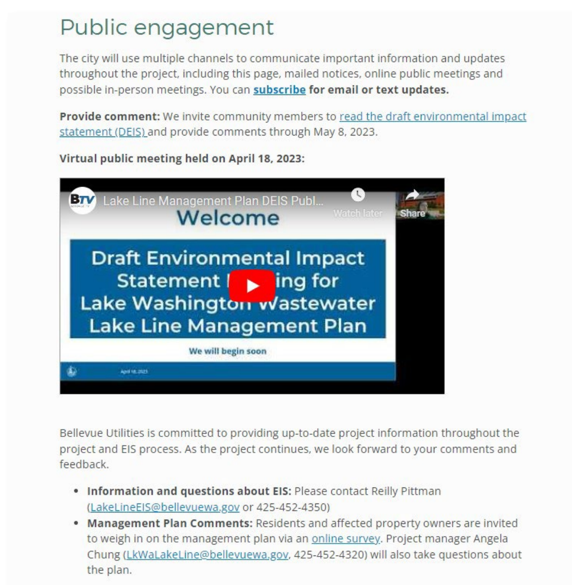
How to stay involved

Visit BellevueWA.gov/lake-line-project to sign up for email or text updates and find more details about the management plan. Questions or comments? Reach out to project manager Angela Chung (LkWaLakeLine@bellevuewa.gov or 425-452-4320).

Bellevue's aging Lake Washington wastewater line runs along the eastern shore for 15 miles.

Fall 2023 IT'S YOUR CITY | 7

Example of It's Your City article


Public engagement

The city will use multiple channels to communicate important information and updates throughout the project, including this page, mailed notices, online public meetings and possible in-person meetings. You can subscribe **for email or text updates.**

Provide comment: We invite community members to read the draft environmental impact statement (DEIS) and provide comments through May 8, 2023.

Virtual public meeting held on April 18, 2023:

Bellevue Utilities is committed to providing up-to-date project information throughout the project and EIS process. As the project continues, we look forward to your comments and feedback.

- **Information and questions about EIS:** Please contact Reilly Pittman (LakeLineEIS@bellevuewa.gov or 425-452-4350)
- **Management Plan Comments:** Residents and affected property owners are invited to weigh in on the management plan via an online survey. Project manager Angela Chung (LkWaLakeLine@bellevuewa.gov, 425-452-4320) will also take questions about the plan.

Example of project website update

Appendix H – Full list of public comments

DEIS public comments

After reviewing the draft EIS please share your comments.
Entire Bellevue-managed sewer line should be inspected and areas that show concern should be addressed first. FYI - Its odd to ask the public what they would study without defining what an EIS is supposed to encompass.
How it impacts residents

Alternatives selection survey

Is there anything specific about the area our team should know as we plan for the management of the lake line in your service area?
No
Not really
we strenuously object to anything that dramatically encumbers our property such as easements that make that area unbuildable. Something must be done eventually with the line, but some of the proposed approaches can disproportionately harm properties served by a line update. We have 150' of lakefront on a small shelf of land before the bluff. Trenching and defining an easement across our property could seriously impact our ability to use or build on our property. We would want to know how the city plans to address this in the proposals. we do not want to see a process in which community input is simply a performative process because the city has already predetermined the option it wants. we also don't want internal priorities like the ease and convenience for staff working on this or departmental objectives that don't care about cost or impact on property owners don't trump the interests of citizens that will be affected by any changes.
It would be terribly difficult to move the sewer lines from the water to land in Meydenbauer Bay.
this could be an excellent opportunity to replace the waste water system and to potentially put all the utility lines underground.
I think that residents that do NOT have waterfront property - with it's accompanying gigantic property values - will naturally be interested in how the cost of these improvements will be shared. Clearly it's in the interest of all to maintain water quality in the lake and to get in front of necessary system improvements - but solutions will naturally have differing costs associated with them. I am encouraging the City to keep the cost and cost-sharing elements of the project transparently in front of all residents who will be expected to participate in the cost of the project.
Many families and children swim in the Meydenbauer Bay area and it is important to keep the water safe for them to use.
Why did you rank the alternatives evaluation criteria the way you did?
I feel that we need to prioritize the environment before any work can begin.
I think thats important

Thinking more on long term, how the action will effect it. Want to be sustainable long term (good quality and little impact). And then feasibility (permits and access etc). If quality is good then people would be less disrupted in the long term
Cost is important but permitting and the local people are more important
My number one concern was how much changes might jeopardize usage of our property. The current lakebed solution has worked successfully for 60 years...it's unclear why this wouldn't be the preferred approach. If there are challenges with permits for this, keep working at permits and the choice of construction tech to mitigate any concerns in doing this. We do care about the environment, but my concern would be that the city may use concern about it to drive through options that disproportionately and needlessly impact us. I'm distrusting because previously, a city-maintained sewer line running across our neighbor's lot down the bluff to the lake sewer line broke. There was landslide and raw sewage that dumped onto our property. The city fixed the break, but did nothing to remedy the debris or sewage and showed complete lack of concern when we raised this with them.
We need action and the ordering above is in my opinion the most expeditious.
Right of way will drive the cost and impact to the community. You have left our two options, lining the current pipe, and a floating line.
It needs to be taken care of so prioritization of doing it regardless of impact to residents/partners etc seems important to me. Cost of course is critical, but in light of the potential for fail and the impact to the lake quality and fish habitat etc, not as important in the end.
This area is home to many. People need to be considered, but animals and environment even more so.
It is a hard place to work.
placing the new system in a logical location should be the number on criteria
Unless you are a waterfront property owner - the environmental, ease of maintenance, and costs are primary. The permitting, right of way, and temporary inconvenience to property owners are administrative and comparatively short lived. I'm hoping the City ensures that the costs of special attention to high end property is paid by those property owners, and not just spread out to all City residents.
I appreciate that this will be challenging for the departments involved but I feel we need to prioritise the impact on the environment and the ease of future repair (if/when necessary) and think ahead - which is something that the City of Bellevue does exceptionally well.

APPENDIX C

HYDRAULIC MODEL DEVELOPMENT AND CALIBRATION TECHNICAL MEMORANDUM

City of Bellevue, Washington
Lake Washington Wastewater Lake Line Management Plan

Technical Memorandum 1
MODEL DEVELOPMENT AND CALIBRATION

FINAL | July 2024

City of Bellevue, Washington
Lake Washington Wastewater Lake Line Management Plan

Technical Memorandum 1
MODEL DEVELOPMENT AND CALIBRATION

FINAL | July 2024

Digitally signed by Edward A. Wicklein
Contact Info: Carollo Engineers, Inc.
Date: 2024.07.12 11:45:56-07'00'

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Figures

Abbreviations

ADWF	average dry weather flow
Carollo	Carollo Engineers, Inc.
City	City of Bellevue
DWF	dry weather flow
ft	feet
ft^2	feet squared
GIS	geographic information system
gpd	gallons per day
gpm	gallons per minute
HGL	hydraulic grade line
lake line	Lake Washington lake line system
MG	million gallons
n	Manning's roughness coefficient
RDII	rainfall-derived infiltration and inflow
SCADA	supervisory control and data acquisition
TM	Technical Memorandum
UDG	Urban Drainage Group
WWF	wet weather flow

Technical Memorandum 1

MODEL DEVELOPMENT AND CALIBRATION

1.1 Introduction

This Technical Memorandum (TM) summarizes the development and calibration of the City of Bellevue's (City) Lake Washington lake line system (lake line) hydraulic model. The model was developed consistent with City standards and built in InfoSWMM for system analysis.

1.2 Model Development

A sewer collection system model is a simplified representation of the real sewer system. Collection system models are used to evaluate the conveyance capacity of a collection system and for planning scenarios. This model was created to represent all the lake line piping system and includes some additional skeletonized piping upstream. All key infrastructure along the lake line was included in the model to replicate the hydraulics of the lake line system.

The City provided Carollo Engineers, Inc. (Carollo) with the general lake line geographic information system (GIS) geometry file and the Basin 1-5 SWMM Model on September 15, 2020. This information served as the basis to for building the lake line model. The model was built in the City's datum, NAVD 1988.

The model was calibrated with flows estimated from supervisory control and data acquisition (SACDA) information at every pump station (13 stations) along the lake line. Operational data was provided from February 1, 2020, to May 1, 2020, served as the flow monitoring period for model development. The SCADA included wet well level at all pump stations and pump start and stop time at some of the stations. The wet well geometry at each pump station was used to develop a volume relationship between the horizontal surface area and level. For stations that did not include pump on/off information, the level was used to estimate when the pumps were running. In all cases it was assumed that the pumps delivered the design flow when operating. The wet well level change and pump operations were used to convert the wet well level changes over time minus pump flows to pump station volume inflow rate.

A summary of all the pump stations along the lake line and their attributes are summarized in Table 1.1. Pump station recirculation standpipe elevations and on and off set points were provided by the City and imported into the model. The lake elevation was assumed as 16.8 feet, the low water level, based on the Lake Washington Sewer Lake Line Hydraulic Grade Line figures provided by the City. Pumps were set up with operational on and off levels and pump curves in the model that matched operations in the field, this is summarized in Table 1.1. Figure 1.1 shows a conceptual image of how pump stations and recirculation manholes along the lake line were set up and operate in the model. Recirculation manholes are specialized manholes that protect low lying customers by limiting the pressure in the lake lines. Once the downstream lake line operating capacity is reached, the recirculation returns excess flows to the pump station wet well, rather than forcing additional flow at a higher pressure that may cause backups to low lying customers downstream.

The City provided pump station SCADA data of wet well level. This was converted to influent flows which would then be compared to the modeled flows to assess the model calibration. Pump station data was received at 13 different pump stations along the lake line. The dry and wet weather flow development was done for the contributing area to each lake line pump station, thus 13 lake line flow monitoring tributary basins (monitoring basins) were developed for calibration. Each basin had its own set of wet weather parameters, sanitary inflow rate, and infrastructure assumptions. The hydraulic reaches, which are sections of the lake line system bounded by the upstream and downstream pump stations, are summarized by model monitoring basin in Table 1.2. Figure 1.2 shows an overview of the lake line system and the areas upstream of each pump station.

Table 1.1 Lake Line Pump Station Summary

Pump Station	Recirculation Manhole	Overflow Location	Wet Well Area (ft^2)	No. of Pumps	Pump Start Levels (ft)(2, 3)	Pump Stop Levels (ft)(2, 3)	Design Flow (gpm)	Design Head (ft)	Recirculation Standpipe Elevation (ft)	Overflow Level (ft)(3)
Yarrow Point	Yes	Wet Well	102	2	2.8 and 2.0	1.0	269	13	26.64	7.6
Hunts Point	Yes	Auxiliary manhole on upstream system(1)	102	2	2.5 and 2.0	1.0	341	13	27.57	4.5(4)
Cozy Cove	Yes	Wet Well	150	3	3.0, 2.6 and 2.2	1.0	583	55	N/A	8.4
Evergreen West	Yes	Wet Well	102	2	3.0 and 2.5	1.5	296	5	23.74	7.0
Evergreen East	Yes	Wet Well	102	2	2.5 and 2.2	1.4	301	7	21.58	6.7
Lake Crest	Yes	Auxiliary manhole tied into upstream lake line.	102	2	3.3 and 2.5	1.8	370	12.5	27.21	6(4)
Medina City Hall	No	Wet Well	266	2	3.2 and 2.4(5)	1.3(5)	295	63	N/A	6.7
Parkers	Yes	Auxiliary manhole on upstream system(1)	102	3	7.6, 6.8 and 6(5)	4.0(5)	512	144	19.89	8.7(4)
Lagen	No	None	102	2	2.0 and 1.5(5)	1.0(5)	247	5	N/A	N/A

Pump Station	Recirculation Manhole	Overflow Location	Wet Well Area (ft^2)	No. of Pumps	Pump Start Levels (ft)(3)	Pump Stop Levels (ft)(3)	Design Flow (gpm)	Design Head (ft)	Recirculation Standpipe Elevation (ft)	Overflow Level (ft)(3)
Meydenbauer	No	Auxiliary manhole on upstream system	102	2	3.0 and 2.7	1.5	278	9.5	N/A	6(4)
Killarney	Yes	Wet Well	102	2	3.6 and 2.9	1.6	278	9.5	24.26	10.3
Bagley	No	Auxiliary manhole on upstream lake line(1)	102	2	3.2 and 3.0(5)	3.0 and 2.5(5)	180	35	N/A	N/A
Pleasure Point	Yes	Wet Well	102	2	2.6 and 2.5	1.5	162	10	19.62	7(4)

Notes:
(1) Not included in model, manhole is outside of modeled lake line extents.
(2) On and off set points provided by the City on July 13th, 2022.
(3) Elevation is relative to wet well invert level, so X feet depth above the bottom of the wet well.
(4) No actual overflow data was available. Overflow in the model was assumed at City provided overflow set points instead.
(5) Different start and stop levels were used to estimate pump station flows during the calibration period.
Abbreviations: ft - feet; ft^2 - feet squared; gpm - gallon per minute.

Table 1.2 Lake Line Monitoring Basins

Model Monitoring Basin	Lake Line Reach	Upstream Pump Station	Downstream Pump Station
Yarrow Point	COZ_A_1	Flush Number 1	Yarrow Point
Cozy Cove	COZ_A_2	Yarrow Point	Cozy Cove
Cozy Cove	COZ_B_1	Hunts Point	Cozy Cove
Hunts Point	COZ_B_2	Flush Number 2	Hunts Point
Fairweather	FWR_A_1	Evergreen East	Fairweather
Evergreen East	FWR_A_2	Evergreen West	Evergreen East
Evergreen West	FWR_A_3	Flush Number 3	Evergreen West
Lake Crest	MED_A_1	Flush Number 3	Lake Crest
Lake Crest	MED_A_2	None	Lake Crest
Medina City Hall	MED_A_3	Lake Crest	Medina City Hall
Medina City Hall	MED_B_1	Flush Number 4	Medina City Hall
Parkers	PKR_A_1	Flush Number 5	Parkers
Lagen	BEL_A_1	Parkers	Grange/ Lagen Lift
Meydenbauer	MEY_A_1	Flush Number 6	Meydenbauer
Killarney	SWL_A_1	Flush Number 7	Killarney
Killarney	SWL_A_2	Killarney	King County System
Bagley	NWP_A_1	Pleasure Point	Bagley
Pleasure Point	NWP_A_2	Flush Number 8	Pleasure Point

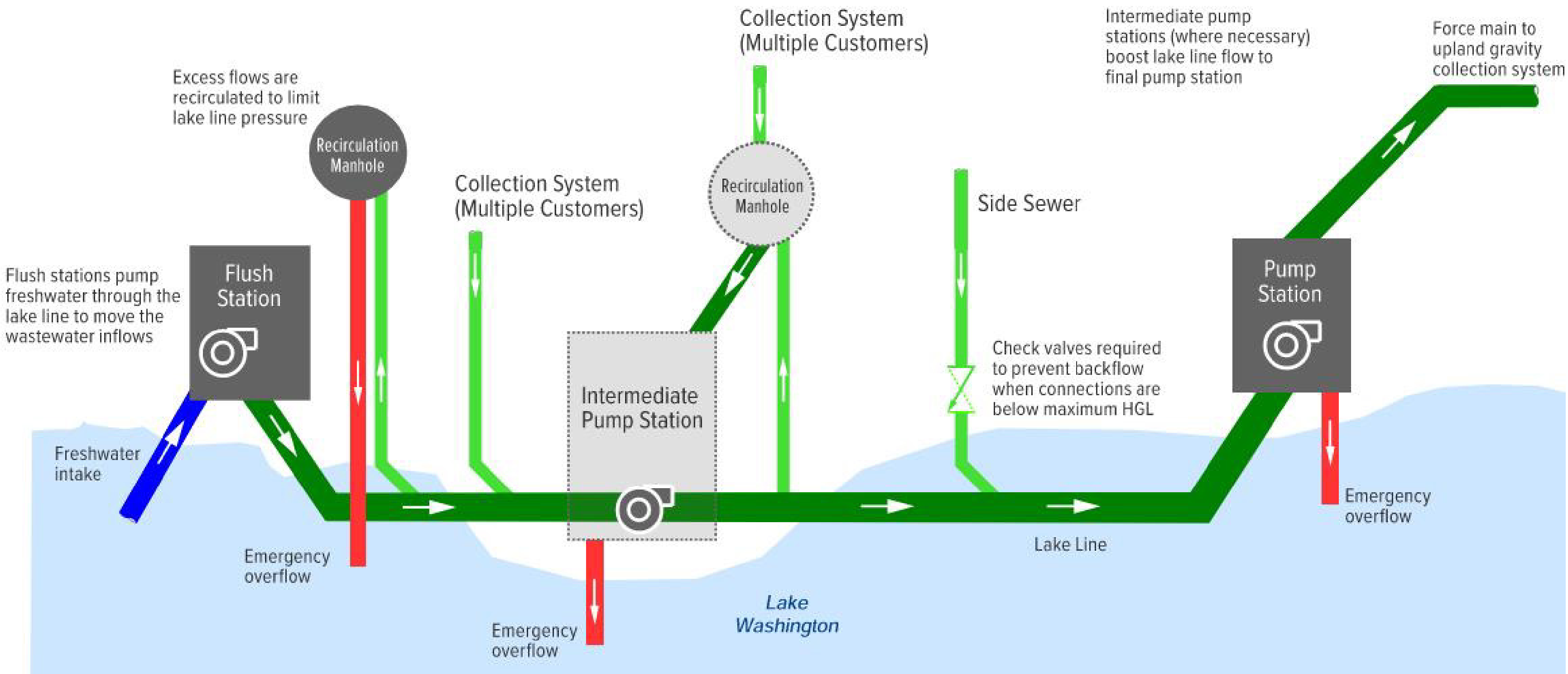


Figure 1.1 Lake Line System

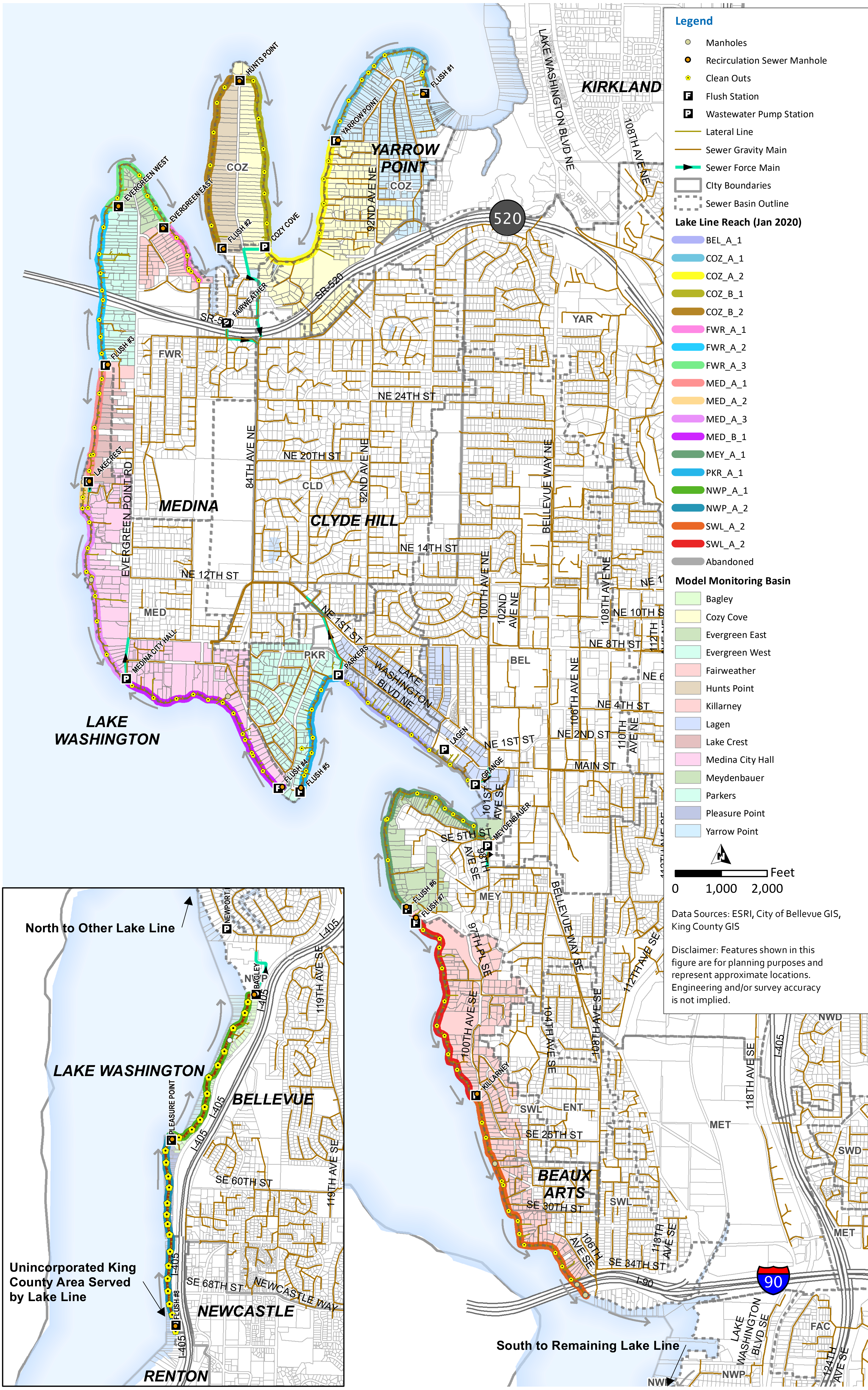


Figure 1.2 Lake Line Reaches and Flow Monitoring Basins

1.3 Dry Weather Flow Calibration

1.3.1 Dry Weather Flow Development and Loading

Average dry weather flow (ADWF) is the expected sewer flows conveyed by the system on a daily basis, and for a lake line includes both sanitary flow and flushing flow. Sanitary flows come from residents and businesses along the line and daily flush station inflow is added to the system to help convey sewage along the lake line due to low pipe slopes.

ADWF from each basin was estimated from a 24-hour average of dry weather flow (DWF) data minus flushing flows measured at each pump station. Measured flows from periods with less than 0.1 inches of rainfall in the previous 24-hours were defined as DWF and used for the ADWF calculation to determine the ADWF per basin. Table 1.3 outlines the DWF for each basin developed for model calibration. The basin DWFs were converted to basin flow factors by combing the number of parcels with the measured flows.

The DWF loading approach was consistent with the City's previous modeling efforts. The city uses a population equivalent per acre and a unit flow volume of 65 gallons per capita per day to develop sanitary flow projections. The lake line is served almost entirely by single family homes, so a population factor of 2.7 people per unit was used throughout. Thus, a 0.12 gpm per parcel was the default flow factor used. Based on the total number of upstream parcels, the planning flow could be compared to the measured flow. As all parcels contributing flow to the lake line are single family, it is assumed that large variations between planning flow and measured flow are indicative of dry weather flow infiltration to the system or recirculation.

The flow factor scaling, and flush station inflow were adjusted so that the total volume of flow into the pump station matched what was measured. For example, the measured flow at the pump station was 1.7 times higher than the planning flows at Yarrow Point, so the gpd/parcel flow factor was adjusted from 0.12 to 0.20 in order to calibrate to DWF volume at the site. Table 1.4 summarizes the adjustments to match the measured volume of flow and set up in the model. The flush station flows were estimated based on flush station capacities, station diurnal patterns, and flush station on and off run times. The flush station set up in the model is summarized in Table 1.5.

Table 1.3 Dry Weather Planning Flow

Pump Station	Estimated Flush Station Average Daily Flow (gpm)	Measured Total Flow (gpm)(1)	Upstream Parcels	Flow Factor (gpm/parcel)
Yarrow Point	10	53.14	250	0.12
Hunts Point	10	52.46	41	0.12
Cozy Cove	20	254.55	251	0.12
Evergreen West	10	23.39	87	0.12
Evergreen East	10	34.37	61	0.12
Lake Crest	10	22.44	25	0.12
Medina City Hall	15	33.31	184	0.12

Pump Station	Estimated Flush Station Average Daily Flow (gpm)	Measured Total Flow (gpm)(1)	Upstream Parcels	Flow Factor (gpm/parcel)
Parkers	17	155.38	272	0.12
Lagen	0	48.31	87	0.12
Meydenbauer	15	25.47	98	0.12
Killarney	15	33.03	165	0.12
Bagley	10	44.21	76	0.12
Pleasure Point	10	14.75	78	0.12

Notes:
(1) Estimated by multiplying the change in wet well volume over time by the wet well area.

Table 1.4 Dry Weather Flow Factor Adjustment

Pump Station	Flow Factor Scaling	Adjusted Flow Factor (gpm/parcel)
Yarrow Point	1.7	0.20
Hunts Point	8.3	0.97
Cozy Cove	4.6	0.55
Evergreen West	1.5	0.18
Evergreen East	1.5	0.18
Lake Crest	4.3	0.51
Medina City Hall	0.4	0.04
Parkers	4.0	0.48
Lagen	4.5	0.54
Meydenbauer	1.0	0.12
Killarney	1.1	0.12
Bagley	3.0	0.36
Pleasure Point	1.0	0.12

1.3.2 Dry Weather Flow Pattern Calibration Process

Sewer inflows typically have a diurnal pattern, which needs to be replicated in the model with the measured DWF data. For the lake line, the DWF pattern is dominated by the flush station run times, as opposed to customer usage as in a typical wastewater collection system. Flush run times were provided by the City, and these were assumed to be consistent every day in the modeled simulation. A capacity of 240 gpm (0.53 cubic feet per second) was initially assumed for each flush station, and then adjusted to match the measured dry weather patterns. The flush station run times were supplied by the City and input into the model. The pertinent information that was added to the model for each flush station is shown in Table 1.5.

Table 1.5 Lake Line Flush Station Summary

Flush Station	Adjusted Flowrate (gpm)(1)	Head (ft)	Hours Run Per Day(2)
1	233	21	1
2	224	21	1
3 North	233	21	1
3 South	233	21	1
4	90	21	0.5
5	233	21	2
6	202	21	1.5
7	233	21	1.5
8	157	10	1

Notes:
(1) Adjusted Flow rate of each flush stations. This reflects the flow through the station while it is running.
(2) Hours run per day correspond to on/off timing of when each flush station is run. A summary of all flush station run times is outlined in Appendix 1A.

Pipe slope effects velocity of the reach which can influence the dry weather pattern. The inverts along the modeled reaches were unknown and could include sags due to uneven settlement. Therefore, part of the calibration process involved adjusting the invert along each of the reaches. The City provided hydraulic grade line (HGL) figures for each lake line reach. These were used to determine the upstream and downstream elevations of the reach. The calibrated reach slopes used in the model are outlined in Table 1.6. Manning's roughness coefficient (n) and the vertical roughness factor were also adjusted to account for sags and possible debris in the system to better match the field measured reach velocities and diurnal patterns at each pump station. High Manning's n and low roughness thresholds were needed for Yarrow Point and Evergreen East so the HGLs in the reaches were sufficiently high when simulating the known recirculation. It is assumed this high roughness is representative of significant sedimentation or other obstructions in the lines.

Table 1.6 Reach Slope Adjustments

Pump Station	Upstream Elevation (ft)	Downstream Elevation (ft)	Reach Manning's n	Vertical Roughness Threshold	Vertical Roughness
Yarrow Point	23.28	15.58	0.015	0.5	0.02
Hunts Point	25.00	15.58	0.011	0.0	0.00
Cozy Cove(1)	15.58, 13.58	13.58	0.065, 0.015	0.5, 0.0	0.02, 0.00
Evergreen West	22.00	15.58	0.015	0.5	0.02
Evergreen East	15.58	15.58	0.10	0.5	0.02
Lake Crest	20.58	15.58	0.015	0.5	0.02
Medina City Hall	15.58, 17.58	15.58	0.015	0.5	0.02
Parkers	20.69	17.08	0.015	0.5	0.02
Lagen	10.93	10.93	0.015	0.5	0.02

Pump Station	Upstream Elevation (ft)	Downstream Elevation (ft)	Reach Manning's n	Vertical Roughness Threshold	Vertical Roughness
Meydenbauer	20.00	17.58	0.015	0.5	0.02
Killarney	17.0	12.47	0.015	0.5	0.02
Bagley	11.58	11.58	0.015	0.5	0.02
Pleasure Point	16.8	11.58	0.015	0.5	0.02

Notes:
(1) 15.58 elevation is from the Yarrow Point Pump Station and 13.58 elevation is from the Hunts Point Pump Station. 0.02 and 0.5 correspond to the portion of the reach downstream from Yarrow Point.

1.3.3 Dry Weather Flow Calibration Criteria

The hydraulic model was calibrated in accordance with international modeling standards. The Urban Drainage Group (UDG), formerly known as Wastewater Planning Users Group, a section of the Chartered Institution of Water and Environmental Management, has established generally agreed upon principles for model verification.

Dry weather calibration should be carried out for two dry weather days and the modeled flows and depths should be compared to the field-measured flows and depths. Both the modeled and field-measured flow hydrographs should closely follow each other in both shape and magnitude.

In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

- The timing of flow peaks and troughs should be within one hour.
- The peak flow rate should be within the range of plus minus 10 percent.
- The volume of flow (or the average rate of flow) should be within the range of plus minus 10 percent. If applicable, care should be taken to exclude periods of missing or inaccurate data.

1.3.4 Dry Weather Flow Calibration Results

Table 1.7 provides a summary of the DWF calibration comparing the average and daily peak flow results for both weekday and weekend conditions. As shown on Table 1.7, the model-simulated volume of ADWF were all within 10 percent. Due to noise in the measured data and general variations in diurnal pattern, some peak differences were larger, but all within 45 percent. Diurnal patterns were significantly impacted by the flush station run times. Variation between peaks occurred because of difficulty matching travel time in the system due to unknown system conditions or challenges accurately capturing the flush station operation. Figure 1.3 show an example DWF calibration flow comparison figure for the FWR_A reach. All DWF calibration comparisons are shown in Appendix 1B.

Table 1.7 Dry Weather Flow Calibration

Pump Station	Measured ADWF Volume (gpd)	Modeled ADWF Volume (gpd)	ADWF Percent Difference (%)	Measured Peak Hour DWF (gpm)	Modeled Peak Hour DWF (gpm)	Peak Hour Percent Difference (%)
Yarrow Point	76,525	83,817	10%	122.5	143.1	17%
Hunts Point	75,537	74,366	-2%	157.9	86.3	-45%
Cozy Cove	366,547	331,259	-10%	422.1	318.9	-24%
Evergreen West	33,688	35,640	6%	89.5	68.7	-23%
Evergreen East	49,491	50,170	1%	87.1	65.4	-25%
Lake Crest	32,315	30,463	-6%	109.8	61.3	-44%
Medina City Hall	47,960	49,631	3%	81.2	75.1	-7%
Parkers	223,754	203,102	-9%	194.5	209.7	8%
Lagen	69,573	69,368	0%	104.4	69.4	-34%
Meydenbauer	36,684	37,170	1%	69.6	39.3	-44%
Killarney	47,559	51,019	7%	143.8	126.0	-12%
Bagley	63,660	59,504	-7%	59.4	51.2	-14%
Pleasure Point	21,234	22,296	5%	89.9	74.3	-17%

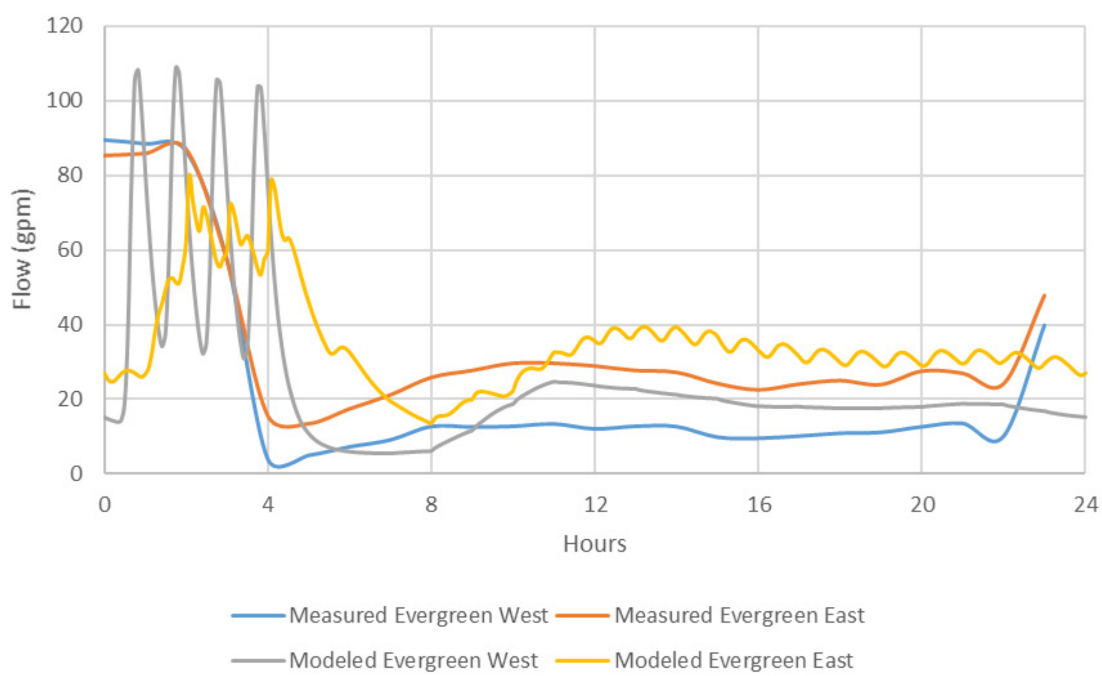


Figure 1.3 Dry Weather Flow Calibration Example

1.4 Wet Weather Flow Calibration

1.4.1 Wet Weather Flow Parameters

For the wet weather flow (WWF) calibration, rainfall-derived infiltration and inflow (RDII) flows are added to collection system. RDII flows are assigned to the model based up upstream tributary areas of each contribution point and RTK parameters which define the short-term, medium-term, and long-term inflow and infiltration into the system. These values were initially set based on engineering judgment, and then adjusted until the model simulated flows (both peak flows and total volume) matched closely with the field measured flows.

1.4.2 Wet Weather Flow Criteria

Ideally a minimum of three separate storms need to be run through the model based on UDG guidance. For at least two storms out of the three events from the flow monitoring period, the model simulated flows and depths should match the field measured flows and depths within the acceptance criteria. The modeled and field flow hydrographs for the calibration storms should closely follow each other in both shape and magnitude, until the flow has substantially returned to DWF rates.

In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

- The timing of the peaks and troughs should be similar with regard to the duration of the events.
- The peak flow rates at significant peaks should be in the range of plus 25 percent to minus 15 percent and should be generally similar throughout.
- Modeled volume of flow should be within plus 20 percent to minus 10 percent of measured volume of flow.

The UDG recommends that for wet weather calibration, the use of a single calibration period incorporating a number of rainfall events should be considered whenever possible. In other words, if the flow monitoring program captured several back-to-back storms, it may be preferable to use the back-to-back storms events as the calibration storms, as opposed to calibrating to two separate storms that have occurred weeks or months apart.

The three calibration rainfall events were selected form the flow data and are summarized in Table 1.8 and shown in Figure 1.4.

Table 1.8 Rainfall Summary Table

Storm	Start Date	End Date	24 Hour Rainfall (inches)	Peak Rainfall (inches per hour)
1	2/3/2020	2/9/2020	2.03	0.14
2	3/3/2020	3/9/2020	0.79	0.09
3	4/21/2020	4/27/2020	0.72	0.26

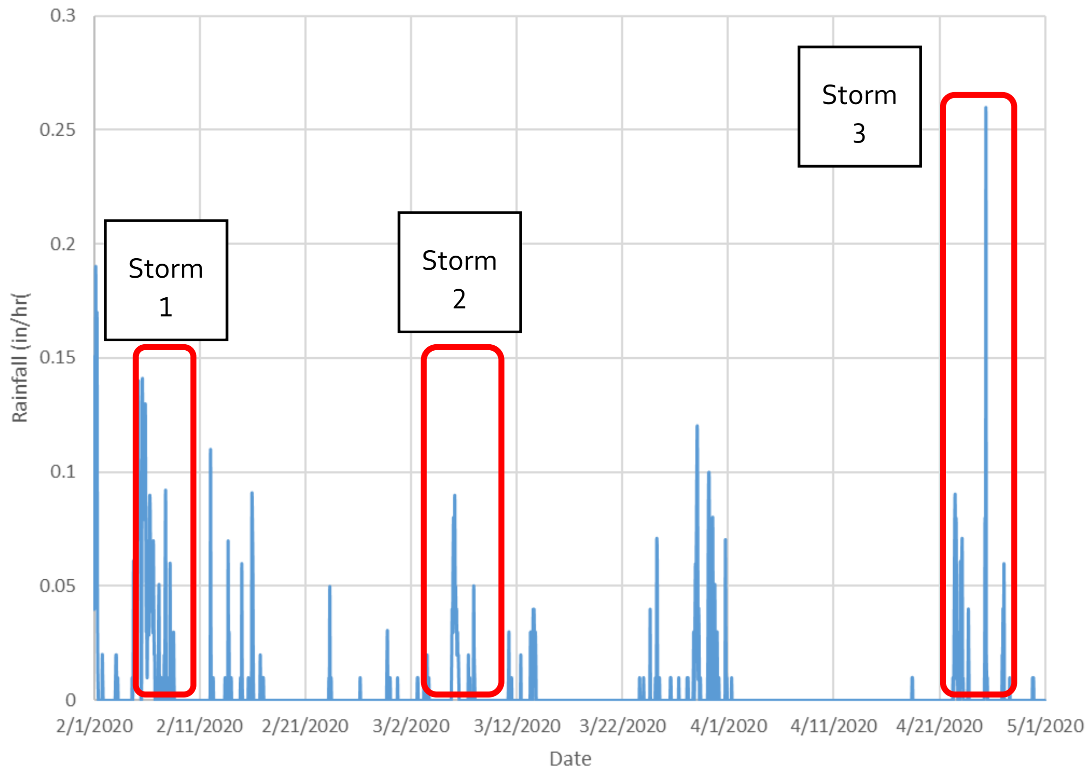


Figure 1.4 Calibration Period Rainfall

1.4.3 Wet Weather Flow Calibration Results

The WWF calibration using the total volume and peak flow results for the three storm events at the pump stations are summarized in Tables 1.9, 1.10, and 1.11. The modeled outputs at each pump station were compared to the data from three storms recorded during the flow monitoring period for calibration. The City indicated on September 20, 2022, via TM comments, that calibration should account for periods during heavy rains where the measured data indicates that the flush stations were sometimes manually turned off, complicating wet weather flow calibration. Based on the measured data, flush stations were assumed to not run at Yarrow Point and Lake Crest after significant rainfall. Of the 13 pump stations with three events, eleven had two or more storm event responses within calibration standards for volume and four within standards for peak flows.

1.4.3.1 Discussion on Sites Out of Criteria

Two sites, Hunts Point and Evergreen East are not in criteria for volume. Both sites had inconsistent storm responses between the three events. Hunts Point had an additional issue with fluctuations in dry weather flow over the calibration period. February and March showed much lower flows than April and May leading to issues calibrating the storm events later in the season.

Matching peaks was difficult due to noise in the pump data, inconsistent rainfall response and manual flush station shutdown. Yarrow Point, Hunts Point, Cozy Cove, Evergreen East, Medina City Hall, Lagen, Meydenbauer, Killarney, and Pleasure Point all had measured flows that were not replicable due to inconsistent rainfall response. Figure 1.5 shows an example of this issue at the Meydenbauer Pump Station, where the largest measured peak, in orange, does not appear be rainfall driven. Similar issues occur at Yarrow Point where there is a significant rainfall response to storm 1, almost no response to storm 2 or 3, as shown in Appendix 1B. Yarrow Point also had an actively recirculating manhole during storm 1 which could not be confirmed in the field. It was difficult to match the volume and peak during a recirculation event. Yarrow Point had additional issues resulting from the seasonal variability of DWF. Figure 1.6 outlines an example WWF calibration figure for the fully calibrated Parkers Pump Station.

Table 1.9 Wet Weather Flow Calibration - Storm 1

Meter Number	Measured Data		Modeled Data		% Error	
	Total Volume (MG)	Peak Flow (gpm)	Total Volume (MG)	Peak Flow (gpm)	Total Volume (%)	Peak Flow (%)
Yarrow Point	0.284	857.8	0.485	1014.4	70%	18%
Hunts Point	0.076	278.5	0.081	100.5	7%	-64%
Cozy Cove	0.849	1179.7	0.565	697.1	-33%	-41%
Evergreen West	0.077	187.1	0.051	104.4	-35%	-44%
Evergreen East	0.260	784.6	0.107	259.9	-59%	-67%
Lake Crest	0.022	126.8	0.028	119.9	26%	-5%
Medina City Hall	0.065	299.8	0.069	111.6	7%	-63%
Parkers	0.372	512.3	0.319	417.4	-14%	-19%
Lagen	0.089	236.3	0.098	124.5	10%	-47%
Meydenbauer	0.036	280.3	0.043	49.6	17%	-82%
Killarney	0.091	333.2	0.059	144.5	-36%	-57%
Bagley	0.064	107.1	0.074	113.6	17%	6%
Pleasure Point	0.021	130.3	0.036	95.7	72%	-27%

Notes:
Abbreviations: MG - million gallons.

Table 1.10 Wet Weather Flow Calibration - Storm 2

Meter Number	Measured Data		Modeled Data		% Error	
	Total Volume (MG)	Peak Flow (gpm)	Total Volume (MG)	Peak Flow (gpm)	Total Volume (%)	Peak Flow (%)
Yarrow Point	0.085	173.3	0.094	370.8	11%	114%
Hunts Point	0.057	444.9	0.073	87.9	27%	-80%
Cozy Cove	0.357	593.3	0.390	493.2	9%	-17%
Evergreen West	0.039	96.7	0.041	88.4	3%	-9%
Evergreen East	0.064	150.7	0.063	218.0	-1%	45%
Lake Crest	0.032	120.7	0.032	119.9	-1%	-1%
Medina City Hall	0.044	227.5	0.052	90.4	18%	-60%
Parkers	0.225	299.1	0.222	326.1	-1%	9%
Lagen	0.071	167.7	0.075	99.1	6%	-41%

Meter Number	Measured Data		Modeled Data		% Error	
	Total Volume (MG)	Peak Flow (gpm)	Total Volume (MG)	Peak Flow (gpm)	Total Volume (%)	Peak Flow (%)
Meydenbauer	0.036	284.0	0.052	42.9	45%	-85%
Killarney	0.054	322.5	0.052	136.6	-4%	-58%
Bagley	0.067	224.1	0.061	102.4	-8%	-54%
Pleasure Point	0.026	318.4	0.024	84.2	-10%	-74%

Table 1.11 Wet Weather Flow Calibration - Storm 3

Meter Number	Measured Data		Modeled Data		% Error	
	Total Volume Flow (MG)	Peak Flow (gpm)	Total Volume Flow (MG)	Peak Flow (gpm)	Total Volume Flow (%)	Peak Flow (%)
Yarrow Point	0.088	163.8	0.096	328.6	10%	101%
Hunts Point	0.092	181.6	0.074	85.9	-19%	-53%
Cozy Cove	0.400	877.0	0.424	516.8	6%	-41%
Evergreen West	0.036	102.8	0.042	85.7	19%	-17%
Evergreen East	0.042	91.6	0.070	217.0	67%	137%
Lake Crest	0.030	126.2	0.030	119.2	-2%	-5%
Medina City Hall	0.045	237.5	0.053	91.9	17%	-61%
Parkers	0.215	248.2	0.237	317.2	10%	28%
Lagen	0.068	126.1	0.079	96.2	15%	-24%
Meydenbauer	0.037	401.2	0.038	43.5	3%	-89%
Killarney	0.048	209.4	0.053	135.4	10%	-35%
Bagley	0.056	118.7	0.064	100.0	14%	-16%
Pleasure Point	0.024	136.4	0.026	83.9	9%	-38%

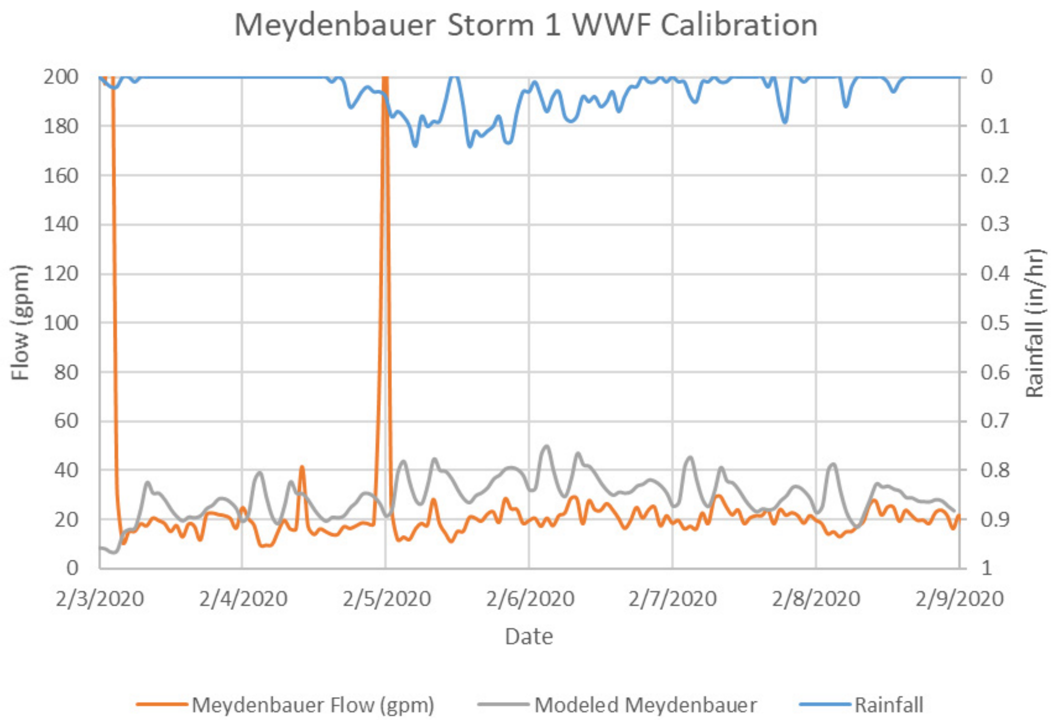


Figure 1.5 Wet Weather Flow Calibration Example of Failing to Match Peak Flow

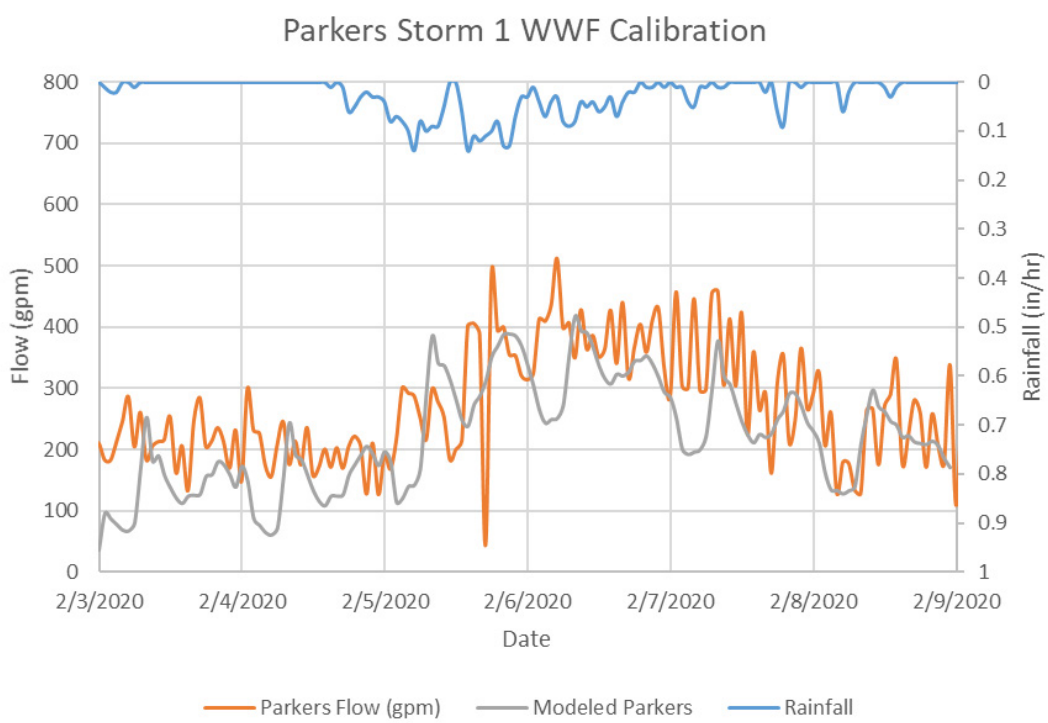


Figure 1.6 Wet Weather Flow Calibration Example of Matching Calibration Criteria

1.4.4 Wet Weather Level Overflow

The City provided records of when the high high alarms were reached at each pump station, during the three-month calibration period. The high high is alarm is just below the pump station overflow. These records were used to verify the modeled HGL in each reach. The alarms are summarized in Table 1.12.

Table 1.12 High High Alarm Records

Storm	Pump Stations Where High High Alarm Is Reached
1	Evergreen East and Yarrow Point
2	None
3	Lagen
Other Period	Cozy Cove, Evergreen East, Evergreen West, Lake Crest, Hunts Point, Medina, Meydenbauer, Parkers, Pleasure Point, and Yarrow Point

Since Evergreen East, Yarrow Point, and Lagen reached the alarm level during rainfall events, the calibration effort ensured the model replicated the elevated HGL seen for reaches upstream of these stations. For Evergreen East and Yarrow Point this indicated a high likelihood of recirculation during these events. Lagen does not have an overflow or recirculation manhole, so no recirculation occurred despite the high HGL.

1.5 Summary

The model is considered calibrated based on the data available for this project. It should be noted there are several limitations in building the model, some of which can be addressed in the future to further enhance the model capabilities. We recommend the following:

- Undefined reach slopes and high/low points should be surveyed.
- Review and survey flush station flows and run times, log when flush stations are turned off.
- Recirculation manhole monitoring to better capture flows.
- Overflow monitoring to confirm high high alarm levels.
- Field verification of reach sedimentation build up for high Manning's n and vertical roughness coefficient reaches.

Given the currently available data, the model is reasonably calibrated for use in system analysis of the lake line.

Appendix 1A

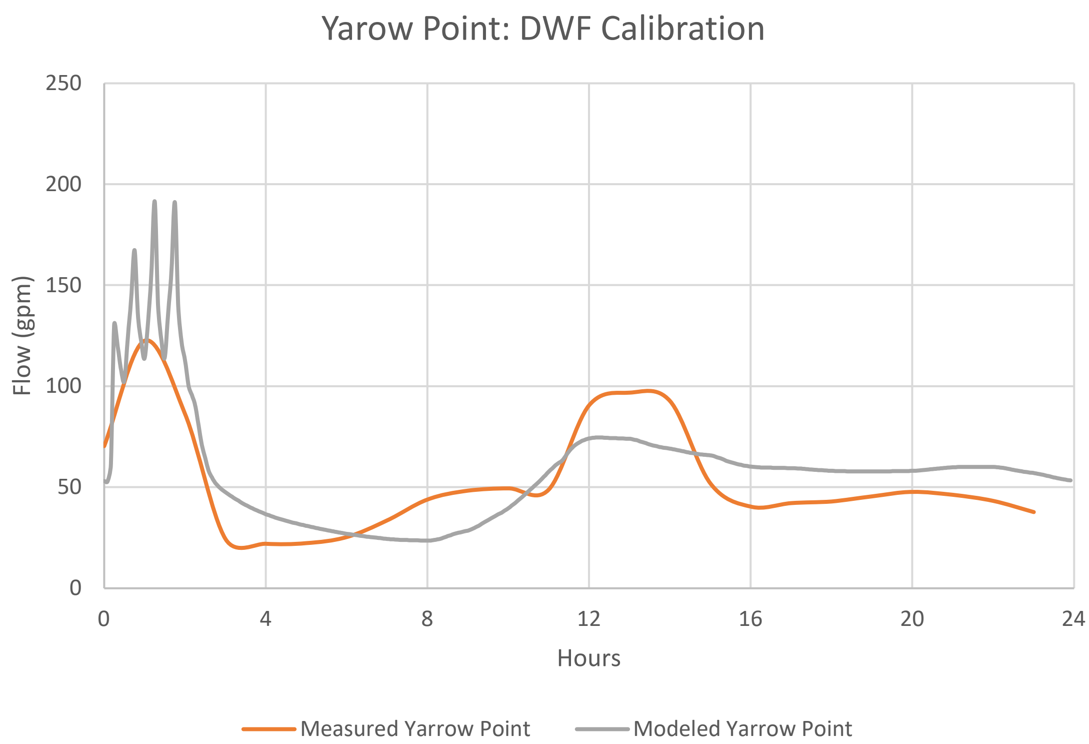
FLUSH STATION RUN TIMES

FLUSH STATION RUN TIMES 12/19/19

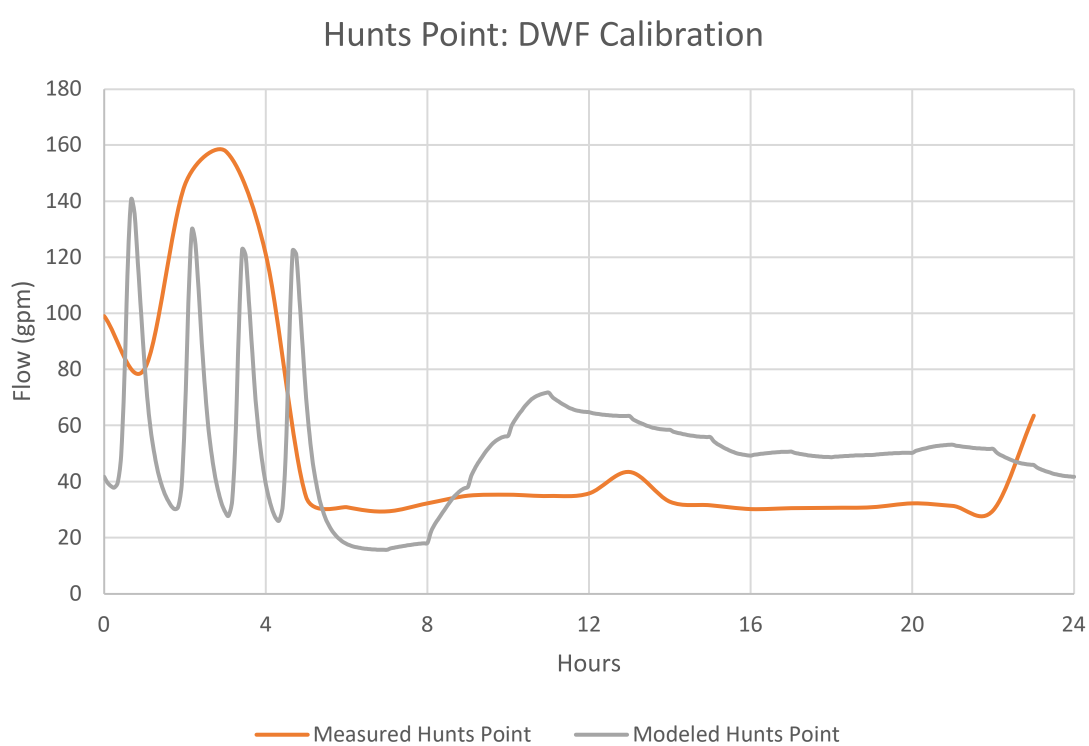
Flush Station 1	FS03-0217	ON	12:00 AM	OFF	12:15 AM
4620 95th Av NE		ON	12:30 AM	OFF	12:45 AM
		ON	1:00 AM	OFF	1:15 AM
		ON	1:30 AM	OFF	1:45 AM
Flush Station 2	FS03-0272	ON	12:00 AM	OFF	12:15 AM
3261 Hunts Pt Rd		ON	1:30 AM	OFF	1:45 AM
		ON	2:45 AM	OFF	3:00 AM
		ON	4:00 AM	OFF	4:15 AM
Flush Station 3 North	FS01-0290	ON	12:00 AM	OFF	12:15 AM
2441 Evergreen Pt Rd		ON	1:00 AM	OFF	1:15 AM
		ON	2:00 AM	OFF	2:15 AM
		ON	3:00 AM	OFF	3:15 AM
Flush Station 3 South	FS02-0101	ON	12:00AM	OFF	12:15 AM
2441 Evergreen Pt Rd		ON	1:15 AM	OFF	1:30 AM
		ON	2:30 AM	OFF	2:45 AM
		ON	3:45 AM	OFF	4:00 AM
Flush Station 4	FS02-0233	ON	12:00 AM	OFF	1:30 AM
8875 Overlake Dr W					
Flush Station 5	FS05-0171	ON	12:00 AM	OFF	12:15 AM
8925 Groat Pt Dr		ON	12:45 AM	OFF	1:00 AM
		ON	12:30 AM	OFF	12:45 AM
		ON	1:00 AM	OFF	1:15 AM
		ON	1:30 AM	OFF	1:45 AM
		ON	2:15 AM	OFF	2:30 AM
		ON	3:00 AM	OFF	3:15 AM
Flush Station 6	FS08-0155	ON	12:00 AM	OFF	12:30 AM
903 SE Shoreland Dr		ON	1:00 AM	OFF	1:30 AM
		ON	2:00 AM	OFF	2:30 AM
Flush Station 7	FS09-0101	ON	12:00 AM	OFF	12:30 AM
1175 SE 96th Av SE		ON	1:00 AM	OFF	1:30 AM
		ON	2:00 AM	OFF	2:30 AM
Flush Station 8	FS36-0197	ON	3::00 AM	OFF	3:30 AM
		ON	4:00 AM	OFF	4:30 AM
Flush Station 9	FS34-0146	ON	3:00 AM	OFF	4:00AM
546 W Lk Samm Pkwy SE					
Flush Station 10	FS43-0272	ON	12:00 AM	OFF	12:15 AM
562 W Lk Samm Pkwy SE		ON	12:45 AM	OFF	1:00 AM
		ON	1:30 AM	OFF	1:45 AM
		ON	2:15 AM	OFF	2:30 AM
Parker Pump Station to Grange	PSS05-0136	ON	11:15 PM	OFF	11:30PM
9011 Lk Wa Blvd NE		ON	12:00AM	OFF	12:15AM
		ON	12:45AM	OFF	1:00am
		ON	1:30AM	OFF	1:45AM
Lift Station 1		ON	12:00 AM	OFF	12:15 AM
2442 W Lk Samm Pkwy SE		ON	12:45 AM	OFF	1:00 AM
		ON	1:30 AM	OFF	1:45 AM
		ON	2:15 AM	OFF	2:30 AM
Lift Station 19		OPEN 2 1/4 TURNS CCW			
1830 W Lk Samm Pkwy NE					

Appendix 1B

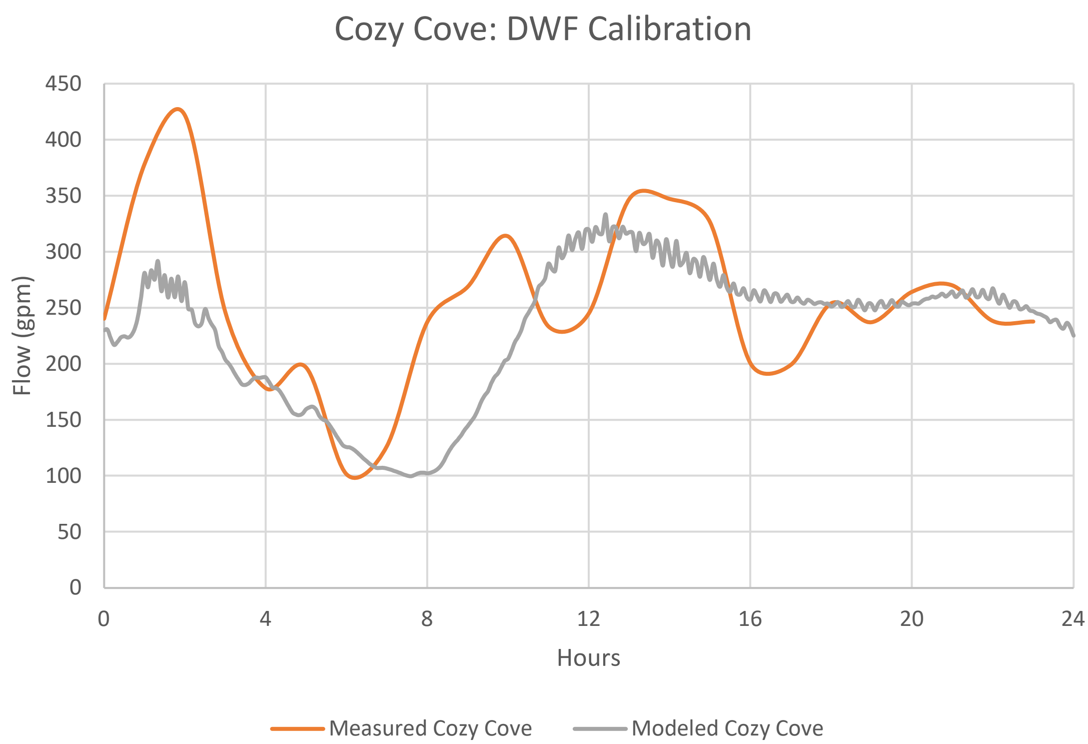
DWF CALIBRATION FIGURES

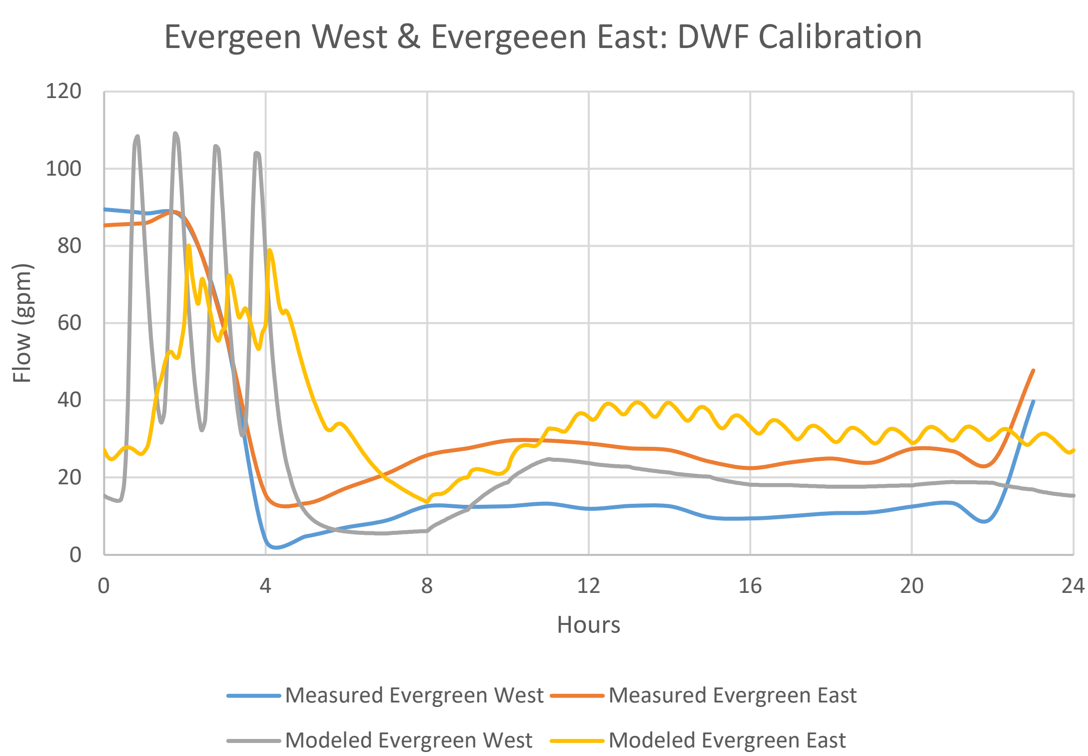


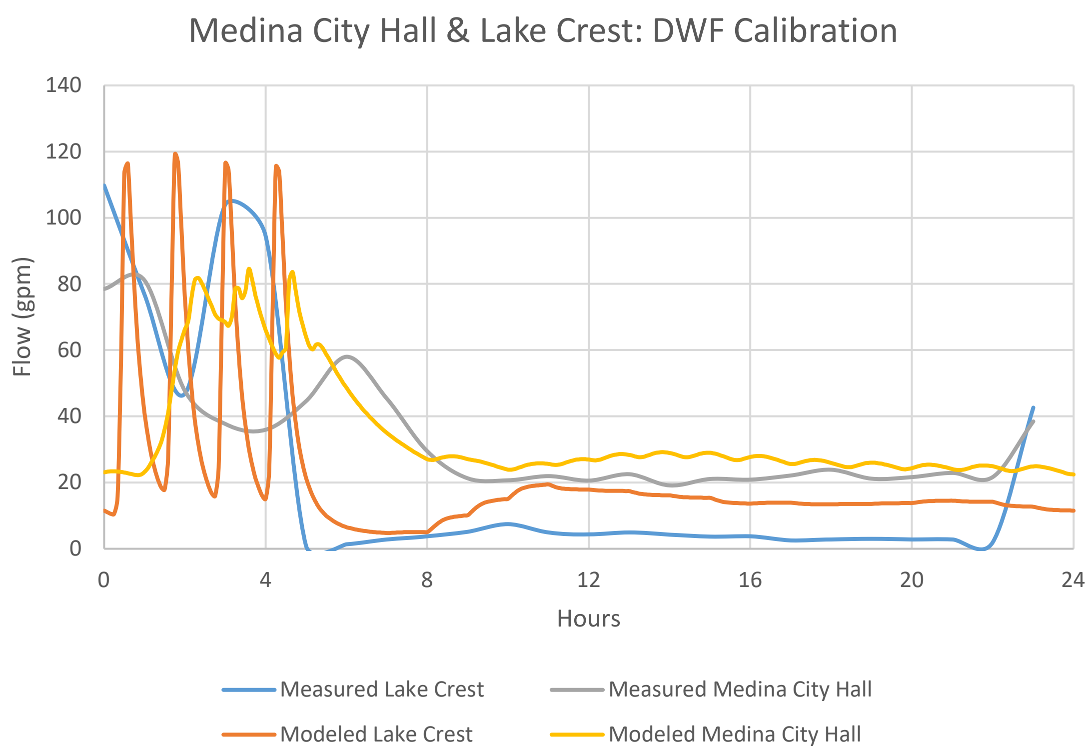
Yarow Point: DWF Calibration
250
200
150
100
50
0
Flow (gpm)
0
4
8
12
16
20
24
Hours
Measured Yarrow Point
Modeled Yarrow Point



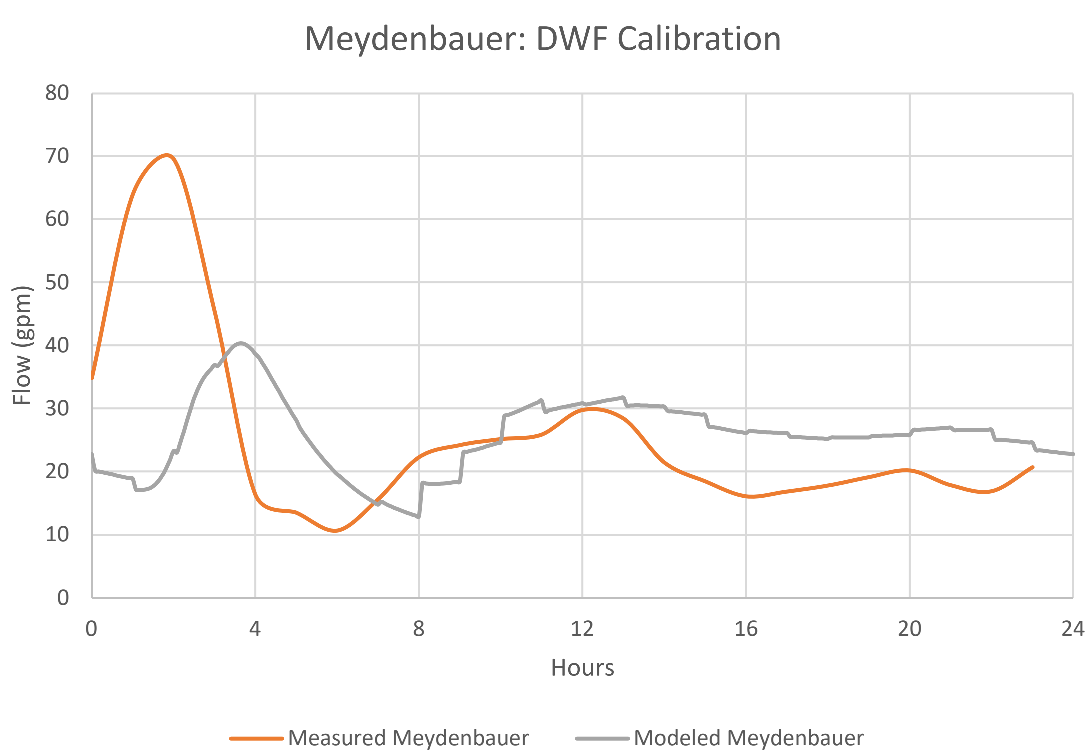
Hunts Point: DWF Calibration
180
160
140
120
100
80
60
40
20
0
Flow (gpm)
0
4
8
12
16
20
24
Hours
Measured Hunts Point
Modeled Hunts Point


Cozy Cove: DWF Calibration
450
400
350
300
250
200
150
100
50
0
Flow (gpm)
0
4
8
12
16
20
24
Hours
Measured Cozy Cove
Modeled Cozy Cove

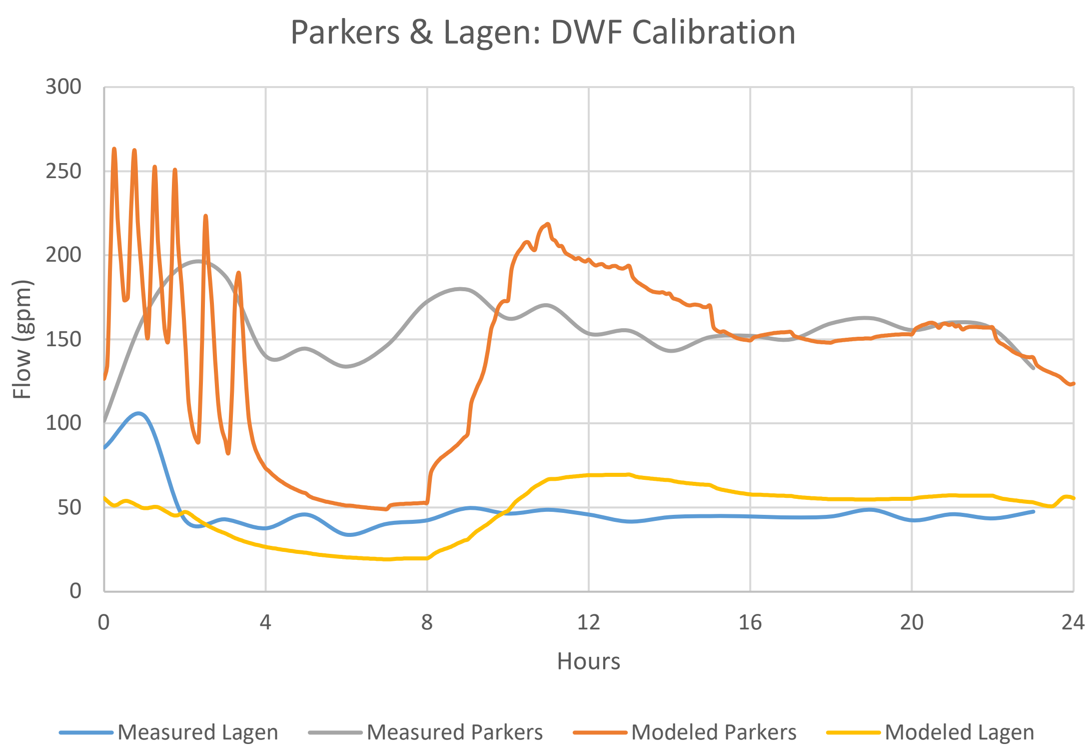

Evergeen West & Evergeeen East: DWF Calibration
120
100
80
60
40
20
0
Flow (gpm)
0
4
8
12
16
20
24
Hours
Measured Evergreen West
Measured Evergreen East
Modeled Evergreen West
Modeled Evergreen East



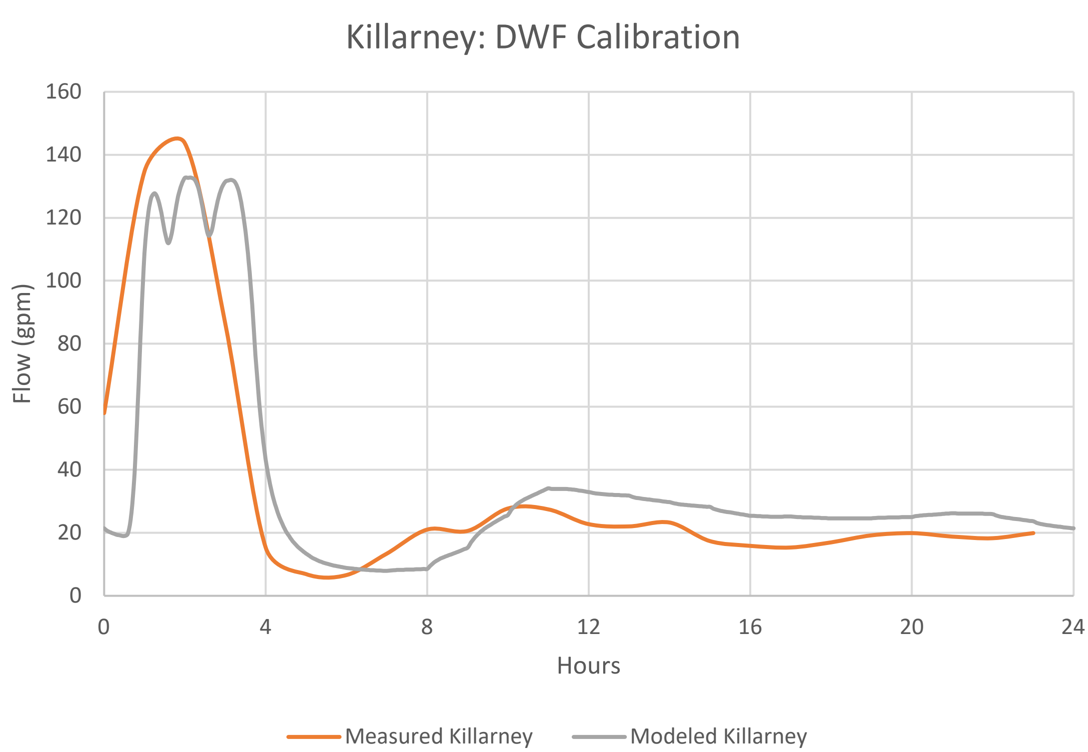
Medina City Hall & Lake Crest: DWF Calibration
Flow (gpm)
140
120
100
80
60
40
20
0
0
4
8
12
16
20
24
Hours
Measured Lake Crest
Measured Medina City Hall
Modeled Lake Crest
Modeled Medina City Hall



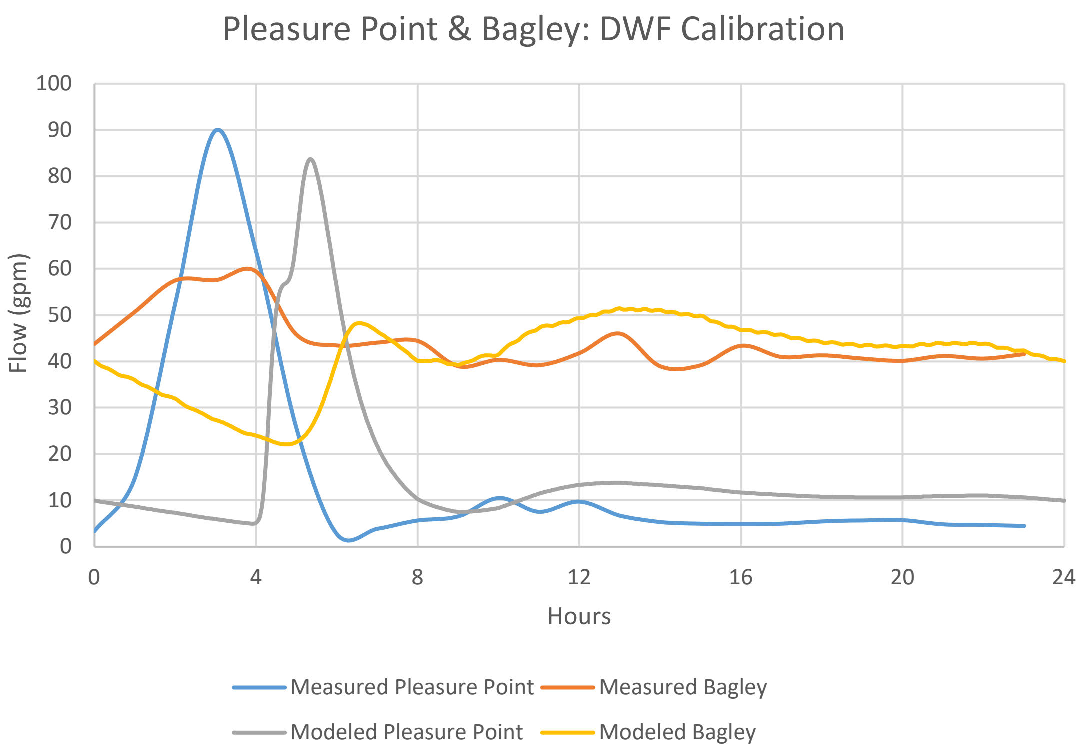
Meydenbauer: DWF Calibration
Flow (gpm)
80
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
Hours
Measured Meydenbauer
Modeled Meydenbauer



Parkers & Lagen: DWF Calibration
Flow (gpm)
300
250
200
150
100
50
0
0
4
8
12
16
20
24
Hours
Measured Lagen
Measured Parkers
Modeled Parkers
Modeled Lagen

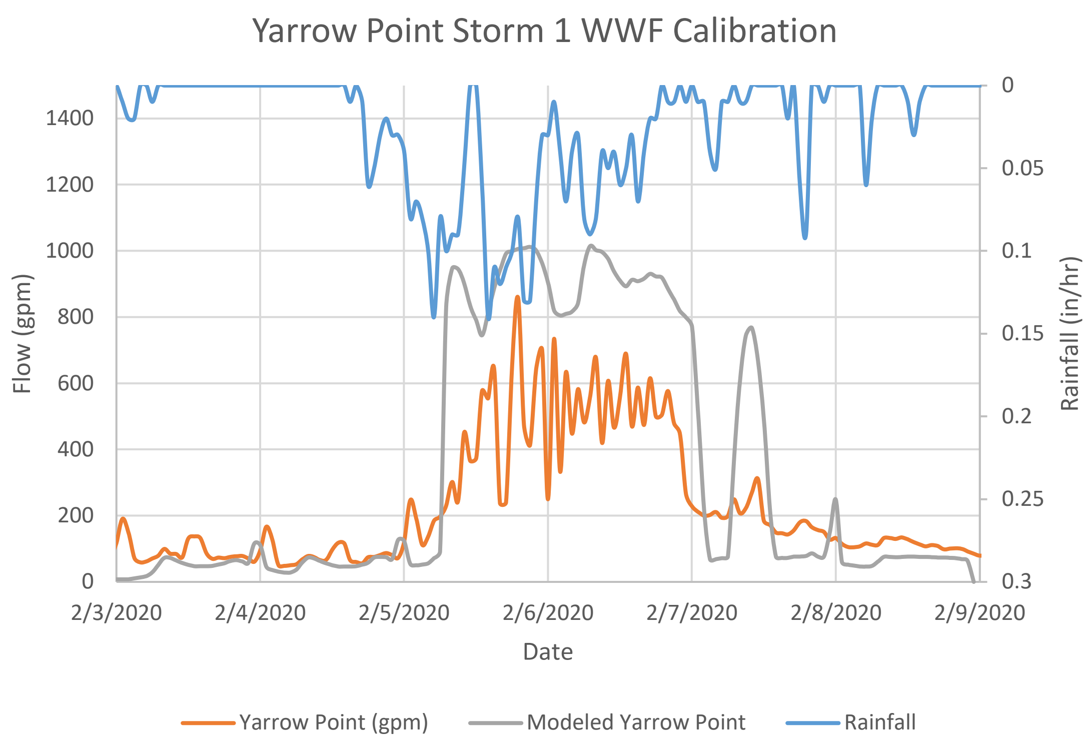


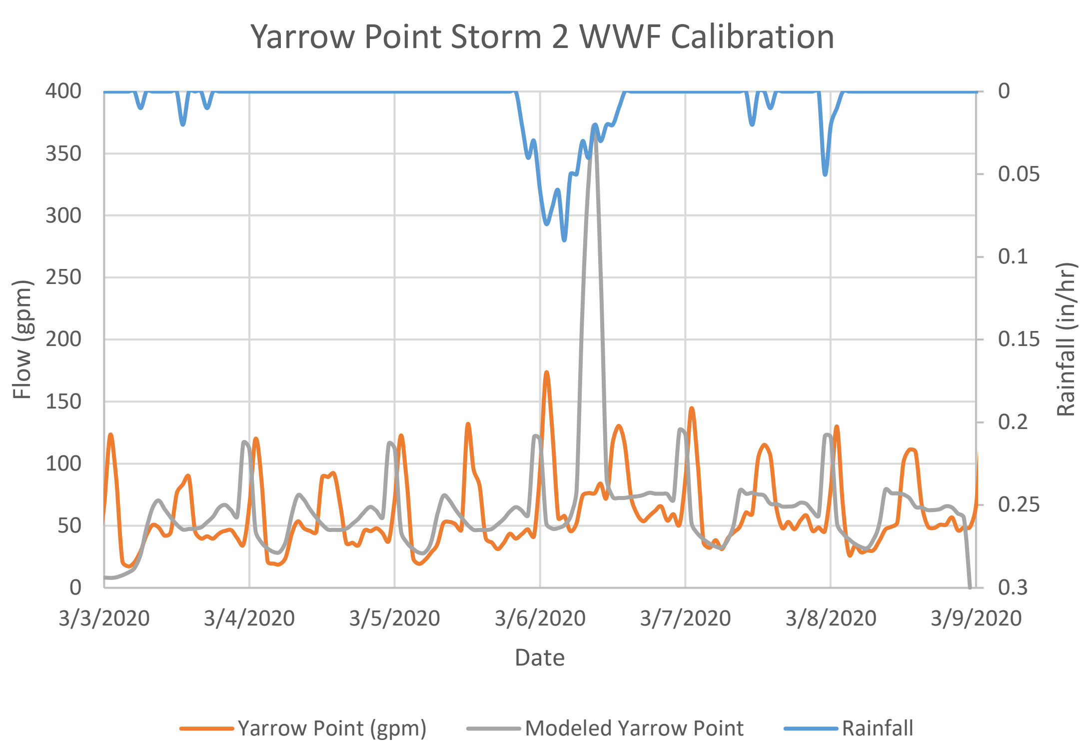
Killarney: DWF Calibration
Flow (gpm)
160
140
120
100
80
60
40
20
0
0
4
8
12
16
20
24
Hours
Measured Killarney
Modeled Killarney


Pleasure Point & Bagley: DWF Calibration
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
Hours
Measured Pleasure Point
Measured Bagley
Modeled Pleasure Point
Modeled Bagley

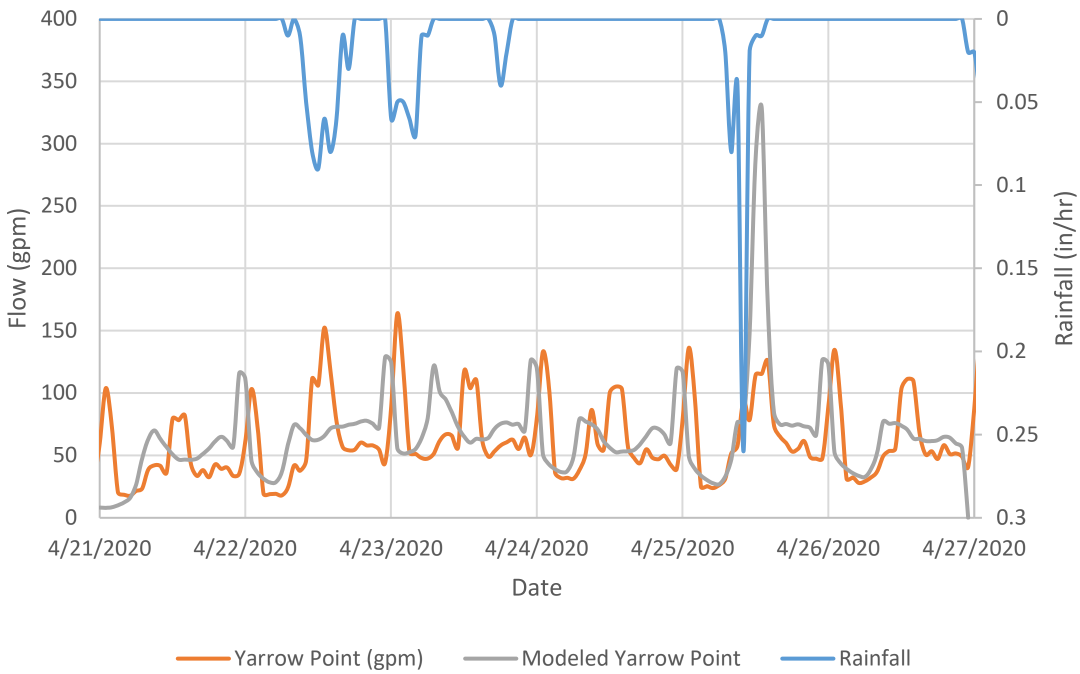
Appendix 1C

WWF CALIBRATION FIGURES

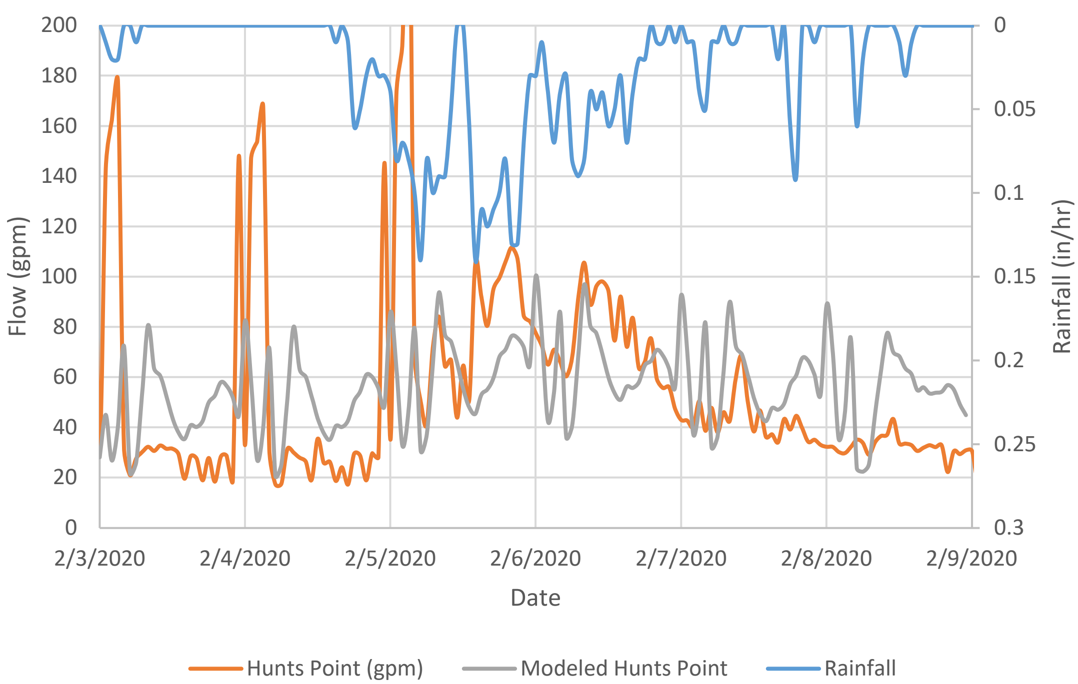

Yarrow Point Storm 1 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
0
200
400
600
800
1000
1200
1400
0
0.05
0.1
0.15
0.2
0.25
0.3
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Yarrow Point (gpm)
Modeled Yarrow Point
Rainfall

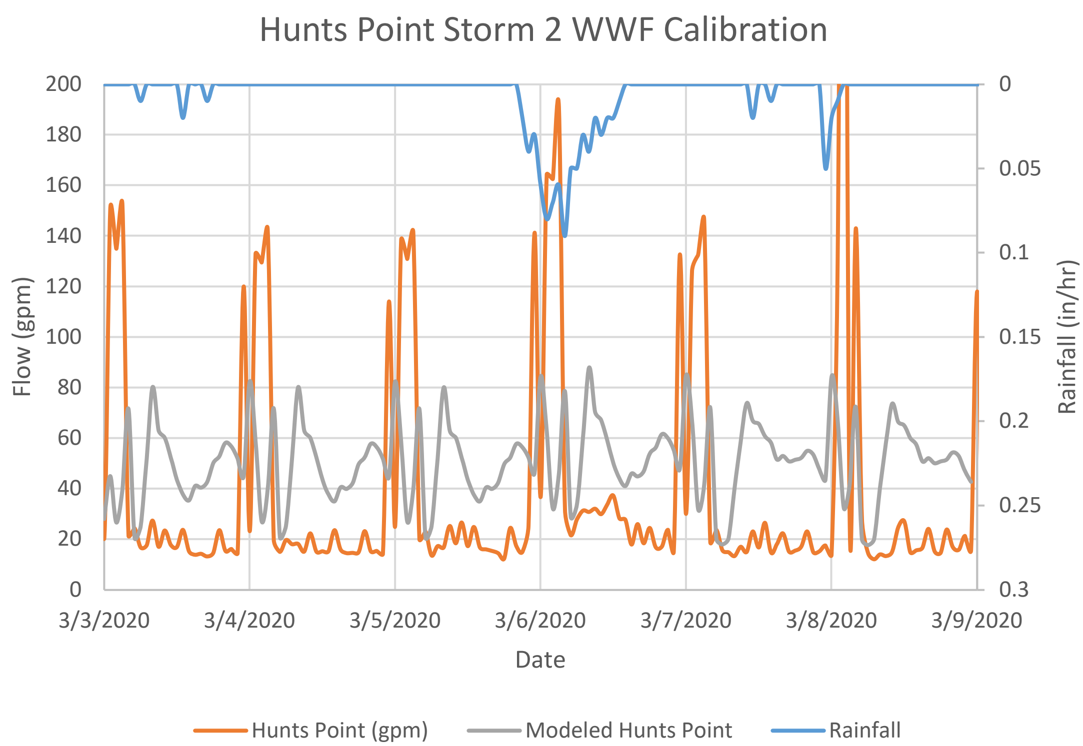

Yarrow Point Storm 2 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
0
50
100
150
200
250
300
350
400
0
0.05
0.1
0.15
0.2
0.25
0.3
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Yarrow Point (gpm)
Modeled Yarrow Point
Rainfall

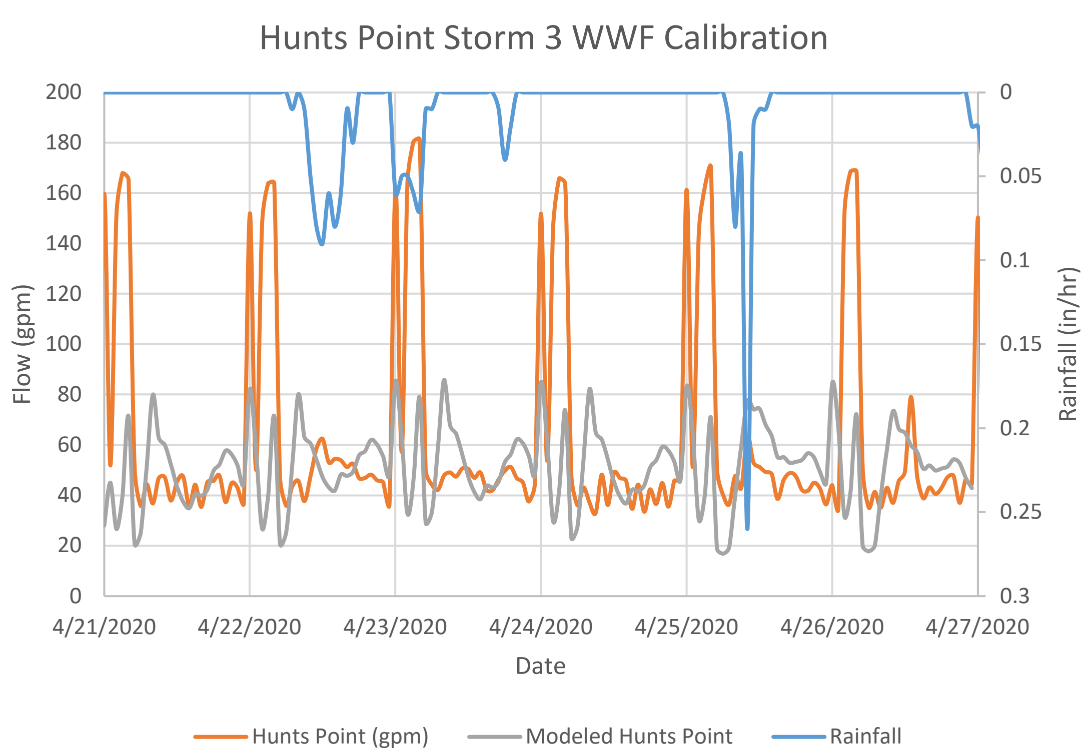
Yarrow Point Storm 3 WWF Calibration

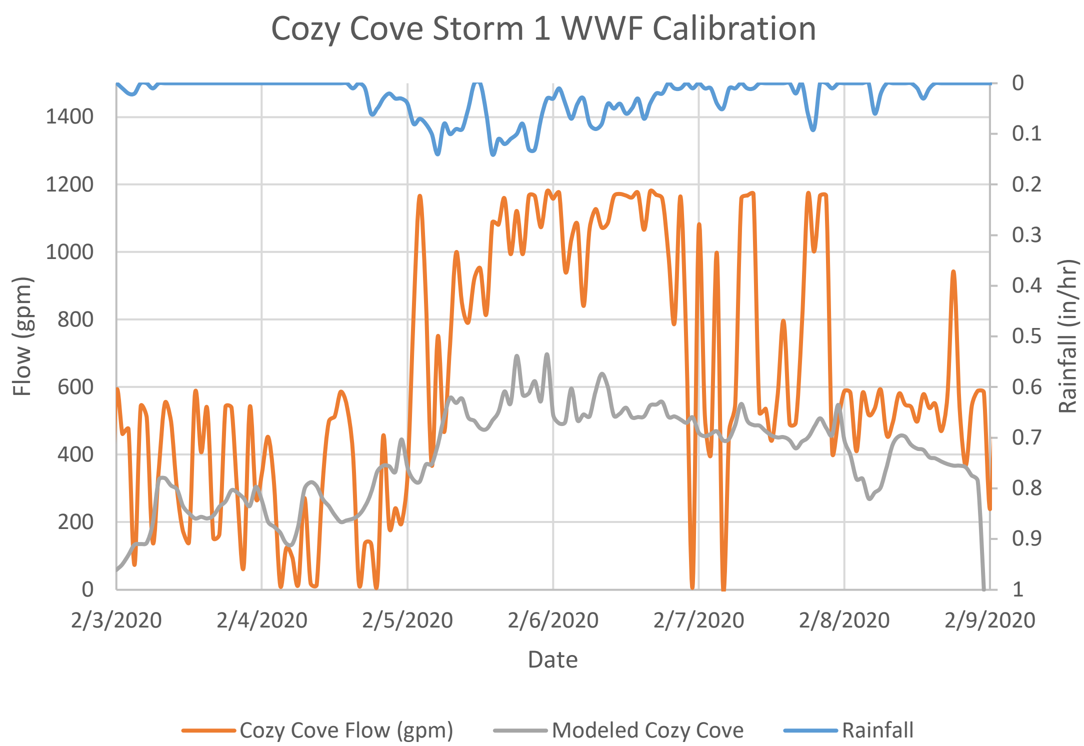


Hunts Point Storm 1 WWF Calibration

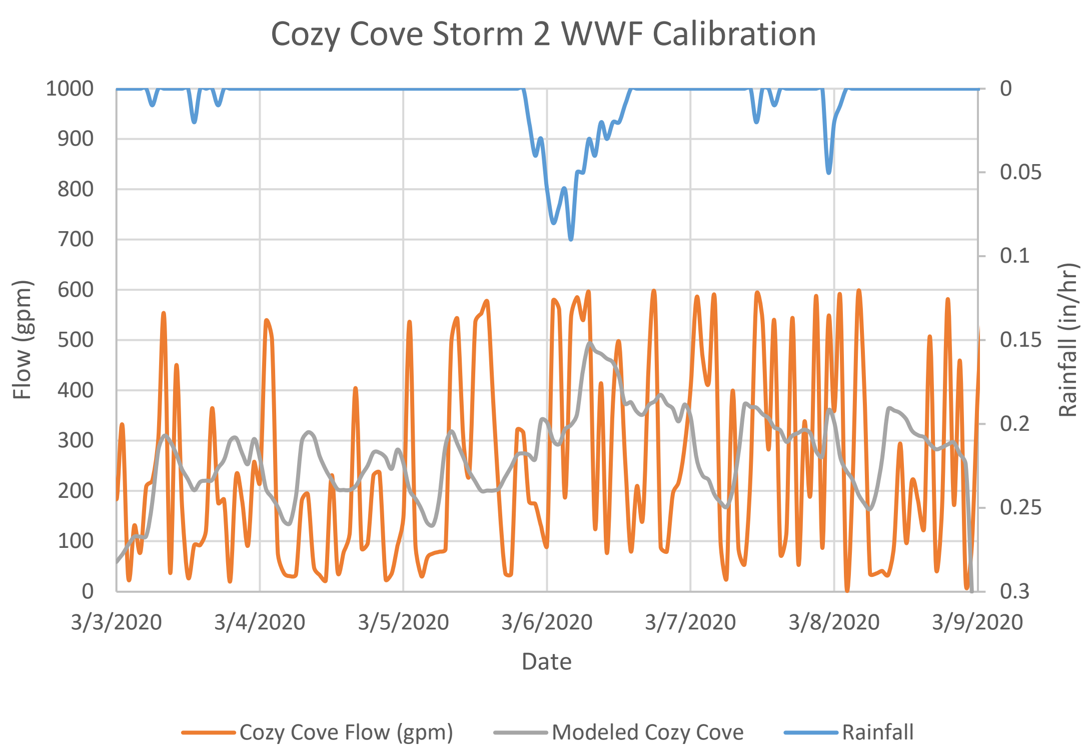



Hunts Point Storm 2 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.05
0.1
0.15
0.2
0.25
0.3
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Date
Hunts Point (gpm)
Modeled Hunts Point
Rainfall

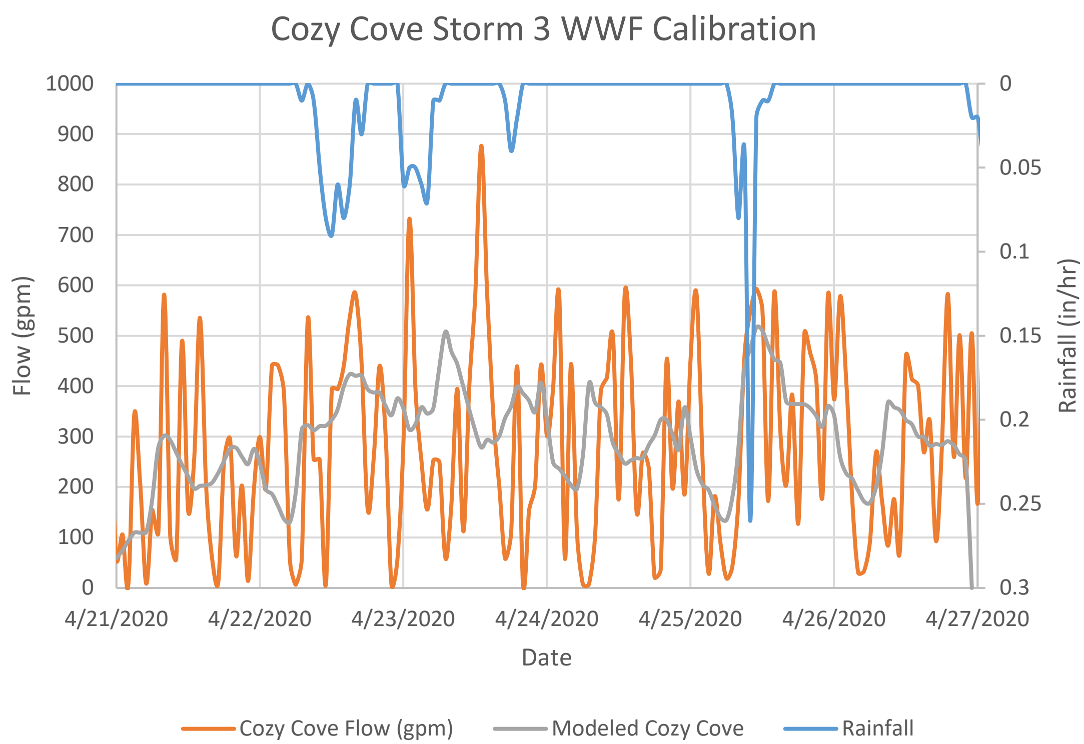

Hunts Point Storm 3 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.05
0.1
0.15
0.2
0.25
0.3
4/21/2020
4/22/2020
4/23/2020
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Date
Hunts Point (gpm)
Modeled Hunts Point
Rainfall

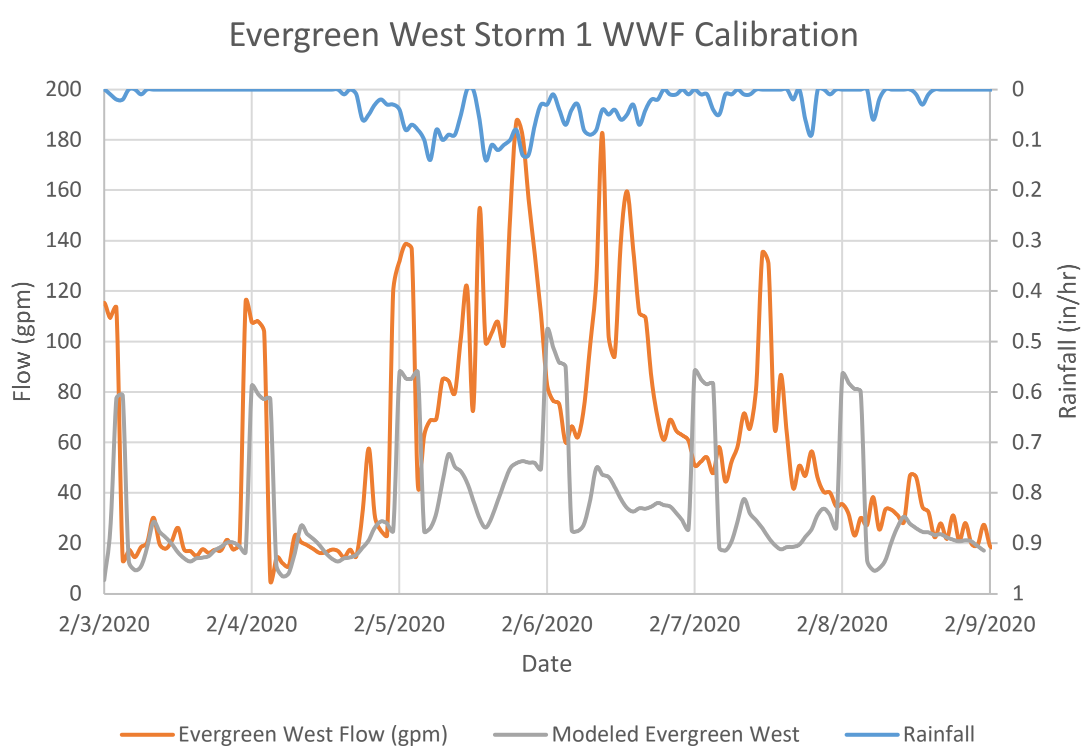


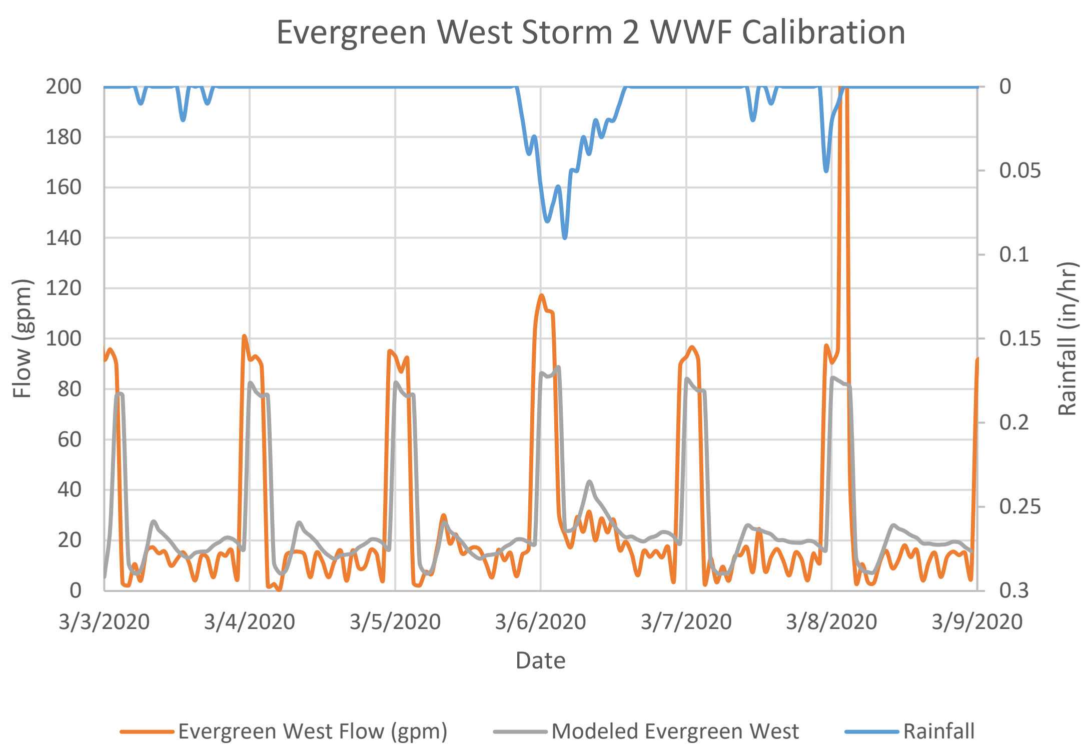
Cozy Cove Storm 1 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
0
200
400
600
800
1000
1200
1400
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Cozy Cove Flow (gpm)
Modeled Cozy Cove
Rainfall



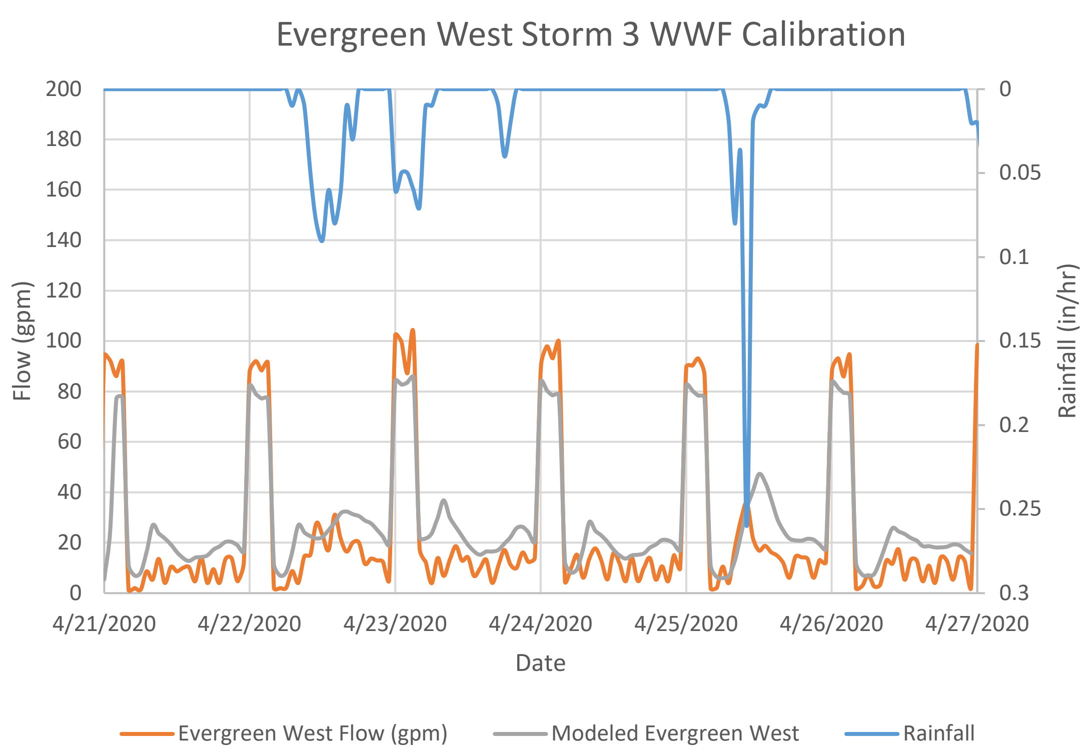
Cozy Cove Storm 2 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
0
100
200
300
400
500
600
700
800
900
1000
0
0.05
0.1
0.15
0.2
0.25
0.3
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Cozy Cove Flow (gpm)
Modeled Cozy Cove
Rainfall


Cozy Cove Storm 3 WWF Calibration
Flow (gpm)
1000
900
800
700
600
500
400
300
200
100
0
Rainfall (in/hr)
0
0.05
0.1
0.15
0.2
0.25
0.3
4/21/2020
4/22/2020
4/23/2020
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Date
Cozy Cove Flow (gpm)
Modeled Cozy Cove
Rainfall

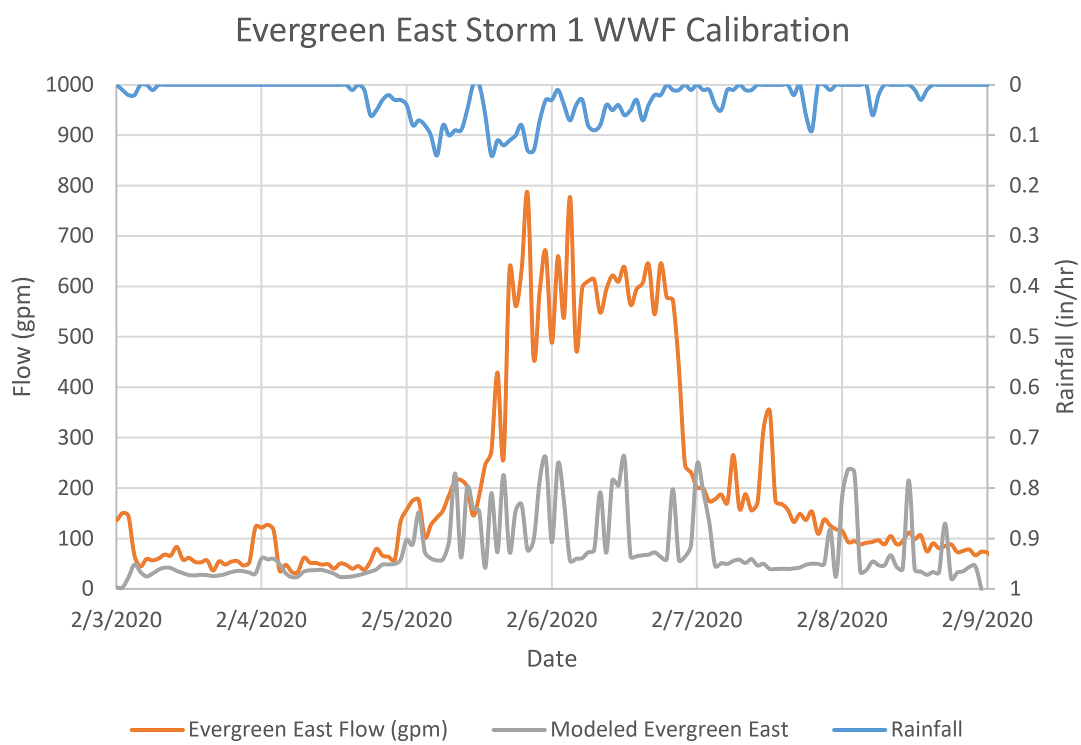

Evergreen West Storm 1 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Evergreen West Flow (gpm)
Modeled Evergreen West
Rainfall

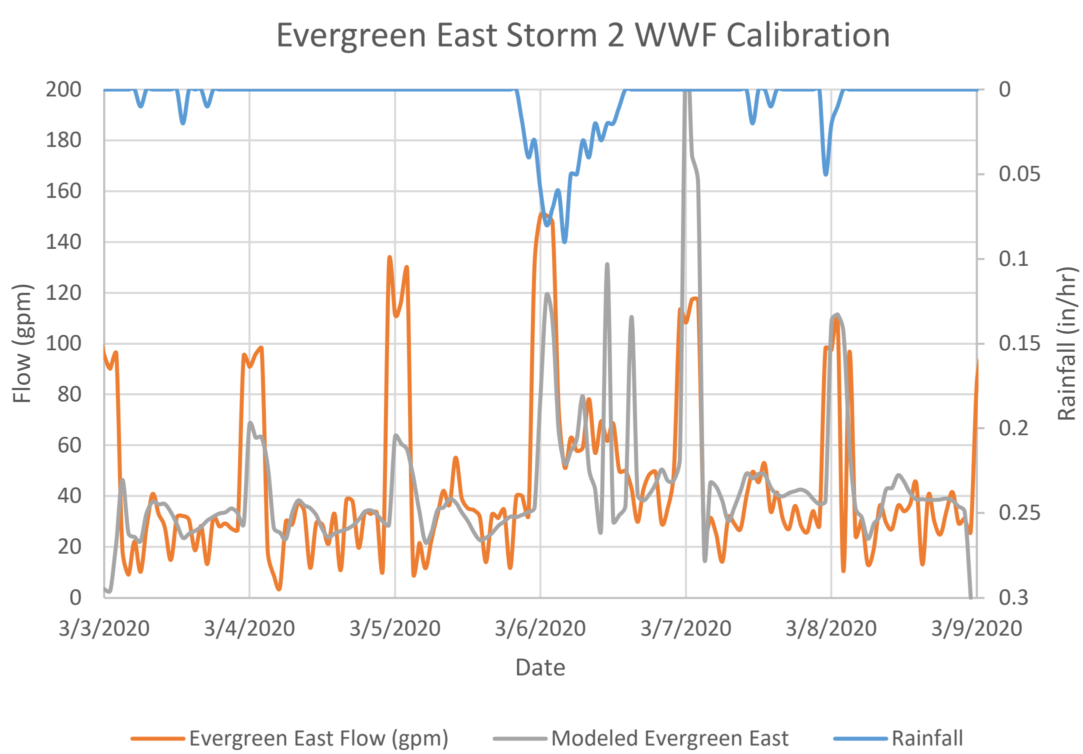


Evergreen West Storm 2 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Evergreen West Flow (gpm)
Modeled Evergreen West
Rainfall

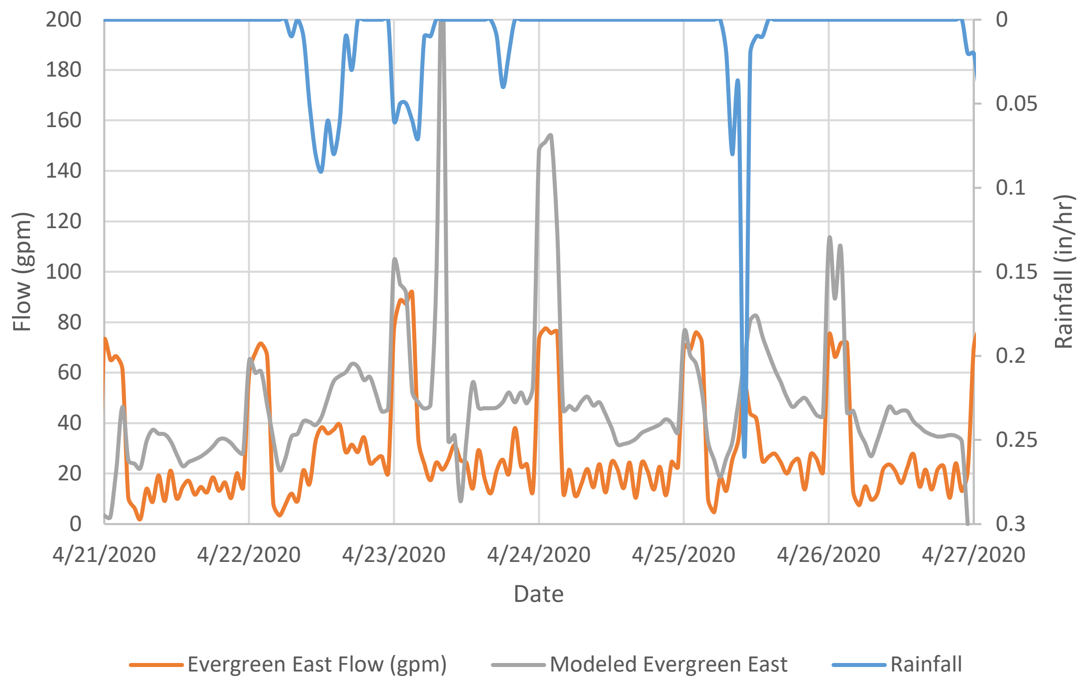


Evergreen West Storm 3 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
4/21/2020
4/22/2020
4/23/2020
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Evergreen West Flow (gpm)
Modeled Evergreen West
Rainfall

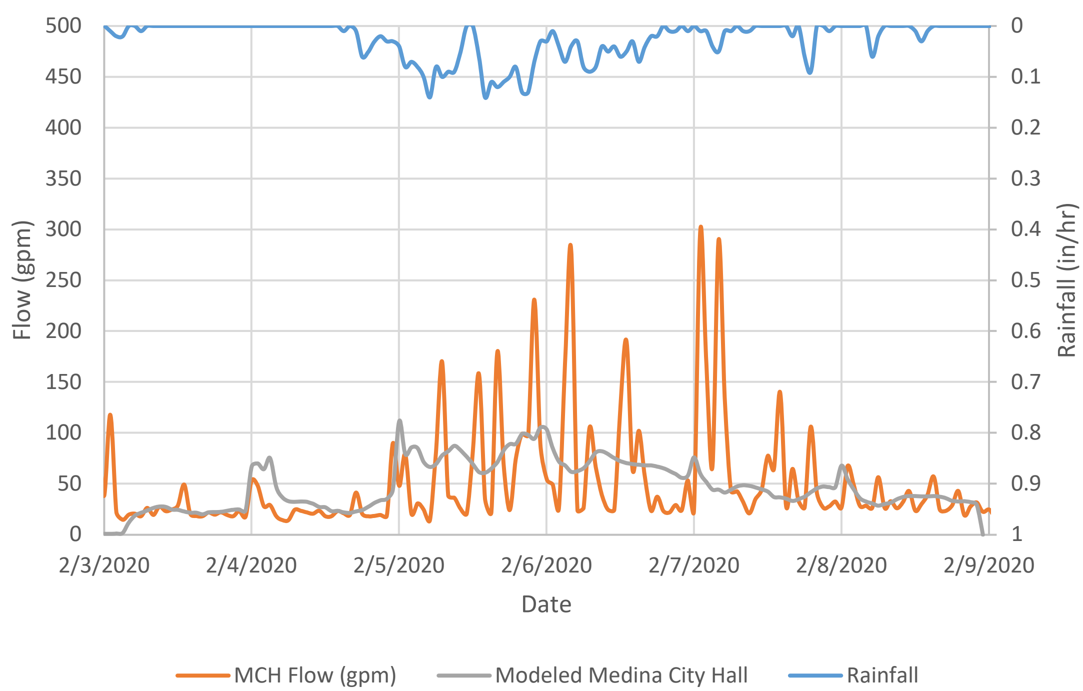

Evergreen East Storm 1 WWF Calibration
Flow (gpm)
1000
900
800
700
600
500
400
300
200
100
0
Rainfall (in/hr)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Evergreen East Flow (gpm)
Modeled Evergreen East
Rainfall


Evergreen East Storm 2 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.05
0.1
0.15
0.2
0.25
0.3
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Date
Evergreen East Flow (gpm)
Modeled Evergreen East
Rainfall

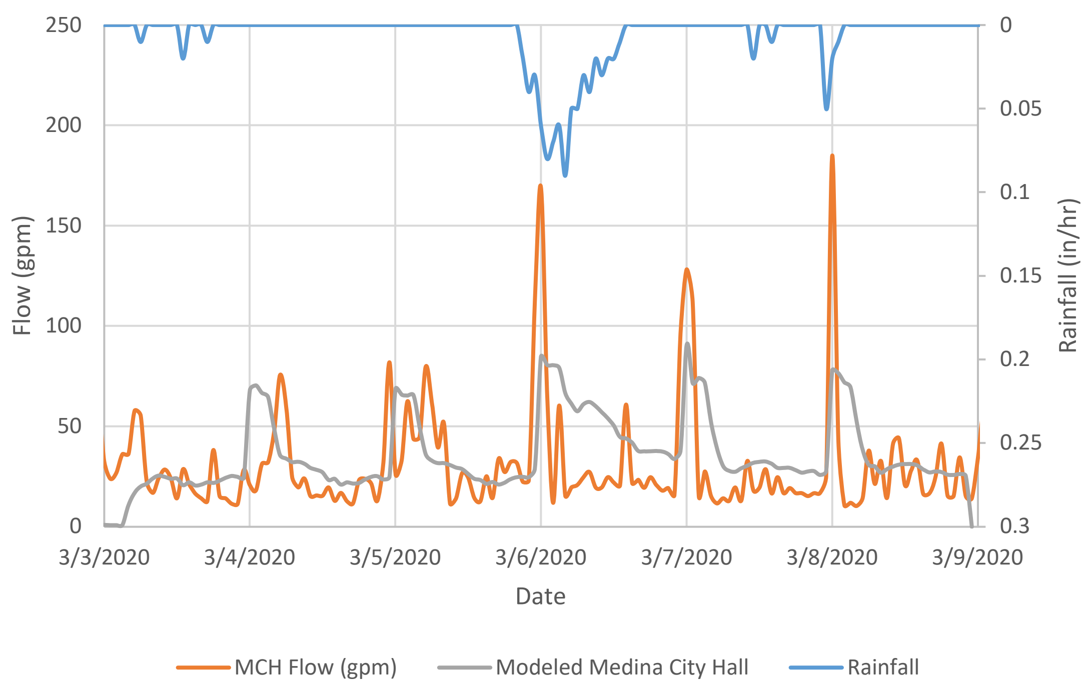
Evergreen East Storm 3 WWF Calibration



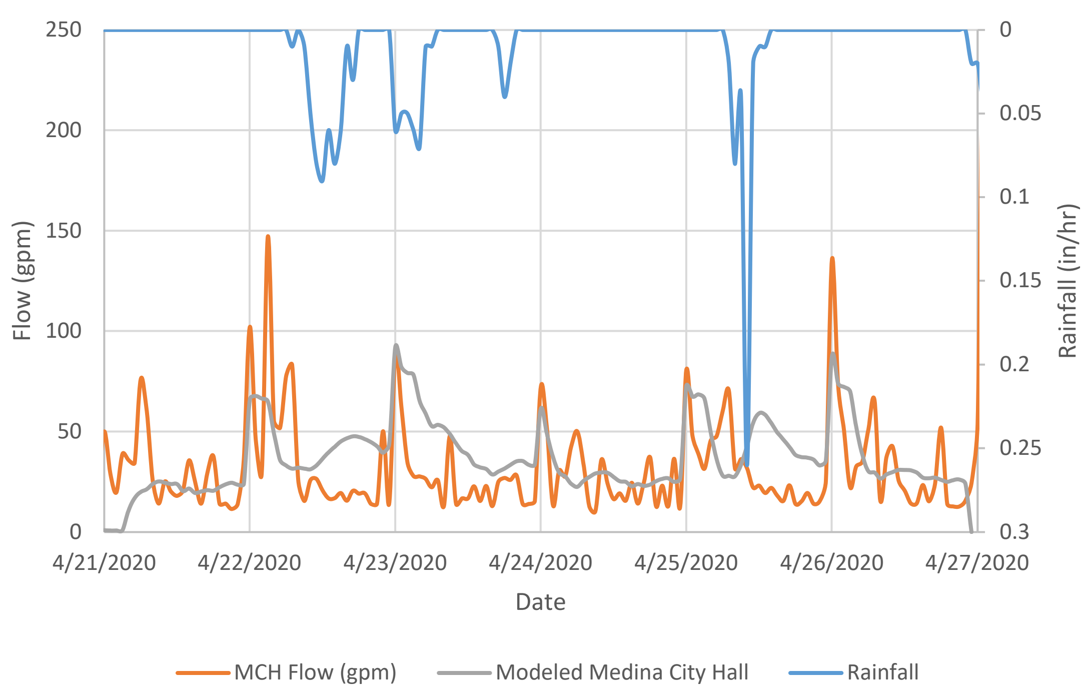
Medina City Hall Storm 1 WWF Calibration

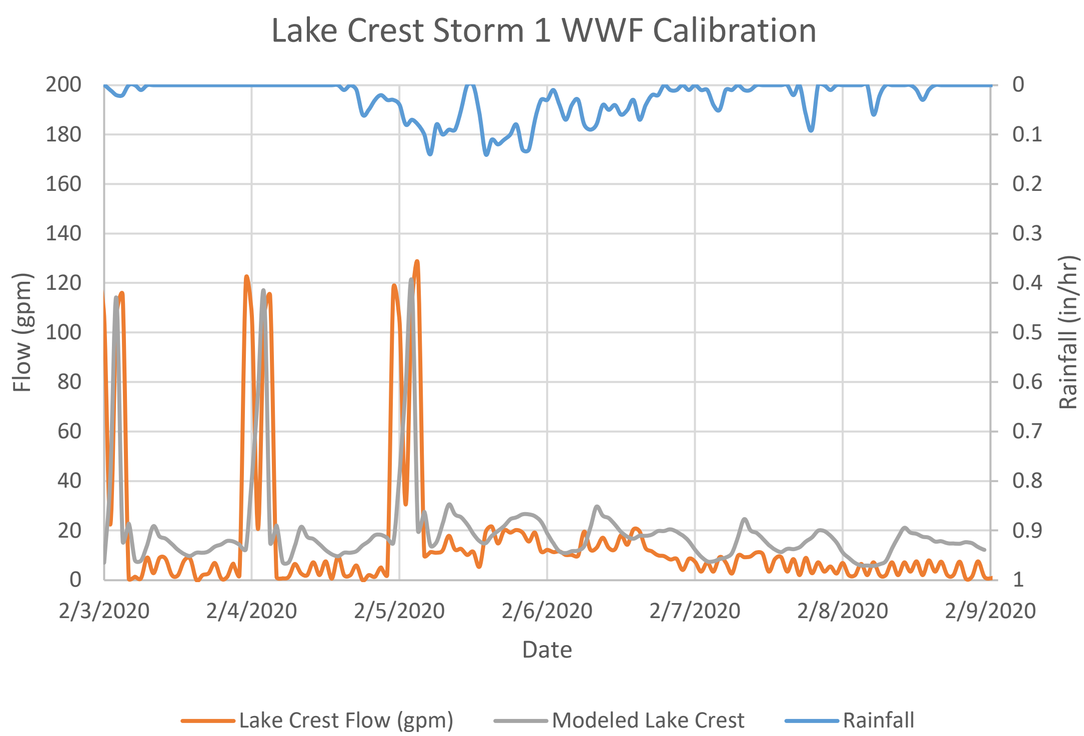


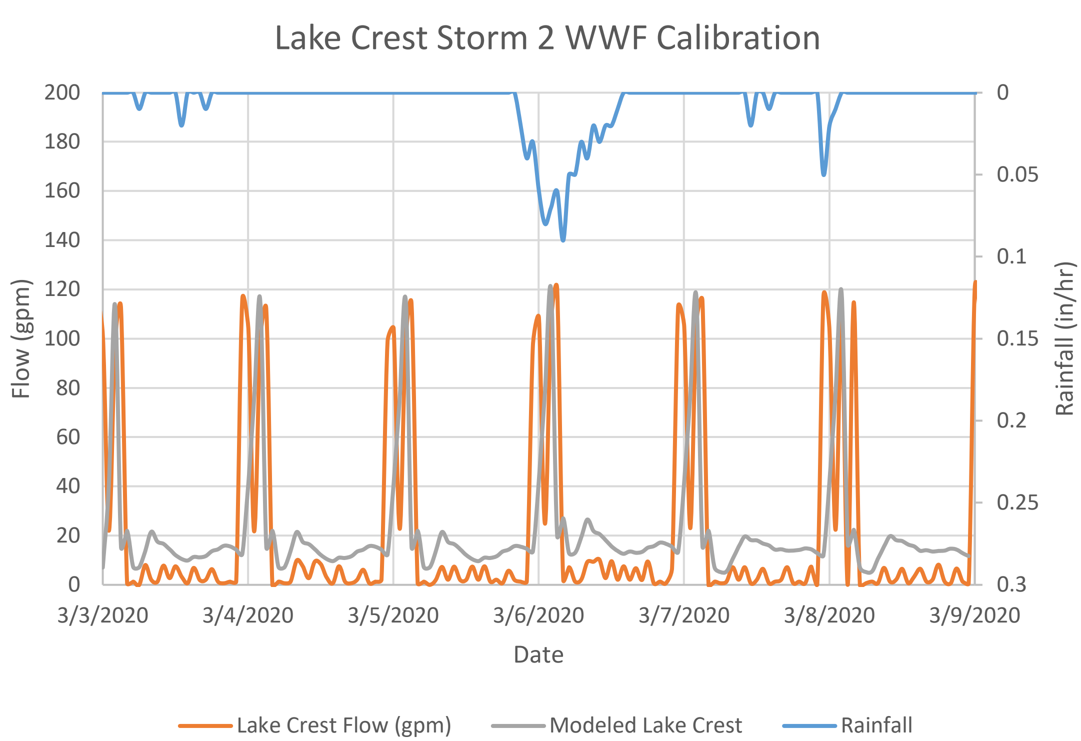
Medina City Hall Storm 2 WWF Calibration

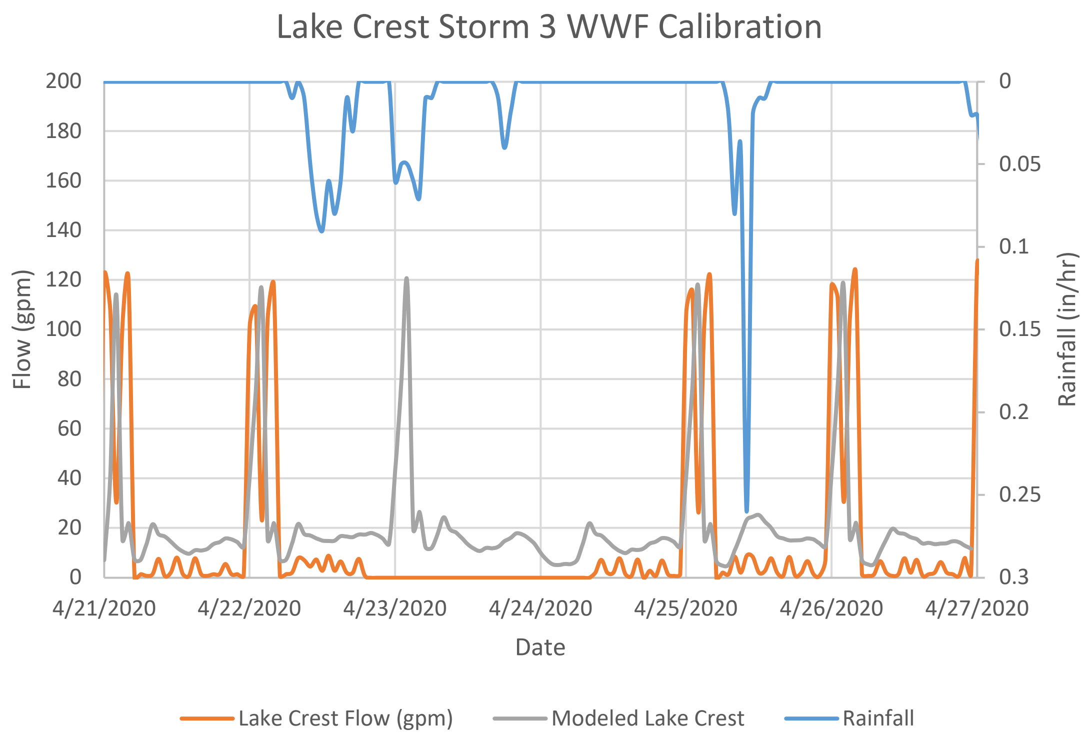


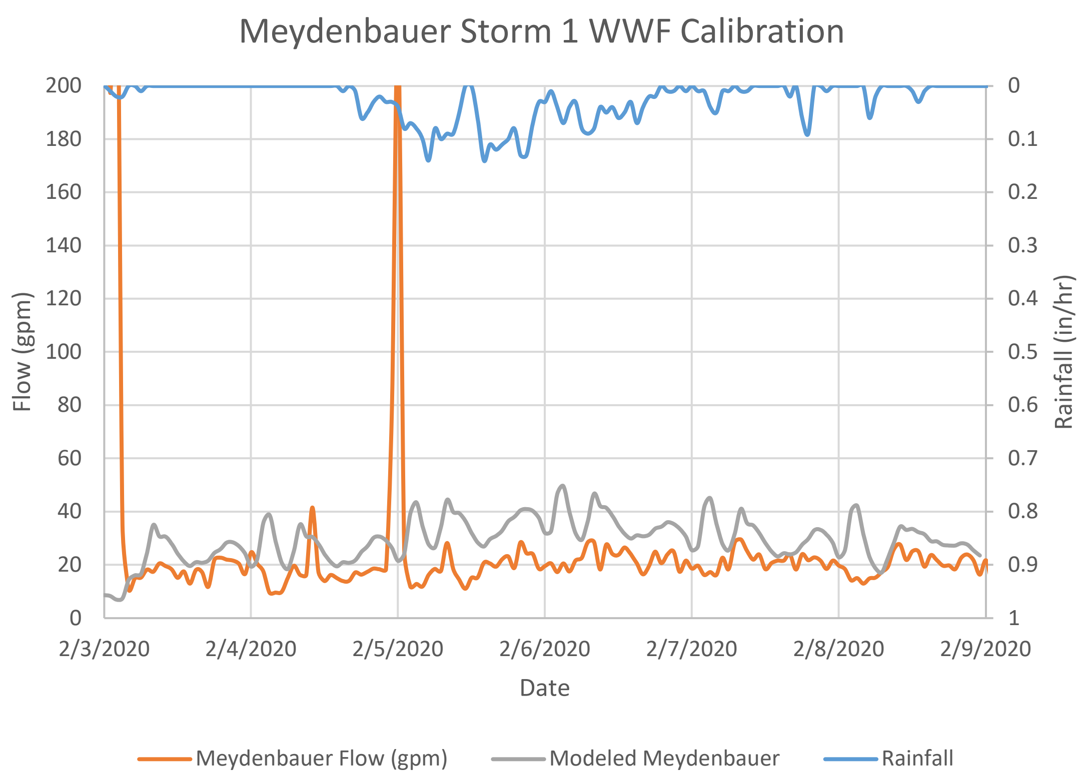
Medina City Hall Storm 3 WWF Calibration




Lake Crest Storm 1 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Lake Crest Flow (gpm)
Modeled Lake Crest
Rainfall


Lake Crest Storm 2 WWF Calibration
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
Rainfall (in/hr)
0
0.05
0.1
0.15
0.2
0.25
0.3
3/3/2020
3/4/2020
3/5/2020
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Date
Lake Crest Flow (gpm)
Modeled Lake Crest
Rainfall


Lake Crest Storm 3 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
200
180
160
140
120
100
80
60
40
20
0
0
0.05
0.1
0.15
0.2
0.25
0.3
4/21/2020
4/22/2020
4/23/2020
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Lake Crest Flow (gpm)
Modeled Lake Crest
Rainfall


Meydenbauer Storm 1 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
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180
160
140
120
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80
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2/6/2020
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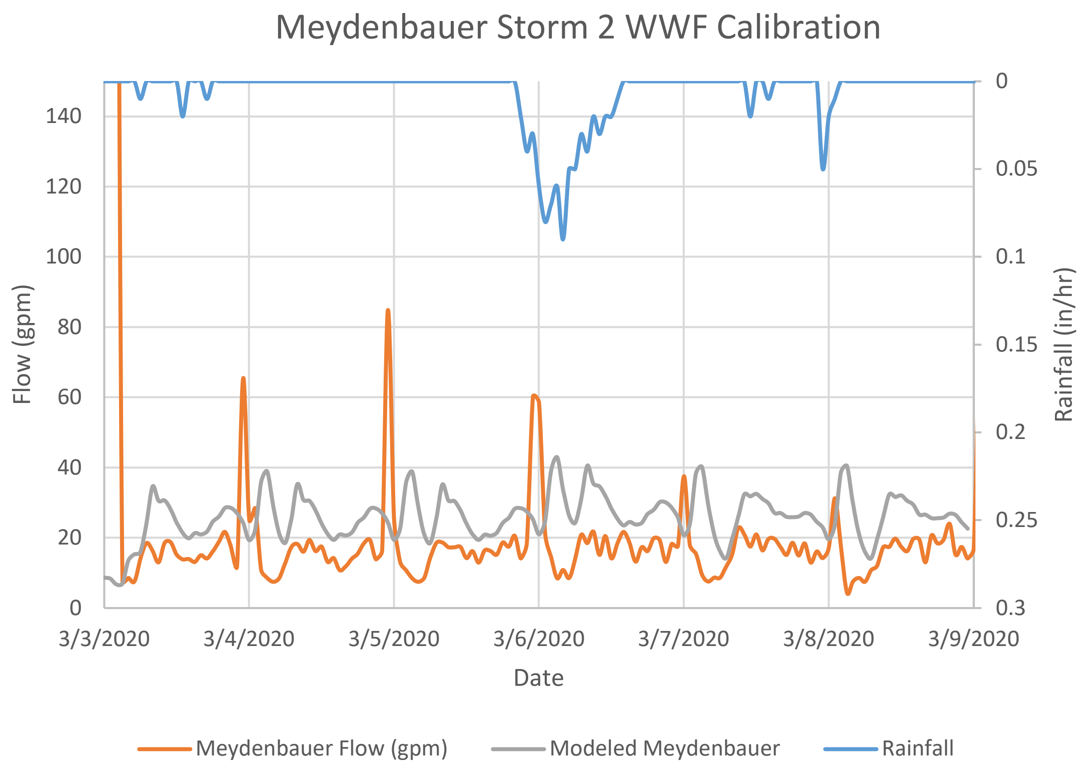
2/8/2020
2/9/2020
Meydenbauer Flow (gpm)
Modeled Meydenbauer
Rainfall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3/8/2020
3/9/2020
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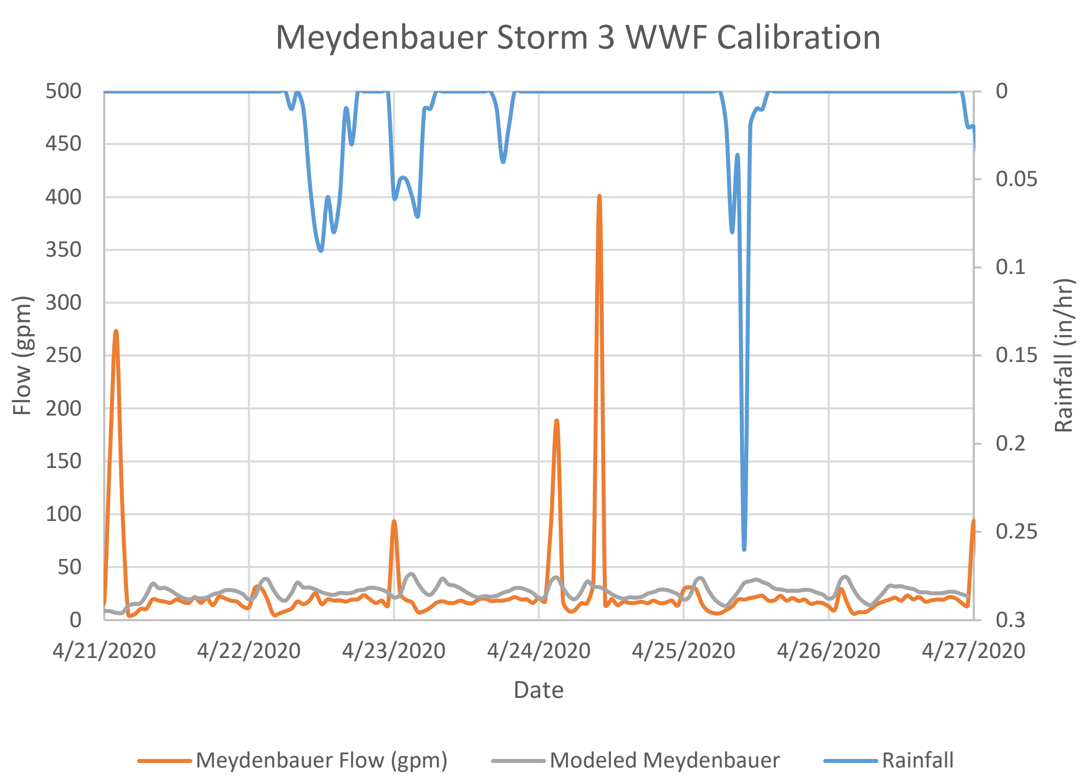
Meydenbauer Flow (gpm)
Modeled Meydenbauer
Rainfall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0.2
0.25
0.3
4/21/2020
4/22/2020
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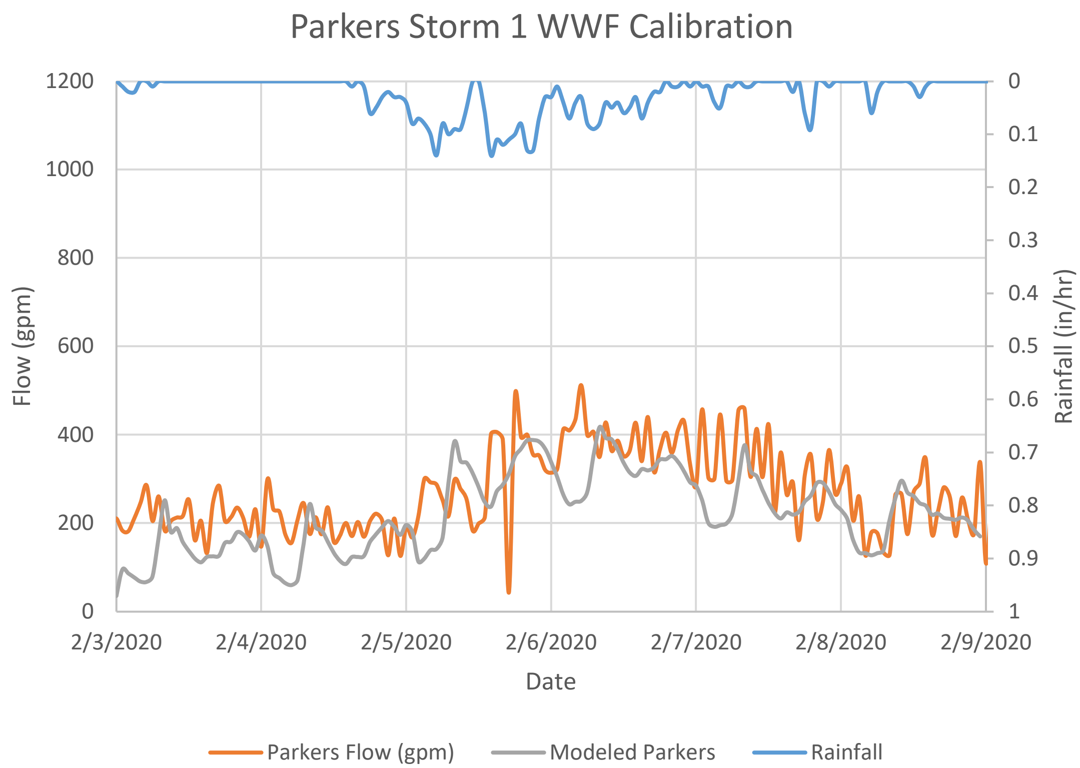
4/25/2020
4/26/2020
4/27/2020
Date
Meydenbauer Flow (gpm)
Modeled Meydenbauer
Rainfall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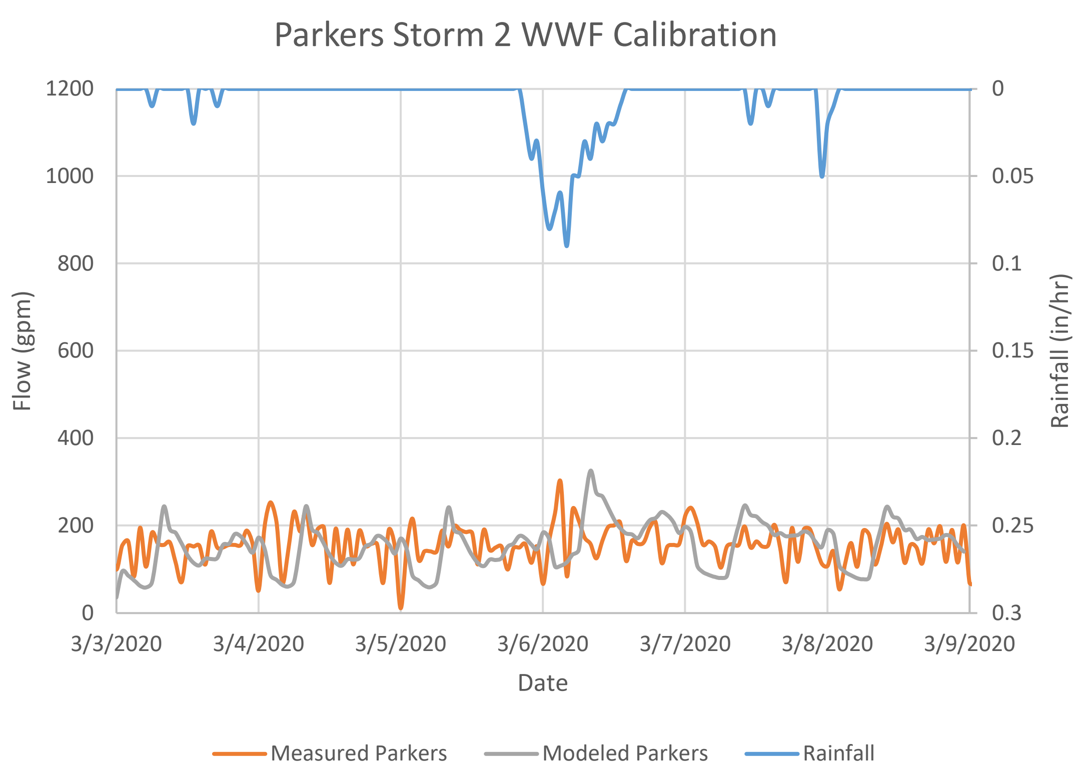
0.9
1
Rainfall (in/hr)
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Parkers Flow (gpm)
Modeled Parkers
Rainfall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200
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Flow (gpm)
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0.3
Rainfall (in/hr)
3/3/2020
3/4/2020
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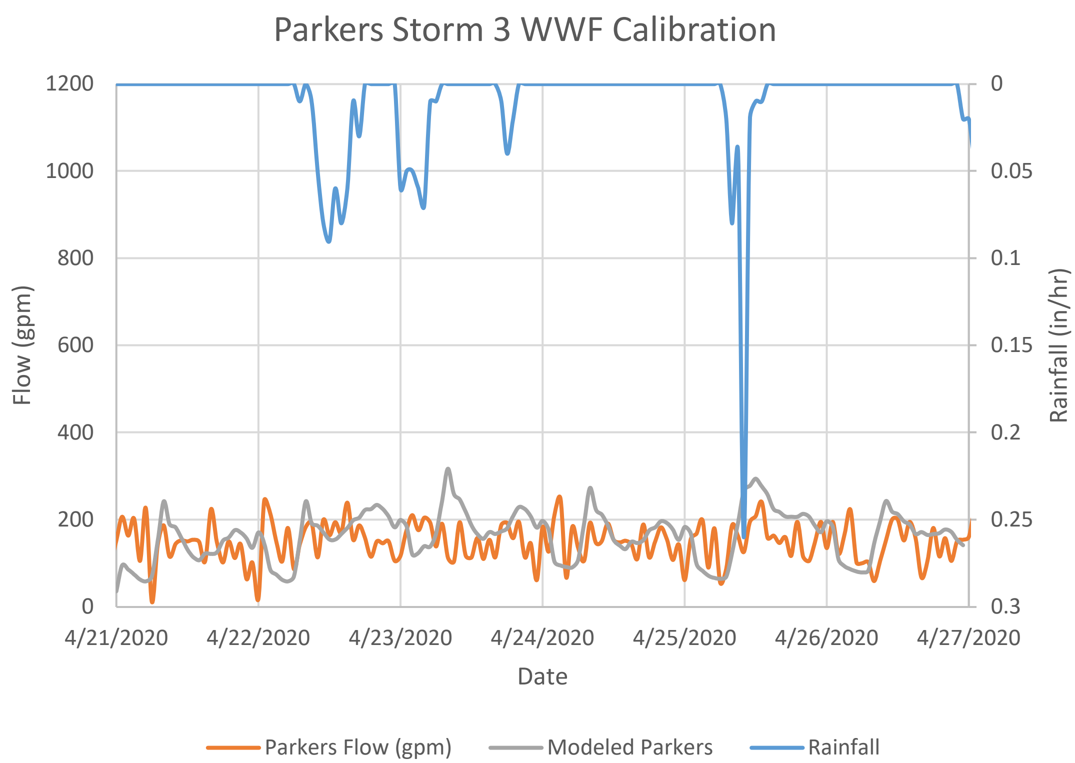
3/6/2020
3/7/2020
3/8/2020
3/9/2020
Date
Measured Parkers
Modeled Parkers
Rainfall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800
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200
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Rainfall (in/hr)
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0.1
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4/21/2020
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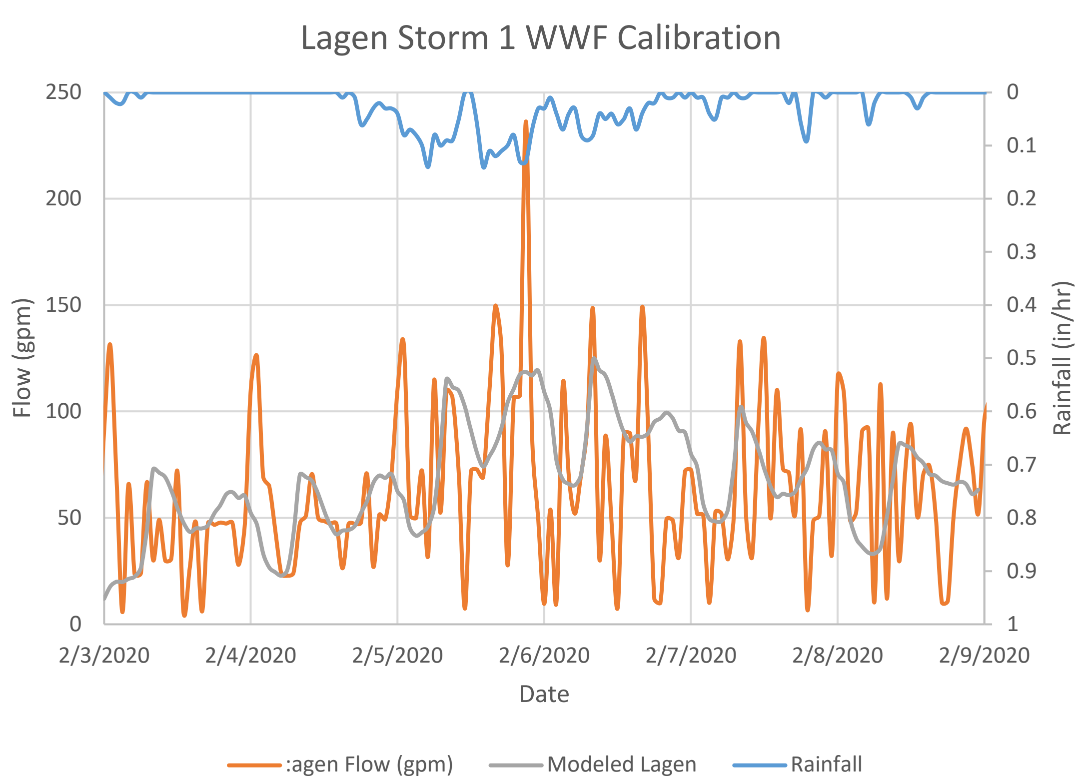
4/23/2020
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Date
Parkers Flow (gpm)
Modeled Parkers
Rainfall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Flow (gpm)
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0
Rainfall (in/hr)
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2/3/2020
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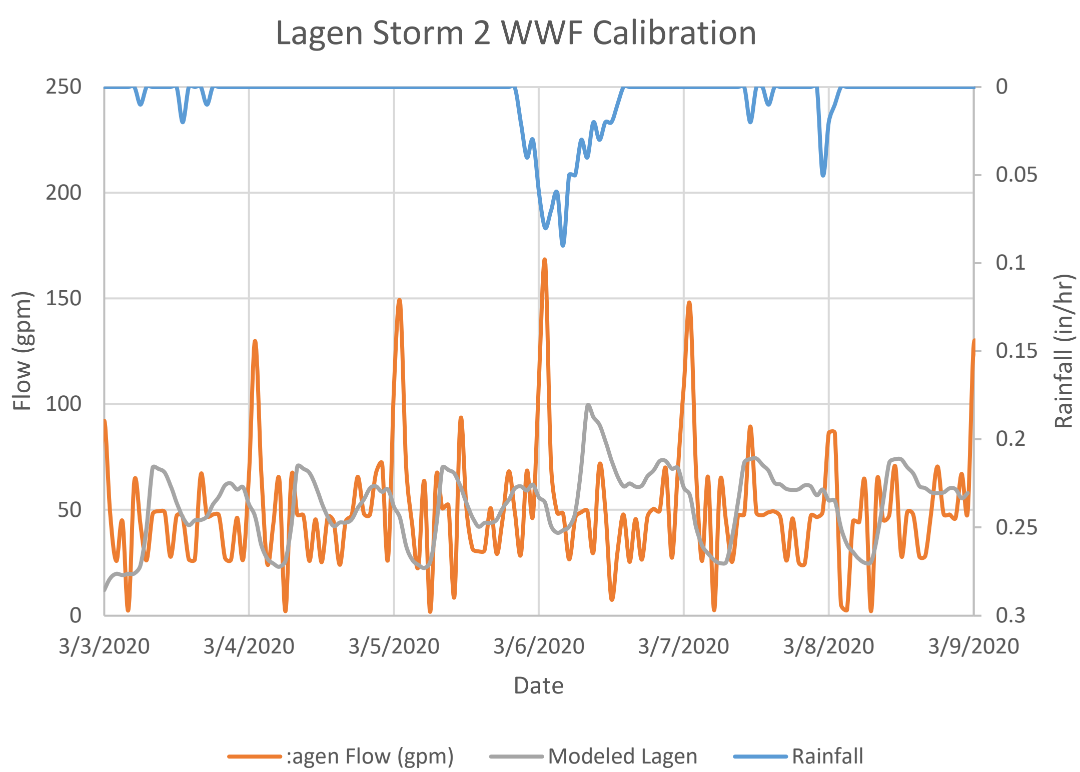
2/8/2020
2/9/2020
Date
:agen Flow (gpm)
Modeled Lagen
Rainfall



Lagen Storm 2 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
250
200
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0.05
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0.15
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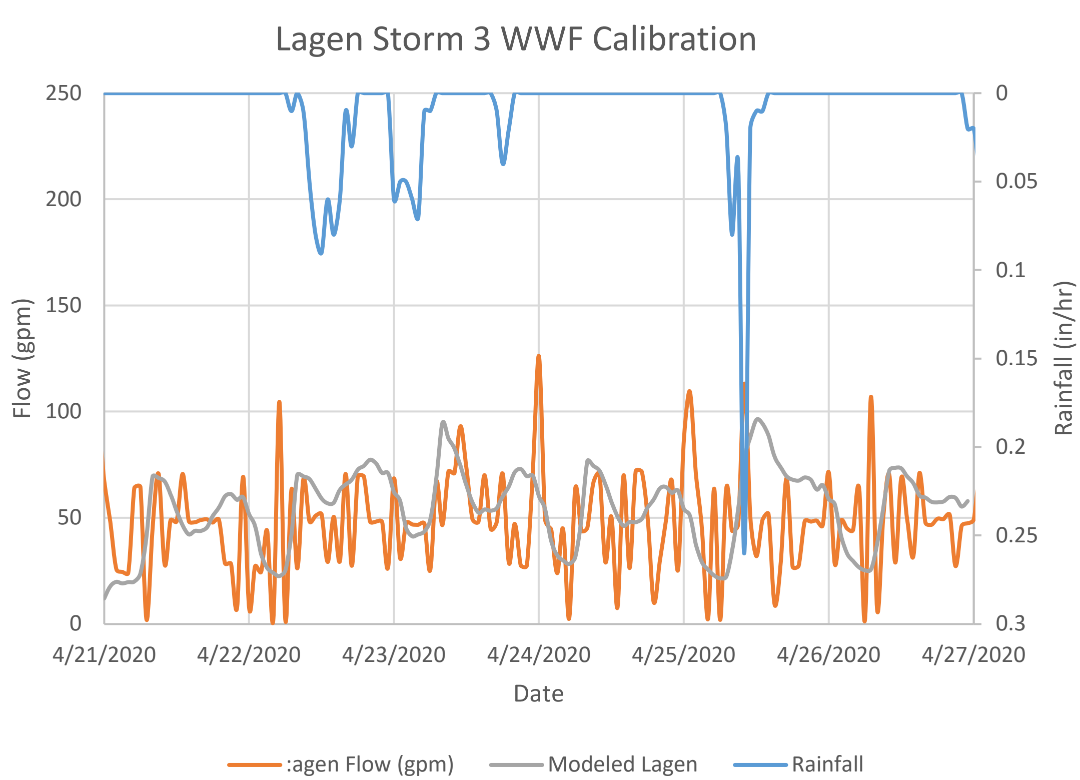
:agen Flow (gpm)
Modeled Lagen
Rainfall



Lagen Storm 3 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
250
200
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0.05
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4/21/2020
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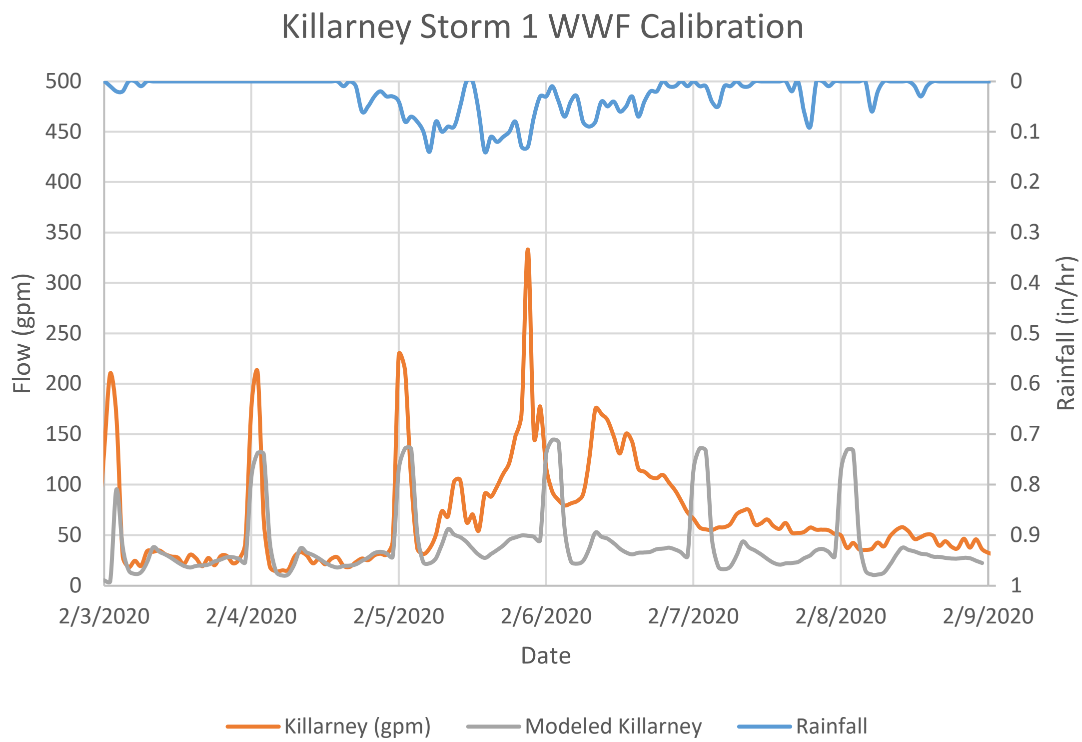
:agen Flow (gpm)
Modeled Lagen
Rainfall



Killarney Storm 1 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
2/3/2020
2/4/2020
2/5/2020
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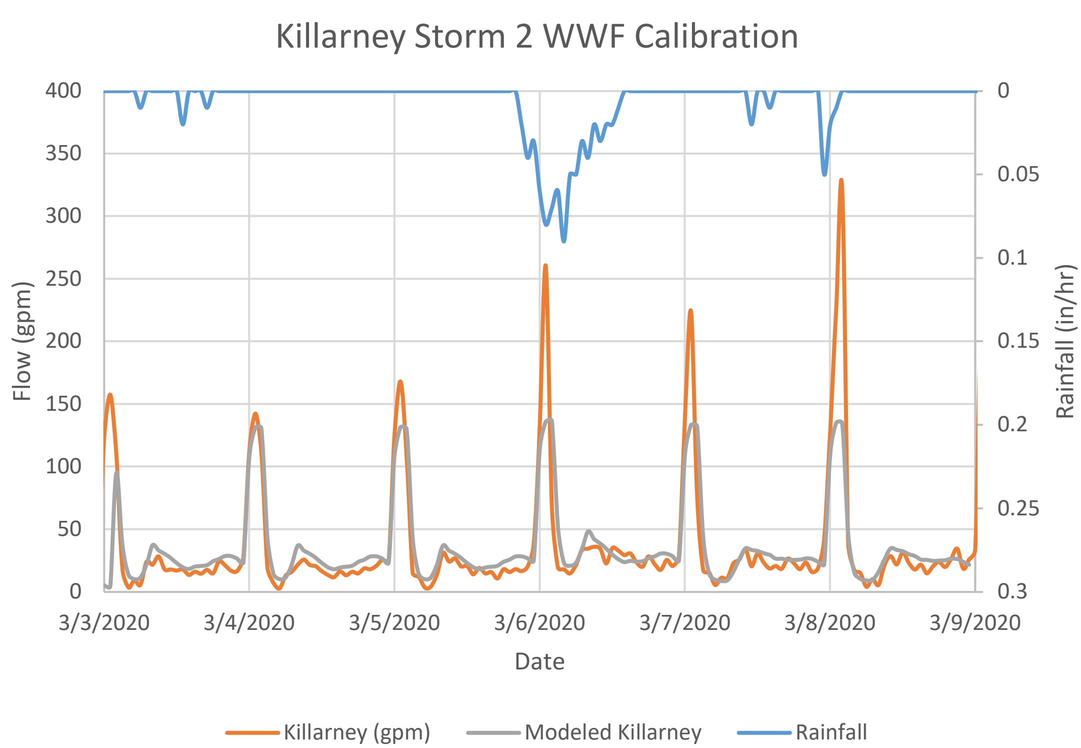
2/9/2020
Killarney (gpm)
Modeled Killarney
Rainfall



Killarney Storm 2 WWF Calibration
Flow (gpm)
Rainfall (in/hr)
Date
3/3/2020
3/4/2020
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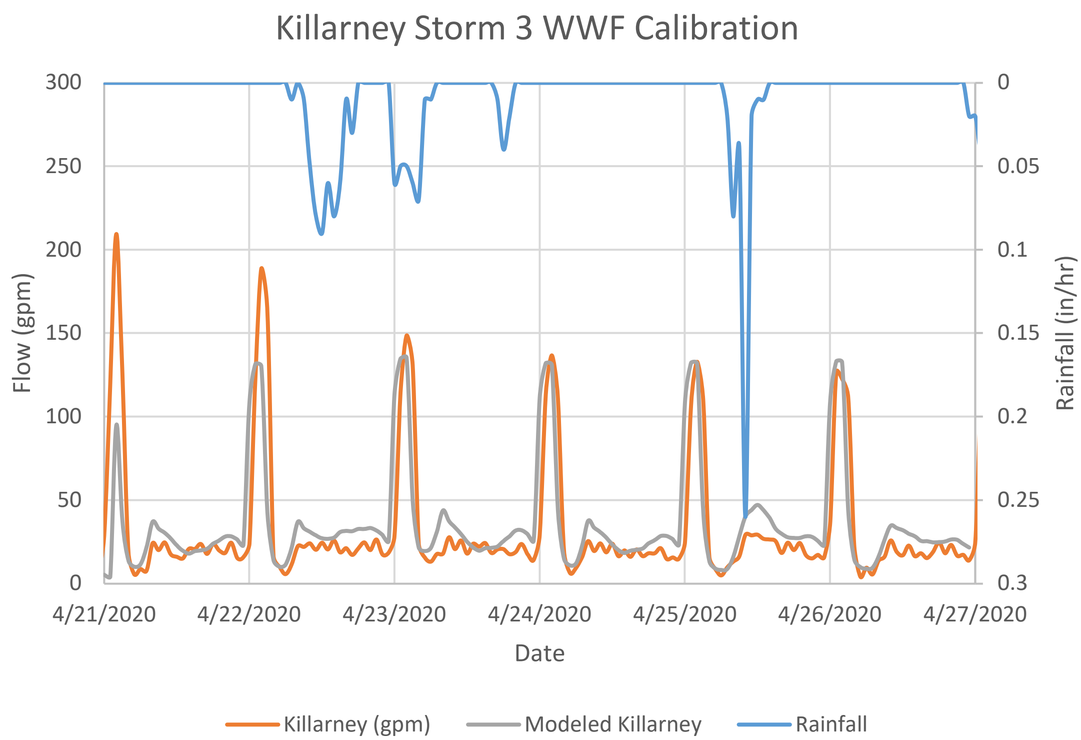
3/7/2020
3/8/2020
3/9/2020
Killarney (gpm)
Modeled Killarney
Rainfall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Flow (gpm)
Rainfall (in/hr)
4/21/2020
4/22/2020
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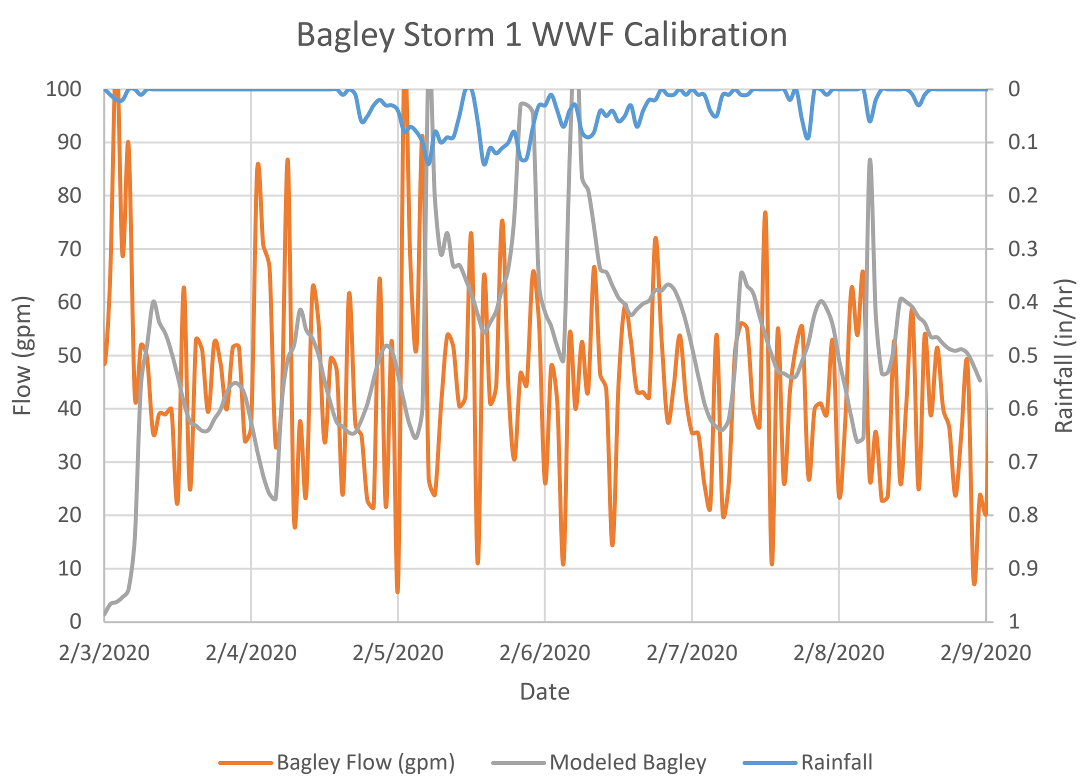
4/25/2020
4/26/2020
4/27/2020
Date
Killarney (gpm)
Modeled Killarney
Rainfall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Flow (gpm)
Rainfall (in/hr)
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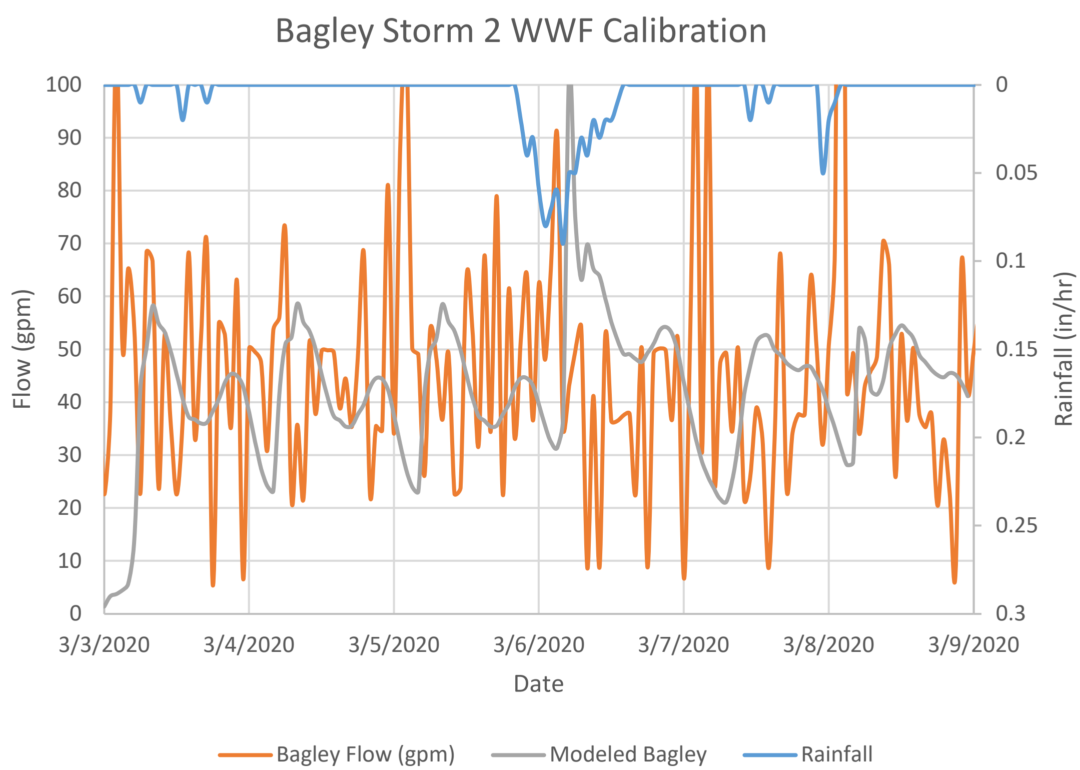
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Bagley Flow (gpm)
Modeled Bagley
Rainfall


Bagley Storm 2 WWF Calibration
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3/3/2020
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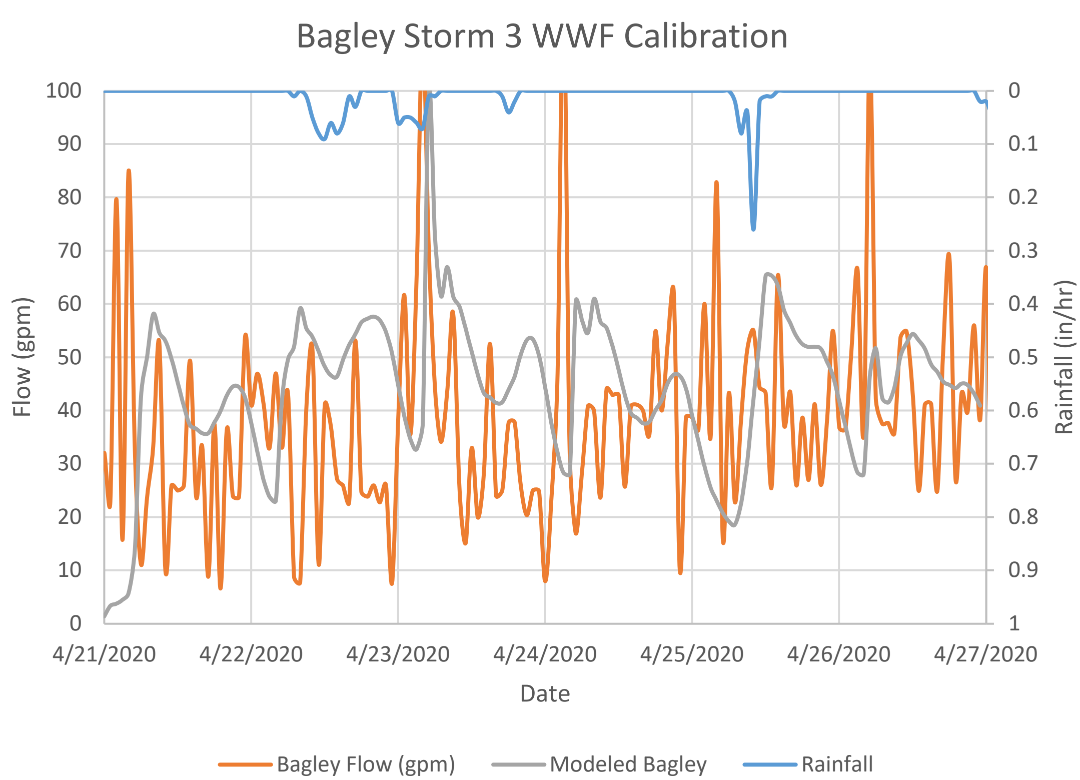
3/9/2020
Date
Bagley Flow (gpm)
Modeled Bagley
Rainfall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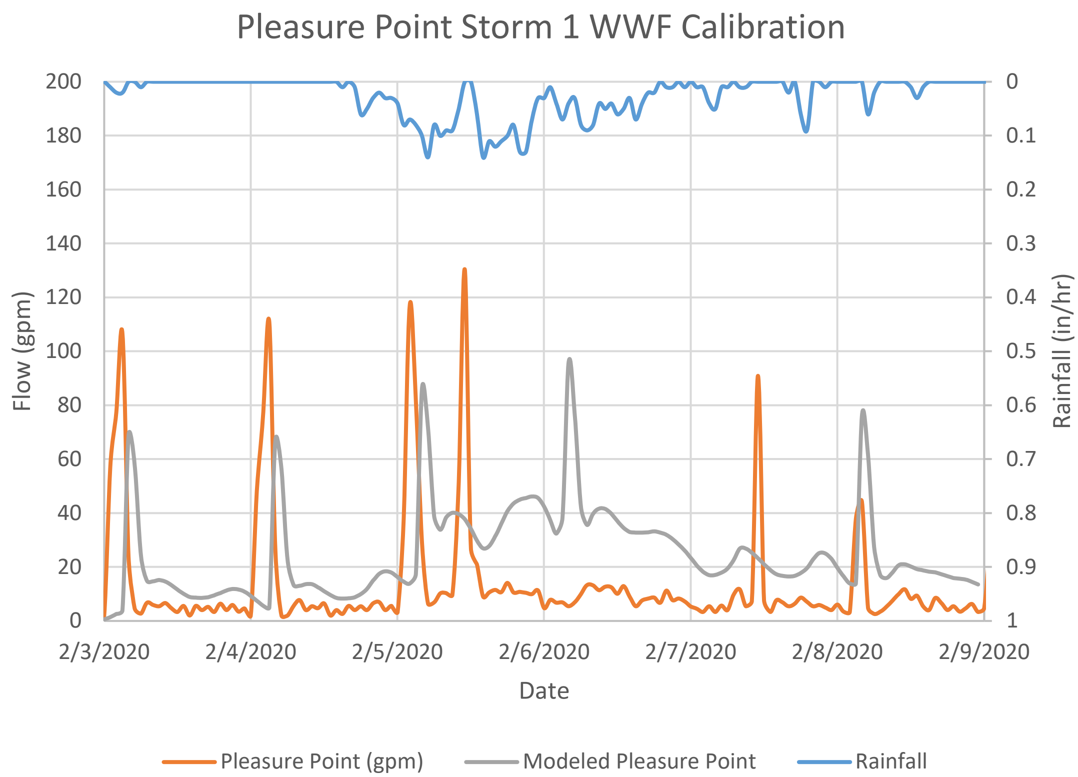
4/24/2020
4/25/2020
4/26/2020
4/27/2020
Date
Bagley Flow (gpm)
Modeled Bagley
Rainfall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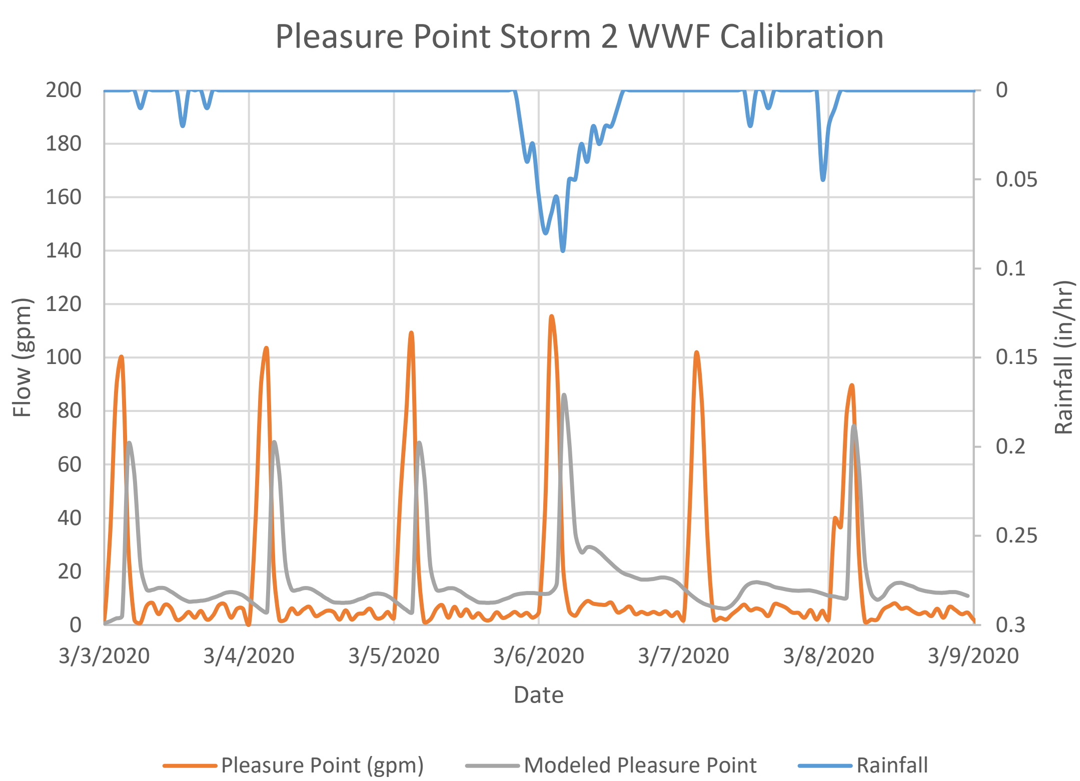
1
Rainfall (in/hr)
2/3/2020
2/4/2020
2/5/2020
2/6/2020
2/7/2020
2/8/2020
2/9/2020
Date
Pleasure Point (gpm)
Modeled Pleasure Point
Rainfall


Pleasure Point Storm 2 WWF Calibration
200
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Flow (gpm)
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0.3
Rainfall (in/hr)
3/3/2020
3/4/2020
3/5/2020
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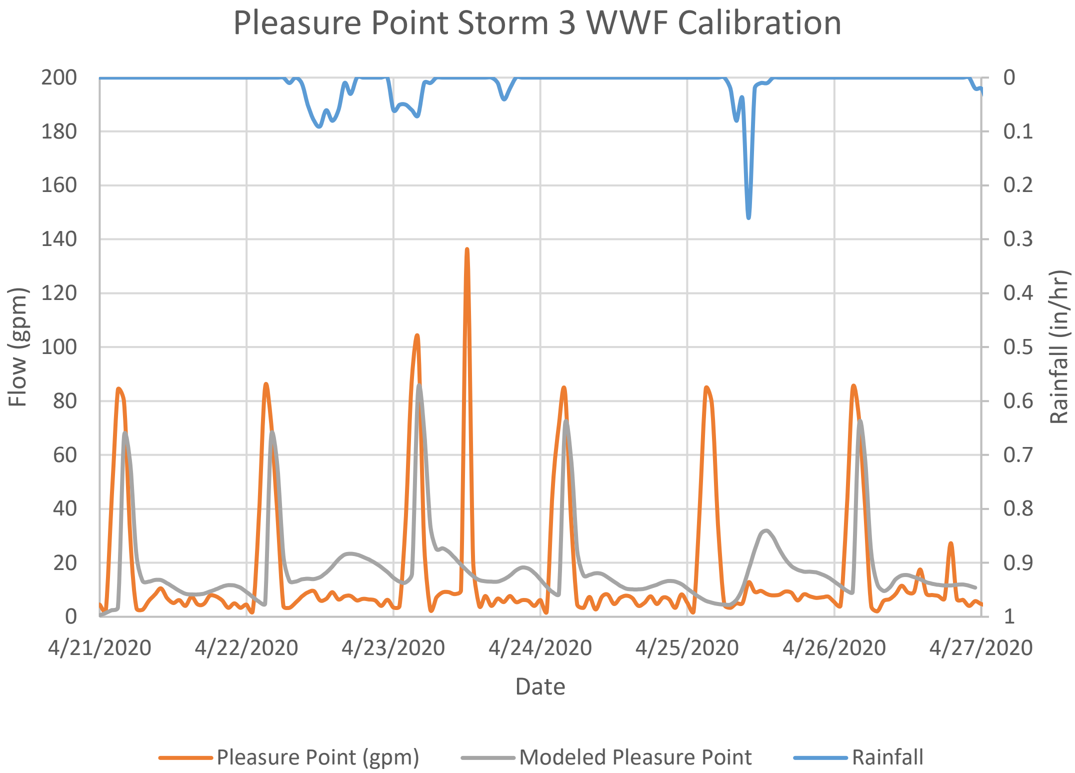
3/7/2020
3/8/2020
3/9/2020
Date
Pleasure Point (gpm)
Modeled Pleasure Point
Rainfall



Pleasure Point Storm 3 WWF Calibration
Flow (gpm)
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Rainfall (in/hr)
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4/24/2020
4/25/2020
4/26/2020
4/27/2020
Date
Pleasure Point (gpm)
Modeled Pleasure Point
Rainfall

APPENDIX D

AQUATIC EXISTING CONDITIONS REPORT

Lake Washington Wastewater Lake Line Management Plan Environmental Impact Statement AQUATIC ENVIRONMENTAL CONDITIONS

Prepared for:

City of Bellevue
Attn: Angela Chung

Authored by:

Confluence Environmental Company

June 2022

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1.0 INTRODUCTION

The City of Bellevue (the City) owns and operates a wastewater lake line system located along the shoreline of Lake Washington. The wastewater lake line system is approximately 69,830 linear feet (LF; 13.2 miles) with 15 pump stations and 8 flush stations. Approximately 9 miles of the wastewater line is cast iron pipe, 3 miles is asbestos cement pipe, and 1 mile is unknown and miscellaneous material types. Construction of these wastewater pipes occurred between the 1950s to 1960s.[1] Potential pipe failures could result in economic costs, threaten sensitive shoreline habitat, disrupt services to homeowners, and close beaches.

The City's wastewater system serves customers in the following jurisdictions (Figure 1):

- City of Bellevue
- City of Beaux Arts
- Medina
- Hunts Point
- Yarrow Point
- Unincorporated King County

The City is developing a Lake Washington Wastewater Lake Line Management Plan (the Management Plan) to rehabilitate, replace, or monitor the wastewater system. As part of that process, the Management Plan is going through an Environmental Impact Statement (EIS) process to understand the potential impacts associated with the proposed alternatives. This document covers the Aquatic Environmental Conditions for the Management Plan EIS.

[1] Note that portion of the wastewater pipes are deteriorating in many locations and in some places known to be partially filled with debris.

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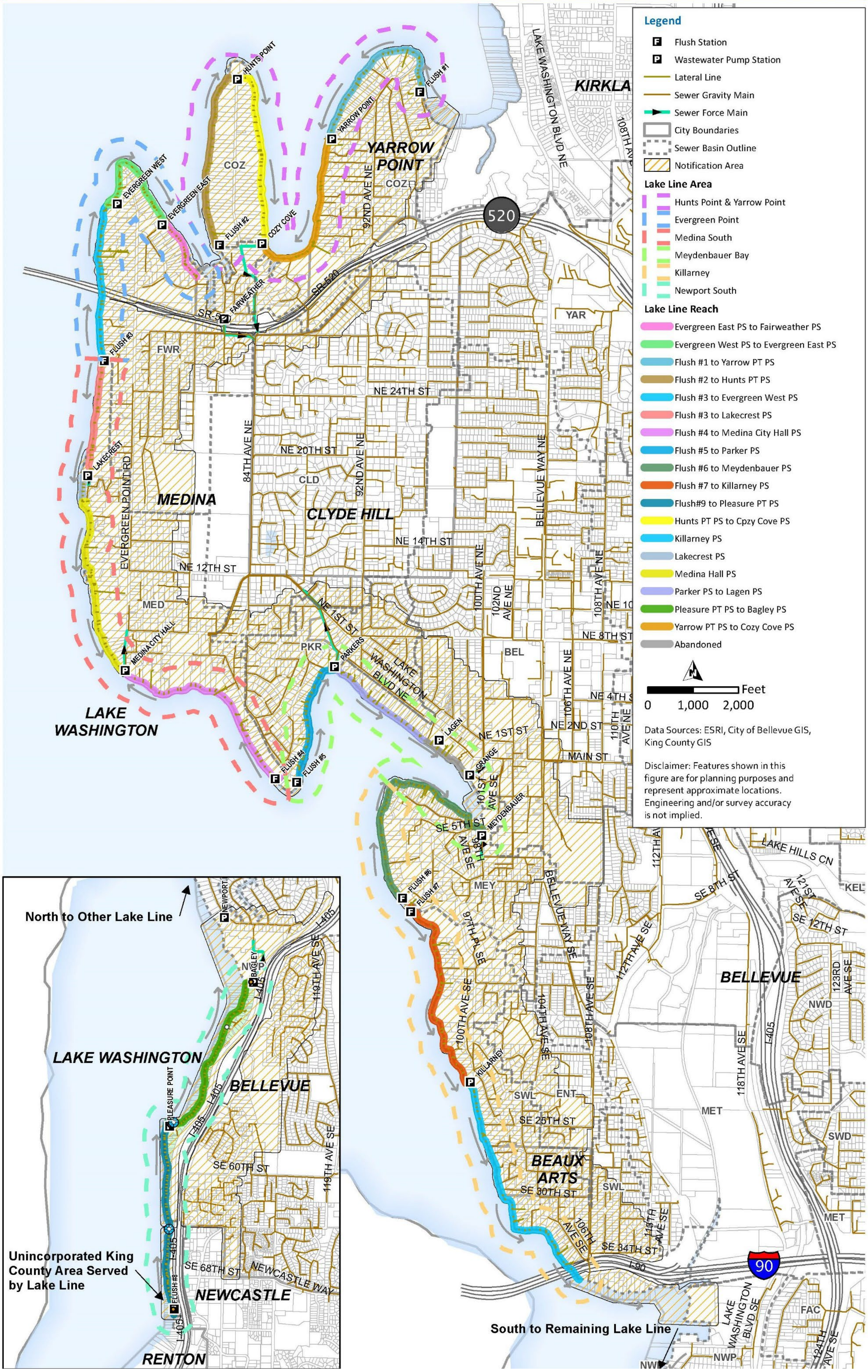

Figure 1. Washington Lake wastewater lake line system areas.
Source: Carollo 2022

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Information below is broken down by aquatic resource within the Management Plan basins for the wastewater system (Table 1). Note that the basins are different than the Management Plan areas identified in Figure 1. Basins are defined as sub-divisions of the city wastewater network draining to a discrete point such as a King County Wastewater Treatment Division (WTD) interceptor, major city trunk, pump station, or neighboring jurisdiction. Areas can cross multiple basins (e.g., Meydenbauer Bay area).

Table 1. Lake Washington wastewater lake line management plan basins.

Basin	Upstream Pump Stations(1)	Downstream Pump Stations(1)	Linear Feet of Pipe(3)
Cozy Cove (COZ)	Flush #1	Yarrow Point	4,122
	Yarrow Point	Cozy Cove	4,144
	Hunts Point	Cozy Cove	4,086
	Flush #2	Hunts Point	4,403
Fairweather (FWR)	Evergreen East	Fairweather	1,553
	Evergreen West	Evergreen East	3,096
	Flush #3	Evergreen West	3,774
Medina (MED)	Flush #3	Lake Crest	2,726
	Lake Crest	Medina City Hall	4,888
	Flush #4	Medina City Hall	4,793
Parkers (PKR)	Flush #5	Parkers	3,221
Bellevue (BEL)	Parkers	Grange/Lagen Lift	2,648
Meydenbauer (MEY)	Flush #6	Meydenbauer	5,366
Sweyolocken (SWL)	Flush #7	Killarney	4,756
	Killarney (2)	King County WTD System	6,079
Newport (NWP)	Pleasure Point	Bagley	5,007
	Flush #8	Pleasure Point	5,168

(1) Pump/flush stations are listed in order from north to south.
(2) Discharges to King County Wastewater Treatment Division (WTD) system at interceptor maintenance hole 415888.
(3) Total lake line pipe length. Excludes laterals.

2.0 AQUATIC ENVIRONMENTAL CONDITIONS SECTION

The following sections focus on aquatic environmental conditions for lakes, streams, and wetlands in the areas associated with the City's wastewater lake line system. The area of analysis is defined as the Lake Washington shoreline extending waterward 300 feet and landward 1,700 feet (Figure 1). This area incorporates the location of the existing wastewater pipes in the lake and potential areas where the pipes could be moved further from shore or upland.

2.1 Surface Water Resources and Water Quality

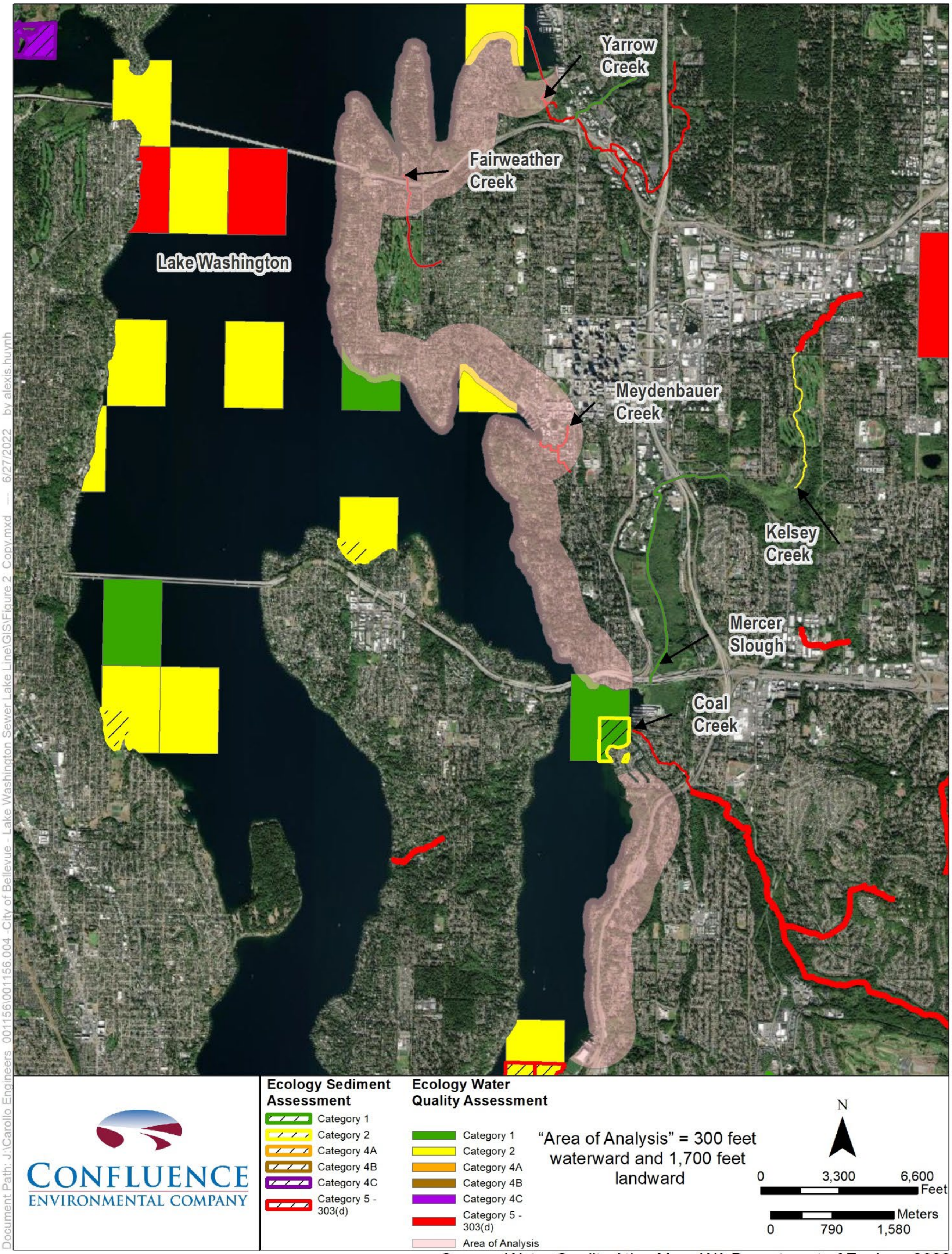
Lake Washington is a part of the Lake Washington/Cedar/Sammamish Watershed (WRIA 8). The 692-square-mile watershed includes two major river systems that connect to Lake Washington: Cedar and Sammamish rivers (Urgenson et al. 2021). The Cedar River connects to the southern portion of Lake Washington, and the Sammamish River connects to the northern portion. Mercer Slough drains into Lake Washington in the southeastern portion of Bellevue and is part of WRIA 8. However, wastewater infrastructure in the Mercer Slough area is part of the King County WTD wastewater system and is not covered in this analysis. Five named creeks drain into Lake Washington within (or adjacent to) the area of analysis (Figure 2):

- **Yarrow Creek:** associated with the Yarrow Bay Wetlands; part of the Cozy Cove basin.
- **Fairweather Creek:** located east of Fairweather Nature Preserve; part of the Fairweather basin.
- **Meydenbauer Creek:** located to the south of Meydenbauer Beach Park in Bellevue; part of the Meydenbauer basin.
- **Kelsey Creek:** located near Enatai and I-90 and flowing through Mercer Slough; not included in the area of analysis.
- **Coal Creek:** located approximately 1,835 feet south of I-90 in the Newport Shores neighborhood of Bellevue; just north of the Newport basin.

Yarrow, Fairweather, Kelsey, and Coal creeks are classified as a type F stream, which are streams that may be perennial or seasonal and are known to be used by fish or meet the physical criteria to be potentially used by fish (Bellevue 2022a, DNR 2022). Meydenbauer Creek is not classified as a surface water on the Washington State Department of Natural Resources (DNR) Forest Practices Application Mapping Tool but is recognized as a stream on local geographical information system (GIS) on-line tools (Bellevue 2022a, King County 2022a). There are several other unnamed creeks along the Lake Washington shoreline within the area of analysis, including a type U stream west of Wetherill Nature Preserve in the Cozy Cove basin.

The water quality of Lake Washington, in general, has been degraded from historical conditions by both point and nonpoint pollution sources. Nonpoint sources include stormwater and subsurface runoff containing pollutants from roadway runoff, failing septic systems, underground petroleum storage tanks, and commercial and residential sites treated with fertilizers and pesticides.

The federal Clean Water Act requires Washington State to perform a water quality assessment every two years to record the status of rivers, lakes, and marine water bodies. The Washington State Department of Ecology (Ecology) is responsible for compiling water quality data and assessing water bodies into five categories. Category 5 listings, also called the 303(d) list, are considered the highest polluted water quality category that requires a water improvement project. Water quality within the area of analysis primarily consists of Category 1 or 2 along the Lake Washington shoreline (Ecology 2022a). Category 1 listings include exceedances of bacteria (i.e., *E. coli*) and total phosphorus, and Category 2 listings include exceedances of mercury and ammonia-N. Category 1 is identified as water that meets tested standards for clean water. Category 2 is identified as a water of concern. Water in Category 2 show some evidence of a water quality problem, but not enough to show persistent impairment.



Source: Water Quality Atlas Map, WA Department of Ecology 2022

Figure 2. Water bodies and water quality within the area of analysis.

Yarrow Bay and Fairweather Creek are listed as Category 5, which is a Washington State 303(d) list water body. Category 5 indicates that water quality is impaired, and a cleanup plan is needed. Yarrow Bay, and associated tributaries into Yarrow Creek, is listed as Category 5 for both dissolved oxygen and bacteria. Fairweather Creek is listed as Category 5 for dissolved oxygen, bacteria, copper, and temperature.

Mercer Slough, Kelsey Creek, and Coal Creek are all listed as Category 5 water bodies. These water bodies occur just outside of the areas identified for analysis. Mercer Slough is south of Killarney area, Coal Creek is north of Newport South area, and Kelsey Creek drains into Mercer Slough and is east of Meydenbauer Bay area.

Water bodies that drain into Lake Washington include both named and unnamed creeks that contribute to water quality conditions (Table 2). Water quality concerns (i.e., Category 5 – 303(d) list) are present for Yarrow Bay and Fairweather Creek, and other areas along the Lake Washington shoreline include water quality conditions that are identified up to water of concern.

Table 2. Water bodies and water quality conditions by basin.

Basin	Water Body	Water Quality(1)
Cozy Cove	Yarrow Creek and Yarrow Bay Wetlands	Category 5: dissolved oxygen and bacteria
	Lake Washington	Category 2: ammonia-N Category 1: bacteria, total phosphorous
Fairweather	Fairweather Creek	Category 5: dissolved oxygen, bacteria, copper, and temperature
	Lake Washington	No water quality assessment listed.
Medina	Lake Washington	Category 1: bacteria
Parkers	Lake Washington	No water quality assessment listed.
Bellevue	Lake Washington	No water quality assessment listed.
Meydenbauer	Meydenbauer Bay	Category 2: ammonia-N, mercury Category 1: bacteria, total phosphorus
	Meydenbauer Creek	No water quality assessment listed.
Sweyolocken	Lake Washington	Category 2: sediment bioassay Category 1: bacteria, total phosphorous
Newport	Lake Washington	No water quality assessment listed.

(1) Water quality is based on the Ecology (2022a) categories that include Category 5 water bodies on the 303(d) list of impaired water bodies where a cleanup plan is needed.
(2) Definitions (note: colors match Ecology (2022a) on-line database and Figure 2):
Category 5: polluted water that requires a water improvement project.
Category 2: water of concern.
Category 1: meets tested standards for clean water.

Other areas surrounding the area of analysis (e.g., Mercer Slough, Coal Creek, and Kelsey Creek) likely contribute to deteriorated water quality conditions in Lake Washington. Similarly, areas to the west of the area of analysis in Lake Washington include deteriorated water quality that likely contribute to conditions along the Bellevue shoreline (refer to Figure 2). For example, sediment and fish tissue sampling resulted in concerns related to polychlorinated biphenyl (PCB). Recent analyses showed no evidence of PCB contamination of juvenile Chinook salmon leaving the Lake Washington system, although the issue is known to be significant elsewhere in Puget Sound (Meador 2013).

2.2 Aquatic Resources

Aquatic resources include the habitat available (aquatic substrate and vegetation) and species use of the area. The following information provides a description of aquatic resources within the area of analysis.

2.2.1 Aquatic Substrate and Vegetation

Aquatic substrate and vegetation within the littoral zone of Lake Washington are important habitat characteristics for many salmonid species and other fish and invertebrates. The formation of the littoral zone along Lake Washington shoreline depends on sediment production, mobilization, and deposition. Sediment sources within Lake Washington come from bank erosion and sediment outflows from streams entering the lake. This zone also supports photosynthesis of vegetation and can protect it from wave action while it is establishing within the substrate. The shoreline of Lake Washington is partially exposed to wave action and is a moderately inclined slope with a terrestrial shoreline (Toft 2001). General shoreline substrate types include mixed coarse materials, sand, gravel, and a layer of fine silt with beds of submerged aquatic vegetation. Areas of sedimentation are noted in Meydenbauer Bay and Newport Shores due to historical dredging (The Watershed Company 2011a).

The area of analysis includes a mix of developed shoreline and shoreline modifications (e.g., bulkheads, docks, and shoreline armoring) that can prevent natural bank erosion processes and do not support suitable habitat for salmonid species. As discussed in Section 2.3, the Lake Washington shoreline in the City's jurisdiction is 81% armored (The Watershed Company 2011a). Areas that can support natural sediment processes include the streams listed above. Specific information on the current substrate found within Yarrow Creek and Fairweather Creek was not found. Meydenbauer Creek is documented has having a substrate that is sandy with a silt layer (The Watershed Company 2001). Substrate conditions within Coal Creek are predominantly gravel and cobble with a high percentage of fines due to associated stormwater outfalls located upstream (Herrera and Jacobs 2021). In summary, creek habitat found within Coal and Meydenbauer Creeks have potential to support the natural sediment process that development of the shoreline has prevented and to provide habitat and pathways for aquatic species.

Most of the Lake Washington shoreline is composed of single- or multi-family residential development (79%) or marinas (7%), which does not support natural sediment processes or aquatic vegetation (The Watershed Company 2011a). However, park beaches and nature preserves can support these habitat features. Public parks with beaches or natural shorelines located along the Lake Washington shoreline include, Morningside Park, Medina Beach Park, Clyde Beach Park, Meydenbauer Bay Park, Chism Beach Park, Chesterfield Beach Park, Enatai Beach Park, and Newcastle Beach Park. Nature preserves surrounding Lake Washington include Yarrow Bay Wetlands, Wetherill Nature Preserve, and Mercer Slough Nature Park. Overall, these areas represent approximately 13% of the 9.12-mile Lake Washington shoreline in City's jurisdiction. Many of these parks and nature preserves include wetlands, as described below (Section 2.4).

Although substantial portions of the Lake Washington shoreline are modified, the lake still provides habitat complexity and processes that establish and maintain aquatic environments. For example, the benthic habitat likely provides adequate aquatic macroinvertebrates that support an abundant food base (Toft et al. 2014). Alternatively, surface water temperatures typically exceed 68 degrees Fahrenheit (°F) for substantial portions of the summer (King County 2007). Overall, there is some critical habitat available within the area of analysis for salmonids, even though it has been modified and significantly reduced from historical conditions.

King County (2022a) GIS map data was used to evaluate the presence of noxious emergent weeds within the area of analysis. Purple loosestrife (*Lythrum salicaria*) was the only emergent plant listed. According to the King County guide to aquatic weeds garden loosestrife (*Lysimachia vulgaris*), a class b weed is also found in Lake Washington (King County 2017). Additional aquatic invasive species found within Lake Washington include Eurasian watermilfoil (*Myriophyllum spicatum*), parrotfeather milfoil (*Myriophyllum aquaticum*), and fanwort (*Cabomba caroliniana*). Eurasian water milfoil is known to be very problematic along the Lake Washington shoreline (The Watershed Company 2011a). The City has permits for treatment in high use public access areas, but the extent of this invasive species is larger than these small efforts can control. Native submergent aquatic plants found within King County include bushy pondweed (*Najas flexilis*), yellow pond lilies (*Nuphar lutea*), bladderworts (*Utricularia spp.),* and cattails (*Typha latifolia*) (King County 2022b).

In summary, the general ecological condition of the Lake Washington shoreline is considered low/moderate value (The Watershed Company 2011a). Most of the shoreline is impacted by urban development, which reduces natural sediment processes and native aquatic vegetation. This condition is defined by various invasive aquatic species and modified shorelines. There are pockets of moderate or higher rated shorelines near the mouths of Mercer Slough and Coal Creek, which include vegetated conditions with little shoreline modifications. There are also other parks and nature preserves along the shoreline that improve natural sediment processes.

2.2.2 Species Use

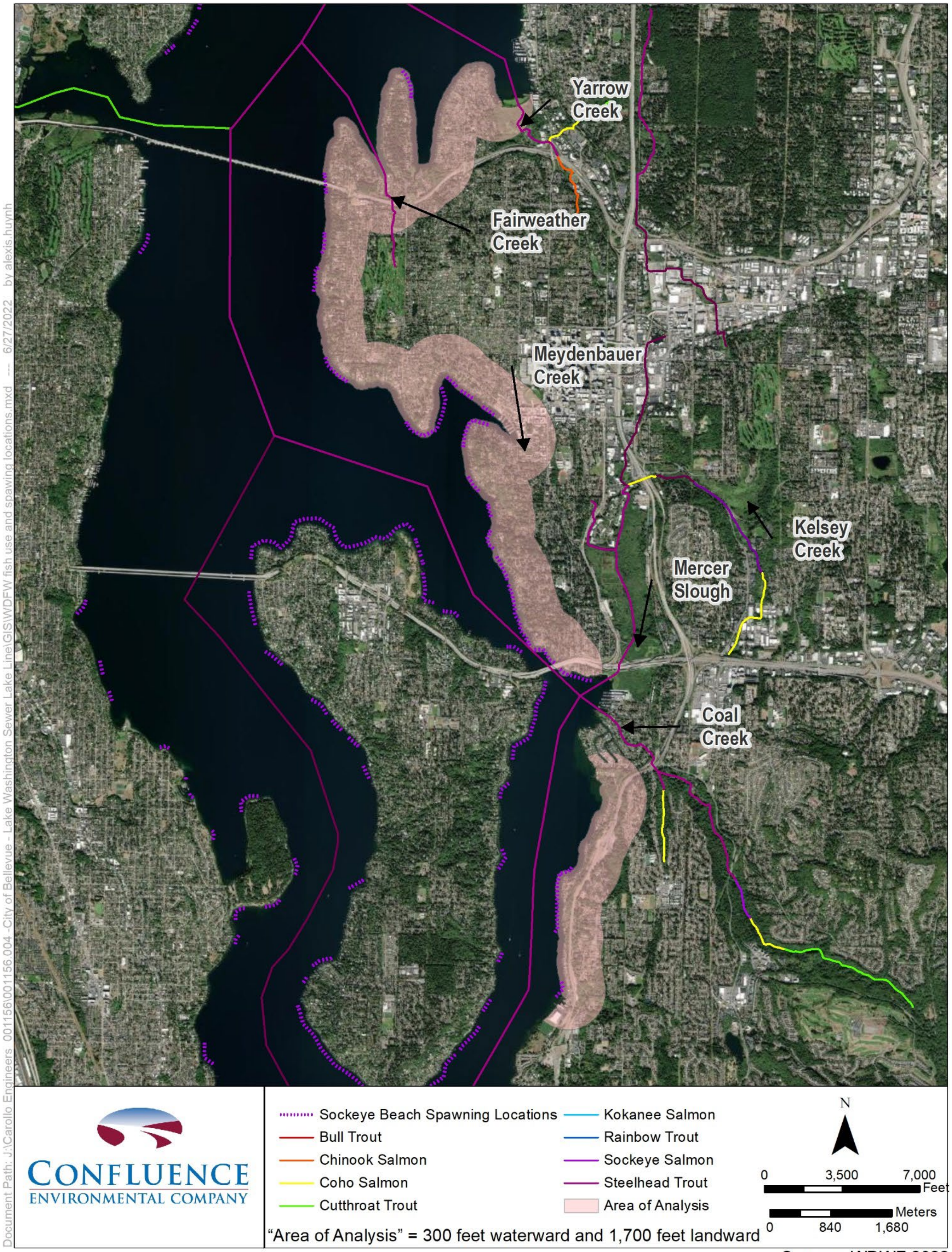
Habitat within the area of analysis includes use by salmonids and other fish (Figure 3). According to WDFW (2022a), there are seven fish species present in Lake Washington and associated stream that are considered priority habitat species. Of these species, three are ESA-listed, including bull trout (*Salvelinus confluentus*), Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), and Puget Sound steelhead (*O. mykiss*) (WDFW 2022b). The remaining species are considered locally important and covered below under "non-ESA-listed species." There are also several invasive species, which are also discussed below.

Bull Trout

Bull trout listed as threatened in 1998 and remained as threatened in 2000 (85 FR 14240), and populations have been documented within the boundary of WRIA 8 (WDFW 2022c). According to the Coastal Recovery Unit Implementation Plan (USFWS 2015), Lake Washington is designated as a shared foraging, migration, and overwintering (FMO) area that allows for the support of continued natural population dynamics. Shared FMO areas are particularly important to the anadromous and fluvial life history forms due to their complex migratory patterns associated with foraging and overwintering. Mercer Slough is also recognized as a shared FMO for bull trout (75 FR 63898).

The potential for bull trout spawning in WRIA 8 is believed to be low because most of the accessible habitat is at a low elevation; therefore, it is not expected to have suitable water temperatures for successful bull trout spawning. USFWS (2015) identified the Lake Washington Ship Canal as a temperature barrier to bull trout. There are some cold water springs in the watershed and tributaries that may provide marginal spawning temperatures or thermal refuge areas for rearing or foraging during warm summer periods (USFWS 2004). These tributaries are primarily part of the Cedar River area in the southern portion of Lake Washington.

A small number of subadult and adult bull trout have been observed in Lake Washington (Shepard and Dykeman 1977 King County 2000,). While bull trout occasionally occur in Lake Washington, they are not expected to occur in the surface waters of Lake Washington during the summer when water temperatures typically exceed 59°F for several months. Note that temperatures below 59°F is a physical or biological feature (PBF) for bull trout (75 FR 63898). Therefore, the apparent remnant population likely uses the lake primarily as a migration route to marine waters for foraging and rearing.



Source: WDWF 2022

Figure 3. Documented fish use within the area of analysis.

Overall, adult and subadult bull trout may occur in Lake Washington throughout the year, most likely in spring and early summer when temperatures are lower. This observation is based on bull trout captured at the Ballard Locks and the Lake Washington Ship Canal between May and July (Bradbury and Pfeifer 1992, USFWS 1998, USFWS 2008). Bull trout likely use the area of analysis for either foraging or migrating to other marine or estuarine foraging habitats. Bull trout are anticipated to be from the core areas of the Stillaguamish, Snohomish-Skykomish, and Puyallup rivers, and use of Lake Washington is not expected to be a regular occurrence

Puget Sound Chinook Salmon

Puget Sound Chinook salmon were as threatened in 2005 and remained as threatened in 2011 (76 FR 50448). Chinook salmon spawning populations (the north Lake Washington population and the Cedar River population) use Lake Washington for rearing and migration (WDFW 2022d). A third population, the Issaquah stock, is a nonnative stock from the Issaquah Hatchery, which has been in operation since the 1930s (WDFW 2004, Ruckelshaus et al. 2006). Critical habitat for Chinook salmon is designated in Lake Washington and Mercer Slough (70 FR 52630).

The status of the Lake Washington populations is based on their abundance, productivity, diversity, and spatial structure, but substantial development in WRIA 8 has degraded their spawning and rearing habitat. Lake Washington populations have shown some of the steepest declines of the 22 extant populations of the Puget Sound Chinook salmon evolutionarily significate unit—greater than 5% per year since the peak returns during the mid-1980s (Myers et al. 1998, Weitkamp and Ruggerone 2000).

According to WRIA 8 Salmon Recovery Council (2017), adult migration in Lake Washington occurs from June through September. Migration occurs from Shilshole Bay through the Ballard Locks and Ship Canal, Lake Union, Portage Bay, and Union Bay to Lake Washington. Chinook salmon travel south to reach the Cedar River or north to reach the Sammamish River and other tributary streams. The Cedar River is recognized as providing the largest number of natural-origin Chinook salmon in WRIA 8 providing critical rearing and spawning habitat (WRIA 8 Salmon Recovery Council 2017), but smaller drainages also provide spawning opportunities. Spawning Chinook salmon generally migrate to spawning streams in the area of analysis from early July through September, with spawning activities occurring in the tributaries in October (WDFW 2018).

WDFW (2018) released the 1999-2017 Bellevue Salmon Spawner Surveys report for Kelsey Creek, West Tributary, Richards Creek, and Coal Creek. The report provides a consolidation of the survey information collected for the past 18 years. This spawning salmon survey report indicated that large numbers of Chinook salmon spawn in Kelsey Creek in some years, with the most recent peaks occurring in 2006 and 2007. Most documented spawning occurred in the Kelsey Creek mainstem. Chinook salmon spawning in the West Tributary and Richards Creek is sporadic and only occurs in small numbers.

Initially, Chinook salmon fry tend to concentrate in the littoral zone at the south end of Lake Washington between January through March, until they grow large enough to move offshore (Fresh 2000, Tabor et al. 2004, 2006). The larger fingerlings enter the lake between mid-May and June after spending up to 6 months rearing in the rivers and streams. Overall lake rearing and migration occurs from January through July, with small numbers of Chinook salmon rearing year-round in Lake Washington and Lake Union (WRIA 8 Salmon Recovery Council 2017).

After entering the lake, juvenile Chinook salmon rear in the shallow littoral zone as they gradually migrate to Union Bay and the Lake Washington Ship Canal. Juvenile Chinook salmon tend to prefer gradually sloping sand-silt substrate habitat less than 1.6 feet deep (Tabor et al. 2006). They also congregate at the mouths of small tributary streams, possibly attracted by flow, shallow-water depths, benthic invertebrate or terrestrial insect food sources, fine-particle substrate accumulated at the stream delta fans, or some combination of these factors (Shared Strategy for Puget Sound 2007). Juvenile Chinook salmon tend to increase their use of deeper-water habitat areas as they get larger, likely as a response to prey availability, reduced predation risks, and possibly more favorable water temperature conditions (Warner and Fresh 1998, Celedonia et al. 2008). Chinook salmon fry typically rear in Lake Washington from 1 to 4 months before migrating through the Lake Washington Ship Canal to Puget Sound (Seiler et al. 2004, Tabor et al. 2006).

Possible threats to the Lake Washington Chinook populations during their rearing and migration stage include predation, lack of shoreline habitat due to shoreline development, insufficient food sources, high temperatures, and poor water quality (WRIA 8 Salmon Recovery Council 2017). While predation is one of the main factors limiting Chinook salmon populations, issues such as artificial nighttime lighting, shoreline hardening and overwater structures, and increased water temperatures exacerbate the effects of predation on Chinook salmon in WRIA 8. While riparian vegetation that hangs over the water tends to be the preferred cover habitat, docks and piers are sometimes used as substitute cover, particularly during the day (Tabor and Piaskowski 2002). However, the considerable number of piers and docks lining the Lake Washington shoreline is expected to substantially affect the natural behavior of juvenile Chinook salmon and other salmonids rearing and migrating through the lake.

Puget Sound Steelhead

Puget Sound steelhead were listed as threatened in 2007 and remained as threatened in 2011 (76 FR 50448). There are two steelhead populations in WRIA 8: (1) natural-origin Cedar River population, and (2) introduced north Lake Washington population. Allozyme analysis of steelhead sampled in the Cedar River in 1994 clusters them with winter steelhead in the Green, White, and Puyallup rivers, including some Snohomish basin steelhead stocks (WDFW 2004). NMFS published the final rule designating critical habitat for Puget Sound steelhead salmon in February 2016 (81 FR 9251). However, the rule excludes Lake Washington and Mercer Slough as designated critical habitat for steelhead.

Returning adult steelhead pass through the Ballard Locks to Lake Washington between December and early May (WDF et al. 1993). The fish spawn primarily in the mainstem Cedar River from March through early June (Burton and Little 1997), although there are historical records of steelhead spawning in Cedar River tributaries such as Rock Creek. The Cedar River population of winter-run steelhead have undergone steep declines in recent decades and have a "critical" stock status (WDFW 2006). Steelhead were also historically present in Kelsey Creek, but there are no records of steelhead from recent surveys (WDFW 2018). Adult returns have not been adequate to sustain a viable steelhead run, with total natural spawners totaling fewer than 100 fish every year since 2000, and fewer than 10 fish since 2007 (WDFW 2022e). Based on these numbers, the relative risk of extinction for the Lake Washington winter steelhead population is considered very high.

Juvenile steelhead migrating out of WRIA 8 will pass through the area of analysis using the area as a migratory corridor. There is no available information that identifies specific areas of the Lake Washington as used by juvenile steelhead for rearing. In general, juvenile steelhead rear in freshwater, including Lake Washington, for several years before migrating to Puget Sound (Kerwin 2001). Due to their larger size, steelhead are expected to be less dependent on the shallow nearshore habitat in the lake than the smaller Chinook salmon fry. Migration of steelhead juveniles is expected to be concentrated between April and May in Lake Washington (WDF et al. 1973).

Non-ESA-Listed Fish

A large range of non-ESA-listed fish can be found in Lake Washington and the surrounding tributaries. There is documented presence of coho salmon (*Oncorhynchus kisutch*), sockeye salmon (*Oncorhynchus nerka*), and kokanee (*Oncorhynchus nerka*) (Kerwin 2001, WSDOT 2006, The Watershed Company 2009, WDFW 2022a). Sockeye salmon spawning habitat has been documented along the Lake Washington shoreline (Figure 3). Other salmonids have been documented from stream surveys, such as chum salmon (*O. keta*), resident rainbow trout (*O. mykiss*), and resident cutthroat trout (*O. clarki clarki*) (The Watershed Company 2009). Populations of coho salmon are depressed within Lake Washington (Fresh 1994, Fevold et al. 2001, WRIA 8 Steering Committee 2005). Comparatively, populations of cutthroat trout appear to be increasing. Cutthroat trout are an identified predator of Chinook salmon in Lake Washington (Celedonia et al. 2008). As discussed above for ESA-listed fish above, anadromous salmonids primarily use the area of analysis for migration and rearing. Resident salmonids use streams for all life stages, although most spawning activities occur in Kelsey Creek. Other native species include prickly sculpin (*Cottus asper*), and largescale sucker (*Catostomus macrocheilus*) (The Watershed Company 2009, Fish and Wildlife Commission 2021).

Invasive Species

There are several species of invasive species that have been documented in the area of analysis, including yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), northern pikeminnow (*Ptychocheilus oregonensis*), smallmouth bass (*Micropterus dolomieu*), grass carp (*Ctenopharyngodon idella*), and largemouth bass (*M. salmoides*) (The Watershed Company 2009, Fish and Wildlife Commission 2021). Most of these species are ambush predators that have been known to prey on juvenile salmonids. WRIA 8 Salmon Recovery Council (2017) identifies predation by fish in Lake Washington and the Ship Canal as a key constraint on juvenile Chinook salmon rearing and migration.

2.3 Riparian Resources

Riparian resources along the Lake Washington shoreline and surrounding areas (within 1,700 feet of the shoreline) includes a mix of urban development and natural areas. Historically, lowering the lake elevation in 1916 by 9 feet decreased the lake shoreline by 12.8% and drained many of the lake's wetlands (WRIA 8 Salmon Recovery Council 2017). The following information provides details on the current level of development, upland vegetation, and species use of these areas.

2.3.1 Level of Development

Extensive development of the shoreline has reduced the quality of habitat within the riparian zone within the area of analysis. Developments that utilize bulkheads have greatly reduced the natural process of shoreline erosion, which prohibits the natural influx of gravel movement. Additionally, developments that include non-native landscapes along the shoreline, such as grass and other ornamental species, also lack the ability to provide overhanging vegetation preferred by rearing salmonid. For example, the loss of overhanging vegetation can result in a reduction in prey for juvenile salmonids (Toft et al. 2014). The Watershed Company (2011a) reported land use along the Lake Washington shoreline and Kelsey Creek/Mercer Slough area (Table 3). Added to this data was information specific to the Town of Beaux Arts Village (The Watershed Company 2011b).

A desktop analysis was performed to assess the shoreline along Medina, Hunts Point, and Yarrow Point using the Washington State Coastal Atlas Map (Ecology 2022b). An approximate 95% of the shoreline is residential and less than 5% is marina or natural undeveloped land. The total percentage of shoreline that is armored or impervious is unknown. Based on King County (2022a) aerial imagery, approximately 287 shoreline modification related structures were counted that extended into the aquatic zone.

Table 3. Land use and shoreline modifications along the Bellevue shoreline and Beaux Arts Village.

	Shoreline	Units	Lake Washington(1)	Kelsey Creek/ Mercer Slough(1)	Town of Beaux Arts Village(2)
Inventory Data	Length of Shoreline	Miles	9.12	3.74	0.2
	Total Area	Acres	219	449	4.35
	Associated Wetlands	% of area	10	92	--
	Vegetative Cover	% of area	57	83	86.2
Land Use	Single-Family Residential	% of area	76	6	--
	Multi-Family Residential	% of area	3	<1	--
	Park or Preservation	% of area	13	71	98
	Marina	% of area	7	0	--
	Commercial	% of area	<1	23	2
Shoreline Modifications	Impervious Surface	% of area	41	18	5.3
	Shoreline Armoring	% of length	81	--(3)	93
	Piers and Docks	#/mile	38	--(3)	7

(1) Data from The Watershed Company (2011a).
(2) Data from The Watershed Company (2011b).
(3) Shoreline armoring and piers not inventoried as part of the GIS database.

2.3.2 Upland Vegetation

Vegetation within residential properties consists of mostly of a mix of ornamental landscaping and monocultures of residential grasses. The Watershed Company (2015) noted that native western Washington trees and shrubs found in riparian areas are generally related to the undeveloped parks, preserves, and forested/shrub or emergent wetlands. Species in these areas typically include salmonberry (*Rubus spectabilis*), hardhack (*Spiraea douglasii*), serviceberry (*Amelanchier Florida*), red-osier dogwood (*Comus stolonifera*), red-flowering currant (*Ribes sanguineum*), black cottonwood (*Populus trichocarpa*), and Pacific willow (*Salix lasiandra*). Vegetation in the Town of Beaux Arts Village includes lawn grasses with some groupings of native conifers and deciduous trees near the water's edge (The Watershed Company 2011b). Native species documented include Douglas-fir (*Pseudotsuga menziesi*), western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), red alder (*Alnus rubra*), and Oregon ash (*Fraxinus latifolia*). The additional area of analysis outside the City (Medina, Hunts Point, Yarrow Point, and City of Beaux Arts) is mostly zoned as residential and has minimal native riparian habitat along its shoreline.

U.S. Fish and Wildlife Service (USFWS 2022) identifies multiple wetlands within the area of analysis, including:

- Yarrow Bay Wetlands
- Between Yarrow Point and Hunts Point
- Beaux Arts Village
- Mercer Slough Wetland Complex

Yarrow Bay Wetlands consist of approximately 88 acres of palustrine wetland, with a combination forested/scrub-shrub/emergent class that is semipermanent to permanently flooded. Additionally, the riverine habitat within this wetland contains a class of unconsolidated bottom and is permanently flooded throughout the year. A freshwater forested/shrub wetland is identified in an inlet between Yarrow Point and Hunts Point. The wetland consists of approximately 10 acres of palustrine and forested wetland that is considered a seasonally flooded system. The Beaux Arts Village wetland, just south of Chesterfield Beach Park, consists of approximately 0.5 acre of palustrine emergent wetland that is considered a persistent seasonally flooded system.

Mercer Slough Wetland Complex is located to the east of the area of analysis. It is a 320-acre wetland that is comprised of riverine, palustrine forested, scrub-shrub, and emergent wetland classes that is semipermanent to permanently flooded (USFWS 2022). Mercer Slough Wetland also includes a blueberry farm, Mercer Slough Nature Park, Environmental Education Center, and a boat launch (Bellevue 2022b).

2.3.3 Species Use

WDFW has documented two great blue heron (*Ardea herodias*) nests in Medina Park and a colony was observed nesting near the slough entrance of Yarrow Bay (WDFW 2022a). According to NatureMapping (2022), the area of analysis is within the predicted breeding habitat for the bald eagle (*Haliaeetus leucocephalus*), Pileated woodpecker (*Drycopus plieatus*), great blue heron (*Ardea herodia*), Vaux's swift (*Chaetura vauxi*), purple martin (*Progne subis*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*); and western big-eared bat (*Plecotus townsendii*). This does not mean; however, the current habitat is being used by these species. No nesting or breeding sites other than the great blue heron sites noted above were documented within the area of analysis.

2.4 Environmental Summary

The area of analysis is defined as the Lake Washington shoreline extending waterward 300 feet and landward 1,700 feet found within the Bellevue wastewater lake line system. The shorelines included in this area are highly developed and mostly used for residential purposes, with the exception of the adjacent Mercer Slough Wetland Complex.

The water quality of Lake Washington, in general, has been degraded from historical conditions by both point and nonpoint pollution sources. Nonpoint sources include stormwater and subsurface runoff containing pollutants from roadway runoff, failing septic systems, underground petroleum storage tanks, and commercial and residential sites treated with fertilizers and pesticides. Vegetation within residential properties consists of mostly of a mix of ornamental landscaping and monocultures of residential grasses. The identified wetlands with the area of analysis and the adjacent Mercer Slough Wetland Complex provide habitat for both aquatic and upland species.

Lake Washington and its surrounding tributaries support salmonid populations that are determined to be locally important species. Bull trout may occur in Lake Washington throughout the year, but most likely during spring and early summer when temperatures are lower. Chinook salmon adult migration in Lake Washington occurs from June through September. Chinook salmon spawning populations use Lake Washington mainly for rearing and migration. The two steelhead populations within WRIA 8 utilize the area of analysis as a migratory corridor. Migration of steelhead juveniles is expected to be concentrated between April and May in Lake Washington. Historically, adult returns have not been sufficient to sustain a viable steelhead run, based on past low numbers, the relative risk of extinction for the Lake Washington winter steelhead population is considered very high. Additional species identified by WDFW include great blue heron within the area of analysis.

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APPENDIX E

ALTERNATIVES ANALYSIS TECHNICAL MEMORANDUM

Jacobs

Technical Memorandum
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Subject: **City of Bellevue Lake Washington Wastewater Lake Line Management Plan Project Alternatives Analysis**

Attention: Lara Kammereck, PE, Carollo Engineers
Cheyenne Thompson, PE, Carollo Engineers

From: Leanne Nguyen, EIT, Jacobs
Jeff Schmidt, PE, PMP, Jacobs

Date: May 3, 2024

1. Purpose and Background

1.1 Purpose of Report

The purpose of the Lake Washington Wastewater Lake Line Management Plan Project (Project) is to develop a management strategy for improvements to the Lake Washington wastewater lake lines (lake lines), including key operational and capital investment strategies to phase future repair, replacement, and operations of the lake lines. The development of the management plan included a programmatic analysis of alternatives for replacement of the existing lake line system. These alternatives are used to provide a basis for forecasting associated financial and policy changes, and capital improvements. The purpose of this technical memorandum is to summarize the alternatives analysis process and the selected alternative for each service area.

1.2 Project Background

In the 1950s and 1960s, the City of Bellevue (the City) constructed approximately 14.4 miles of lake lines along the Lake Washington shoreline with 15 pump and lift stations and 8 flush stations as part of the City's sewer system. Wastewater enters the lake lines through City-owned sewer collectors, pump stations, and numerous private laterals that discharge directly to the lake line. The original lake lines are now deteriorating in multiple places and are known to be partially filled with debris in some areas. There is a rising concern for potential pipe failures that can result in economic, environmental, and social impacts, threatening sensitive shoreline habitat, closing beaches, and interrupting service to homeowners.

These lake lines serve customers within the cities of Bellevue and Medina; the Towns of Hunts Point, Yarrow Point, and Beaux Arts Village; and unincorporated King County. For the purposes of planning and analysis, the lake line system was divided into six service areas, based on commonalities of geography, development, flow basins, and system infrastructure. Attachment 1 provides a map of the lake lines and service areas.

2. Alternatives Analysis

2.1 Alternatives Analysis Overview

The alternatives analysis process consisted of a sequence of steps, summarized in the following section, to identify the recommended alternative for the Plan:

- **Data compilation by reach and service area –** Initially, the lake lines were defined by service area and then further broken down and analyzed by reach, with a reach defined as a portion of lake line between two pump and/or flush stations. Lake line service areas are shown in Attachment 1, and reaches are further identified in Attachment 2. Data for each reach was then summarized using existing geographic information system (GIS) information from the City such as segment length, the number of parcels served by the existing lake line, and the number of sewer laterals connected to the existing lake line. Aboveground structure locations and structure density was also estimated to better understand the existing areas currently served by the lake lines. Elevation GIS data was analyzed to understand the topography of the existing areas. This information is detailed within Attachment 3 and summarized on figures in Attachment 2.
- **Categorization of alternatives –** As defined by the Environmental Impact Statement (EIS) scoping process, lake line alternatives consisted of four options: (1) constructing a new lake line and keeping new pipelines ***"in-water"*** where the existing lake line would be abandoned, (2) constructing the new lake line in close proximity to the shoreline "***on-shore***," (3) relocating the lake line farther "***upland,***" which would require construction of new laterals and pumping along with new sewers within the existing roadways, or (4) taking a "***no action***" approach and only conducting operational improvements and emergency repairs on the existing lake lines. The ***no action*** alternative was not analyzed further as it does not meet the purpose and need of the Plan to recommend a long-term solution for replacing these existing sewer lines.
- **Initial alternative feasibility –** To ensure that the analysis was moving forward with only feasible alternatives, a feasibility check was completed before proceeding with the analysis of alternatives for each service area. This check looked to eliminate any alternatives that could not be constructed due to the site constraints of a specific service area.
- **Low/Medium/High ranking by factors –** Seven factors were identified through discussions with the City as a means to differentiate the complexities of each alternative within the various service areas:
    1. Permitting
    2. Environmental Impact
    3. Right-of-Way (ROW) and Easement
    4. Performance, Operations and Maintenance (O&M)
    5. Constructability
    6. Cost

7. Local Community and Stakeholders

A low, medium, or high ranking was then attributed to these factors for each alternative within the service areas. For this analysis, "low" represents the preferred alternative and the lowest level of risk or complexity, and "high" represents the most complexity for that factor. For visual simplicity on summary tables, green, yellow, and red demonstrate low, medium, and high scoring, respectively. At the initial stage, all seven factors were weighted equally.

- **Alternative assessment by service area** – Once the low, medium, and high rankings were qualitatively applied to each factor for each alternative in each service area, the number of green (low-risk) factors and red (high-risk) factors were summed up for each alternative. The alternative with the overall highest number of green factors and the least number of red factors was then put forth for initial selection. Initial selection of the best apparent alternative was based on an independent assessment for each individual service area. Consideration of the selected alternative was not made based on the proximity of one service area to another since the nature of the existing system's hydraulics essentially has each service area operating individually. Thus, it is feasible to move forward in the analysis with different alternatives for the different service areas.
- **Cost confirmation** – Association for the Advancement of Cost Engineering (AACE) Class 5 cost estimates were developed for each alternative within each service area. The cost estimates included construction contingency, with soft cost guidance provided by the City, such that the costs could provide further insight into determining a selected alternative.
- **Factor weighting** – Each factor was then assigned an initial weighting by the consultant team to differentiate importance among the various factors. This allows some factors, such as "Cost" or "Performance, O&M", to be weighted higher than less critical factors, such as permitting, which is a one-time only impact on the Project. The alternatives could then be numerically scored (red=1; yellow=2; green=3) with this weighting applied to these scores, and then the recommended alternative could be selected for each service area.
- **Selection of recommended alternative** – Workshops were held to present the analysis to the core City team. During these workshops and subsequent discussions, the weighting was further adjusted and scoring recalculated as necessary. Recommended alternative(s) were then selected by the City based on the outcome of the revised weightings.

2.2 Alternatives Development

First, the consultant team compiled information regarding the lake lines in each service area, including the length of the lake line reaches, the number of parcels served by the lake line, the number of parcels adjacent to the lake line, and density of structures. Additional information included the number of sewer laterals connected to the lake line, differentiated by their location in the lake or on the shore, to help understand the scale of effort needed to reconnect laterals from the existing lake line sewer.

Further information on the existing conditions of each reach was gathered, such as if there was an existing sewer in the roadway, the level of difficulty in accessing the lake line via existing rights-of-way, and if there were any open, undeveloped, or public parcels along the lake line. From there, the maximum, minimum, and average elevation changes were estimated using GIS data from the City's GIS database. Typical distances were also determined using GIS so that information such as the average distance from structures to the lake and the lake to the roadway could be estimated. Attachment 3 provides a summary table of this collected lake line data.

Workshops were held with consultant team subject matter experts (SME) to determine a "toolbox" set of possible capital improvement construction technologies for lake line replacement alternatives based on the collected site data. The initial list of technologies developed by the SMEs considered both new installation and rehabilitation, resulting in nine ***in-water*** technologies, four ***on-shore*** technologies, and three ***upland*** technologies. Attachment 4 provides a description of these technologies. These technologies were then further evaluated in conjunction with the various lake line reaches to determine individual feasibility of each technology for that reach, as shown in Attachment 5. Rehabilitation technologies, such as cured in place pipe and pipe bursting, were evaluated during the initial feasibility analysis. Due to the inability to clean and inspect these existing lines, and the difficulty with dewatering the existing lake lines, rehabilitation technologies were generally considered not feasible for the majority of lake line reaches, and thus were not considered viable construction methods.

After additional follow-up meetings with the SMEs, the feasible technologies for each alternative were further refined to select the best technology for each of the alternatives. For the ***in-water*** alternative, the most feasible construction method was to do open cut construction and install a new low pressure or gravity sewer line in parallel to the existing lake line. For the ***on-shore*** alternative, the two feasible construction methods were to install a new low pressure or gravity sewer line via opencut construction or trenchless methods. For the ***upland*** alternative, the feasible construction method was to install new grinder pumps and sewer laterals on properties to pump flows back into a new or existing sewer along the main road. Attachment 5 summarizes the feasibility of each alternative. Note that different or additional technologies may be implemented at the time the capital improvements projects occur. New technologies may be developed over time, and additional information (condition assessments, survey, geotechnical studies) may inform or modify the most appropriate alternative for a reach or area.

Initially, the lake line service areas were broken down and analyzed by reach, with each reach representing a smaller portion of the lake line, typically running between lift stations or pump stations. It was subsequently decided by the City to simplify the analysis and focus on six lake line service areas: Hunts Point and Yarrow Point, Evergreen Point, Medina South, Meydenbauer Bay, Killarney, and Newport South. The compiled information of each reach was then summarized at the service area level for further alternatives comparison.

2.3 Refinement of Alternatives

2.3.1 Initial Alternative Feasibility

The initial feasibility assessment for each alternative was determined by qualitative means. The ***no action*** alternative did not apply for this exercise as the Project need statement requires that eventually all portions of the existing lake lines will be either repaired or replaced. As such, the three alternatives considered at this point were to keep the lake lines either ***in-water***, move them ***on-shore***, or move them farther ***upland***.

The ***in-water*** alternative was considered feasible for all service areas as there is the capability of physically constructing a new sewer line within the lake. At a high level, all the lake lines across the service areas could also be moved upland, assuming that there are ways to avoid or relocate other existing utilities in the right-of-way (ROW). The ***on-shore*** alternatives, however, had the constraint of whether or not there is enough land on the existing shoreline to construct a new 8-inch sewer main. It was determined through further review that moving the lake line on shore in the Newport South service area would be infeasible, as there is limited space along the shoreline in this location. This is the only service area where the on-shore alternative is infeasible.

Table 1 shows the initial alternatives feasibility by service area. Attachment 2 provides summary maps of each service area along with feasible alternatives and summarized service area data. Tables 2 through 8 do not list an ***on-shore*** alternative for Newport South as it is infeasible.

Table 1. Initial Alternatives Feasibility

Service Area	In-Water	On-Shore	Upland
Hunts Point and Yarrow Point	Yes	Yes	Yes
Evergreen Point	Yes	Yes	Yes
Medina South	Yes	Yes	Yes
Meydenbauer Bay	Yes	Yes	Yes
Killarney	Yes	Yes	Yes
Newport South	Yes	No	Yes

2.3.2 Low/Medium/High Ranking by Factors

The selection of low, medium, or high rankings for each alternative were based on a relative comparison to the other alternatives, with a low ranking meaning lowest level of risk or complexity, and a high ranking meaning the most complexity and highest level of risk. The reasoning for this relative approach, rather than a numeric scoring system for each factor, is due to the limited amount of information available at the time of this analysis.

A numeric scoring system would imply that there is sufficient information available to quantitatively compare the factors. Numeric scoring could then result in a misleading interpretation of factor impacts, and so it was determined through discussions with the City to use a relative comparison approach. The rankings refer to the relative risk or complexity of a given factor within each service area. As these comparisons are relative, there may be instances in which two alternatives were ranked similarly – this should be read as the alternatives are relatively equivalent. The alternatives ranking within each service area for each evaluation criterion are further explained below.

Permitting – This factor evaluates the effort required to prepare and obtain the necessary permits from local, state, and federal agencies. All ***in-water*** permitting is essentially ranked as high due to the requirement set forth by the US Army Corps of Engineers that requires proof that no other construction method is feasible for replacing the lake lines. There is also an anticipated higher number of permits and permit coordination efforts with the appropriate agencies compared to the shore or upland work. ***On-shore*** permitting has relatively more complexities in permitting coordination than ***upland***, which is why ***on-shore*** permitting is ranked medium and ***upland*** permitting is ranked low. For Hunts Point and Yarrow Point and Evergreen Point, the ***upland*** alternative is classified as medium due to the lack of upland sewer infrastructure and the likely need for additional permits for new sewer main lines. Table 2 lists permitting rankings.

Table 2. Permitting Rankings

Service Area	Permitting		
	Low	Medium	High
Hunts Point and Yarrow Point	—	On-Shore/Upland	In-Water
Evergreen Point	—	On-Shore/Upland	In-Water
Medina South	Upland	On-Shore	In-Water
Meydenbauer Bay	Upland	On-Shore	In-Water
Killarney	Upland	On-Shore	In-Water
Newport South	Upland	—	In-Water

Environmental Impact – This factor evaluates the extent of impacts to regulated environmental resources, which include Lake Washington, wetlands, streams, and associated buffers. Work on sewer lines within Lake Washington has the most environmental impact as the lake is the most sensitive environment; thus, ***in-water*** work has a high designation. The environment on the shore is less sensitive than in the water (impacting wetlands, streams, and buffers), and protective measures are generally less complex; thus, ***on-shore*** environmental impacts is ranked medium.

Environmental impacts of upland work are less sensitive as the majority of construction areas are developed; thus, the ***upland*** alternative has a low designation. Some service areas have the potential for upland work to impact regulated environmental areas (i.e., a wetland, steep slope, or other protected environment), which would have slightly more environmental impacts and could potentially move these to a medium ranking. Table 3 lists environmental impact rankings.

Table 3. Environmental Impact Rankings

Service Area	Environmental Impact		
	Low	Medium	High
Hunts Point and Yarrow Point	Upland[1]	On-Shore	In-Water

Evergreen Point	Upland[1]	On-Shore	In-Water
Medina South	Upland	On-Shore	In-Water
Meydenbauer Bay	Upland	On-Shore	In-Water
Killarney	Upland	On-Shore	In-Water
Newport South	Upland	—	In-Water

[1] Unless upland zone is a regulated environmental area (i.e., wetland, steep slope, other critical area).

Right-of-Way and Easement – This factor evaluates the extents that land use rights would need to be acquired or modified to implement the alternative. As there is little to no land-use needs for any ***in-water*** work to replace the lake line in the current easement, work in Lake Washington is essentially considered a low ranking for ROW and easement access. However, this changes to a medium ranking if a new alignment either in the lake or on the shore is selected, which is a possibility for the Hunts Point and Yarrow Point and Evergreen Point areas.

Most ***on-shore*** work is ranked medium as there are some land use rights to be acquired and moderate coordination with individual property owners would be necessary. Coordination with the Washington State Department of Natural Resources would also be required as this state agency owns the aquatic lands, including the tidelands and shorelands within the mean high-water line. This can be a low-risk item for the Hunts Point and Yarrow Point and Evergreen Point areas if the current alignment is already on the shore in some locations.

Upland work would require the most coordination for land use rights as the majority of the areas are fully developed, and the coordination would be with individual property owners, resulting in a high ranking. Meydenbauer Bay and Newport South have only one row of properties between the shore and the main road, which indicates less ROW and easement impact, hence the reason for selecting a medium ranking for ***upland*** construction. Medina and Killarney generally have sewers in the adjacent roadways and laterals running between the buildings, which should provide access and easier ROW to reconnect to these main lines, hence ranking these as medium. Newport South does not include an ***on-shore*** alternative because it was determined to be infeasible as there is limited space on shore for any work to occur. Table 4 lists ROW and easement access rankings.

Table 4. Right-of-Way and Easement Rankings

Service Area	ROW and Easement		
	Low	**Medium**	**High**
Hunts Point and Yarrow Point	In-Water/On-Shore *(existing alignment)*	In-Water/On-Shore *(new alignment)*	Upland
Evergreen Point	In-Water/On-Shore *(existing alignment)*	In-Water/On-Shore *(new alignment)*	Upland
Medina South	In-Water	On-Shore/Upland	—
Meydenbauer Bay	In-Water	On-Shore/Upland	—
Killarney	In-Water	On-Shore/Upland	—

Newport South	In-Water	Upland	—

Performance, Operations and Maintenance (O&M) – This factor evaluates how the location of the lake line alternative impacts the overall system performance and the ease of long-term maintenance. The ease of maintaining performance of the sewer line and conducting O&M is less complex for ***upland*** areas; thus, a low designation is assigned as this alternative does not generally require any specialized equipment and access is most easily available through maintenance holes in the public ROW.

On-shore generally increases the complexities associated with O&M as crews would need to potentially access the infrastructure by foot with hand tools, which is why ***on-shore*** has a medium designation. Performing O&M for lake lines ***in-water*** would be most complex, as it would require barges, divers, and specialty equipment, which complicates the overall O&M effort. Table 5 lists performance, O&M rankings.

Table 5. Performance, Operations and Maintenance (O&M) Rankings

Service Area	Performance/O&M		
	Low	**Medium**	**High**
Hunts Point and Yarrow Point	Upland	On-Shore	In-Water
Evergreen Point	Upland	On-Shore	In-Water
Medina South	Upland	On-Shore	In-Water
Meydenbauer Bay	Upland	On-Shore	In-Water
Killarney	Upland	On-Shore	In-Water
Newport South	Upland	—	In-Water

Constructability – This factor evaluates the technical complexity, difficulty, and risk associated with design and construction of the alternative. This factor also considers the consequences of creating new components to the sewer system or modifying an existing system within the service area. There would be substantial technical complexities and constructability challenges for updating the lake lines regardless of their location, and so there are no low rankings for any of the service areas.

The ***in-water*** alternatives have a high ranking to account for technical design complexities associated with working in Lake Washington and avoiding potential docks and unknown ground conditions along with substantial difficulties in construction. The ***on-shore*** alternative is similarly ranked as high in each area based on the challenging design and construction through multiple private properties with high groundwater conditions and difficult accessibility and restoration requirements.

The ***upland*** alternatives are generally considered high complexity resulting from design on private property and large elevation changes between Lake Washington and the adjacent roadway. Two areas, Meydenbauer Bay and Newport South, are ranked medium for the ***upland*** alternatives since both areas include roadways and existing sewer lines relatively close to the lake with less elevation change between the lake and the roadway. This would limit the required length of new sewer laterals discharging from the proposed grinder pumps, making this alternative more attractive than in other service areas. Table 6 lists technical/constructability rankings.

Table 6. Constructability Rankings

Service Area	Constructability		
	Low	**Medium**	**High**
Hunts Point and Yarrow Point	—	—	In-Water/On-Shore/Upland
Evergreen Point	—	—	In-Water/On-Shore/Upland
Medina South	—	—	In-Water/On-Shore/Upland
Meydenbauer Bay	—	Upland	In-Water/On-Shore
Killarney	—	—	In-Water/On-Shore/Upland
Newport South	—	Upland	In-Water

Cost – This factor evaluates the relative total project cost of the alternative, including design, construction, and mitigation. Generally, a low ranking for costs would represent an alternative that is roughly half the cost of the high criteria alternative. Costs are only compared between alternatives within that service area and are not necessarily aligned between areas. In other words, a low cost is low compared to other alternatives for that service area and may not align with the low costs within other service areas.

Upland work appears to generally have the highest costs, largely due to increased pipe length for grinder pump service laterals and for installation of main line sewers within the roadway. These alternatives generally have the lowest cost per linear foot of pipe but also have higher lengths of new pipe installation. ***In-water*** work would likely be the most complex and has a medium cost ranking, except for Evergreen Point, Medina South, and Meydenbauer Bay, where these costs were ranked low since the ***upland*** costs are greater due to required lengths of new upland main line sewers. ***On-shore*** work, while costly due to restoration costs, are generally comparatively low due to limited amounts of new pipe required, and work that is not in Lake Washington. For Newport South, the ***on-shore*** alternative is not considered feasible since minimal (or no) shoreline exists in many locations.

To validate the original qualitative cost comparisons and provide backup, Class 5 AACE construction costs were estimated for each alternative within each service area based on assumptions confirmed by the City, which can be found in Attachment 11. These costs were then converted to total Project costs by including construction contingency and soft costs for design but excluding easements and real estate costs, which are not determined at this time. Table 7 lists cost rankings.

Table 7. Cost Rankings

Service Area	Cost		
	Low	**Medium**	**High**

Hunts Point and Yarrow Point	On-Shore	In-Water	Upland
Evergreen Point	In-Water/On-Shore	—	Upland
Medina South	In-Water/On-Shore	Upland	—
Meydenbauer Bay	In-Water/On-Shore	Upland	—
Killarney	—	In-Water/On-Shore/Upland	—
Newport South	—	In-Water/Upland	—

Local Community and Stakeholders – This factor evaluates the potential concerns from local stakeholders (residents and community groups). Based on the limited feedback from the community during public outreach conducted throughout the development of the Management Plan and EIS, local residents generally had a preference to keeping the work in the water to minimize disturbances, thus low risk rankings were given for the ***in-water*** alternative. The ***in-water*** alternative also impacts the fewest homeowners and may be viewed favorably if private lateral improvements are included with the work. However, ***on-shore*** and ***upland*** work, depending on the area, is ranked either medium or high-risk ranking based on its geographical features. For instance, ***upland*** work would disrupt the main access road for the Hunts Point and Yarrow Point and Evergreen Point areas, leading to a high ranking. For the remaining areas, ***on-shore*** work is deemed more difficult as it would have higher visibility to residents, thus the high ranking for the ***on-shore*** alternatives at Medina South, Meydenbauer Bay, and Killarney. Table 8 lists local community and stakeholders rankings.

Table 8. Local Community and Stakeholders Rankings

Service Area	Local Community and Stakeholders		
	Low	**Medium**	**High**
Hunts Point and Yarrow Point	In-Water	On-Shore	Upland
Evergreen Point	In-Water	On-Shore	Upland
Medina South	In-Water	Upland	On-Shore
Meydenbauer Bay	In-Water	Upland	On-Shore
Killarney	In-Water	Upland	On-Shore
Newport South	In-Water	Upland	—

2.4 Alternatives Analysis

2.4.1 Alternative Assessment by Service Area

After each of the seven factors were qualitatively evaluated with low, medium, and high rankings for each service area, as seen in Table 9, high complexity (red) rankings were attributed with a -1 value, medium complexity (yellow) rankings were attributed with a 0 value, and low complexity (green) rankings were attributed with a +1 value. When a factor had two rankings for an alternative (which was the case for ROW and Easement at Hunts Point and Yarrow Point and Evergreen Point; see Table 4), it was attributed with a +/-0.5 value.

A summation of the factors for each service area was then performed to provide an unweighted, high-level assessment that would be sufficient for selecting the initial alternative and a starting point for further refinement. Table 9 and Table 10 summarize this process.

Table 9. Initial Factor Evaluation Matrix (Unweighted)

Service Area	Permitting			Environmental Impact			ROW and Easement			Performance, O&M			Constructability			Cost			Local Community and Stakeholders		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Hunts Point and Yarrow Point	—	On-shore/ Upland	In-water	Upland[1]	On-shore	In-water	In-water/ On-shore (existing alignment)	In-water/ On-shore (new alignment)	Upland	Upland	On-shore	In-water	—	—	In-water/ On-shore/ Upland	On-shore	In-water	Upland	In-water	On-shore	Upland
Evergreen Point	—	On-shore/ Upland	In-water	Upland[1]	On-shore	In-water	In-water/ On-shore (existing alignment)	In-water/ On-shore (new alignment)	Upland	Upland	On-shore	In-water	—	—	In-water/ On-shore/ Upland	In-water/ On-shore	—	Upland	In-water	On-shore	Upland
Medina South	Upland	On-shore	In-water	Upland	On-shore	In-water	In-water	On-shore, upland	—	Upland	On-shore	In-water	—	—	In-water/ On-shore/ Upland	—	In-water/ On-shore	Upland	In-water	Upland	On-shore
Meydenbauer Bay	Upland	On-shore	In-water	Upland	On-shore	In-water	In-water	On-shore, upland	—	Upland	On-shore	In-water	—	Upland	In-water/ On-shore	In-water/ On-shore	—	Upland	In-water	Upland	On-shore
Killarney	Upland	On-shore	In-water	Upland	On-shore	In-water	In-water	On-shore, upland	—	Upland	On-shore	In-water	—	—	In-water/ On-shore/ Upland	—	In-water/ On-shore	Upland	In-water	Upland	On-shore
Newport South	Upland	—	In-water	Upland	—	In-water	In-water	Upland	—	Upland	—	In-water	—	Upland	In-water	—	In-water/ Upland		In-water	Upland	—

[1] Unless upland zone is a regulated environmental area (i.e., wetland, steep slope, other critical area).

Table 10. Alternatives Evaluation Matrix and Factor Scoring (Unweighted)

Service Area	Permitting	Environmental Impact	ROW and Easement	Performance, O&M	Constructability	Cost	Local Community and Stakeholders		Number of Reds	Number of Greens	Combined Score	Initial Selected Alternative
Hunts Point and Yarrow Point												
In-Water									-4	1.5	-2.5	
On-Shore									-1	1.5	0.5	x
Upland									-4	2	-2	
Evergreen Point												
In-Water									-4	2.5	-1.5	
On-Shore									-1	1.5	0.5	x
Upland									-4	2	-2	
Medina South												
In-Water									-4	3	-1	
On-Shore									-2	1	-1	
Upland									-1	3	2	x
Meydenbauer Bay												
In-Water									-4	3	-1	
On-Shore									-2	1	-1	
Upland									0	3	3	x
Killarney												
In-Water									-4	2	-2	
On-Shore									-2	0	-2	
Upland									-1	3	2	x
Newport South												
In-Water									-4	2	-2	
On-Shore												
Upland									0	3	3	x

Yellow-highlighted cells represent the alternative with the preferred scoring (fewest number of red cells, the greatest number of green cells) and consequently the initial selected alternative for each service area.

2.4.2 Cost Estimates

To better understand the potential Project cost impacts, Class 5 Opinions of Probable Construction Cost estimates were developed for each service area using the latest City of Bellevue cost estimating templates. The cost estimates were developed primarily based on the following:

- Information gathered during the initial compilation of existing conditions
- Background information on the service areas, including pump stations and lift stations
- City GIS data mapping the existing upland sewers, laterals, maintenance holes, and parcels
- Flow data including hydraulic gradients
- *2015 Wastewater Pump Station Evaluation Final Report*[1]

This background information was used for creating Class 5 conceptual cost estimates for the ***in-water*** and ***on-shore*** alternatives based on high-level assumptions. For the ***upland*** alternative, additional assumptions were required to determine the high-level costs using limited existing conditions data and without conceptual design documents. Attachment 6 provides key assumptions made to develop the cost estimates, and Attachments 7 and 8 provide general assumptions for estimating improvements to flush stations and pump stations, respectively.

It was assumed that the ***upland*** alternative would consist of constructing new grinder pumps for each property with force main laterals redirecting flows from the lowest elevation sewer cleanouts back upland to either the existing sewer main line or a new sewer main line within the road. Flows would then be conveyed to the existing pump stations, with the assumption that this effectively removes the need for the existing lake lines. Attachment 9 details the estimated new pipe lengths for the ***upland*** sewer alternative, and Attachment 10 provides the additional detailed cost estimate for pump station rehabilitation for the ***upland*** alternative.

The pump station and lift station recommendations from the 2015 *Wastewater Pump Station Evaluation Report* were used as the basis for recommended improvements for all alternatives that require upgrades to those facilities. Additional cost estimating was performed on those improvements using 2023 costs to develop the proposed pump and lift station upgrade costs, as shown in the individual detailed estimates in Attachment 11.

[1] Murray, Smith & Associates. 2015. *Wastewater Pump Station Evaluation Report*. Prepared for the City of Bellevue. Final. May.

Once these assumptions were confirmed, the consultant team finalized the Class 5 cost estimates for each service area. A meeting was held with the City to review the cost assumptions and establish the appropriate soft cost assumptions, including engineering design, planning, outreach, services during construction, and City labor (see Attachment 11 for details).

Table 11 summarizes the total estimated Project costs, which were based on the City of Bellevue Utilities Cost Estimating templates and include the construction hard costs as well as the soft costs for each service area. The AACE accuracy ranges for Class 5 estimates (-30 and +100 percent) were applied to the construction hard costs only. Soft costs were computed as a percentage of the construction hard costs, including a soft cost contingency, and then added to these low and high range construction hard costs. Since these soft costs do not typically have a similar accuracy range, the resulting overall accuracy range of the total project costs ends up being -19 and +62 percent.

Attachment 11 contains the full cost estimates for each service area. For the ***on-shore*** alternative, cost estimates were developed for both an opencut and a trenchless construction method as a way to compare the range of costs for work on the shore. Generally, if the on-shore alternative is selected, the highest cost would be utilized for budgeting purposes as this would cover the possibility that the project could ultimately be a mix of open cut and trenchless installations. Highlighted rows in Table 11 show the selected alternative for each service area based upon the initial selection indicated in Table 10 above.

Table 11. Service Area Alternatives Cost Summary

Hunts Point and Yarrow Point	Low Range -19%	Total Project Costs	High Range 62%
Alternative 1 - In-Water	$234,000,000	$287,970,300	$467,000,000
Alternative 2 - On-Shore, Opencut	$154,000,000	$188,983,000	$306,000,000
Alternative 2 - On-Shore, Trenchless	$191,000,000	$234,653,800	$380,000,000
Alternative 3 - Upland	$316,000,000	$388,101,100	$629,000,000
Evergreen Point	**Low Range -19%**	**Total Project Costs**	**High Range 62%**
Alternative 1 - In-Water	$112,000,000	$138,193,000	$224,000,000
Alternative 2 - On-Shore, Opencut	$93,000,000	$114,814,800	$186,000,000
Alternative 2 - On-Shore, Trenchless	$104,000,000	$127,400,400	$207,000,000
Alternative 3 - Upland	$172,000,000	$211,262,800	$343,000,000
Medina South	**Low Range -19%**	**Total Project Costs**	**High Range 62%**
Alternative 1 - In-Water	$151,000,000	$185,979,200	$302,000,000
Alternative 2 - On-Shore, Opencut	$144,000,000	$177,303,400	$287,000,000
Alternative 2 - On-Shore, Trenchless	$141,000,000	$173,203,200	$281,000,000
Alternative 3 - Upland	$163,000,000	$199,746,700	$324,000,000
Meydenbauer Bay	**Low Range -19%**	**Total Project Costs**	**High Range 62%**
Alternative 1 - In-Water	$117,000,000	$144,301,700	$234,000,000
Alternative 2 - On-Shore, Opencut	$107,000,000	$131,257,800	$213,000,000
Alternative 2 - On-Shore, Trenchless	$115,000,000	$141,616,000	$230,000,000
Alternative 3 - Upland	$160,000,000	$197,121,600	$320,000,000
Killarney	**Low Range -19%**	**Total Project Costs**	**High Range 62%**
Alternative 1 - In-Water	$149,000,000	$183,748,500	$298,000,000
Alternative 2 - On-Shore, Opencut	$156,000,000	$191,912,700	$311,000,000
Alternative 2 - On-Shore, Trenchless	$152,000,000	$186,598,000	$303,000,000
Alternative 3 - Upland	$142,000,000	$174,713,000	$283,000,000
Newport South	**Low Range -19%**	**Total Project Costs**	**High Range 62%**
Alternative 1 - In-Water	$165,000,000	$202,381,900	$328,000,000
Alternative 3 - Upland	$167,000,000	$205,631,000	$333,000,000

Yellow-highlighted rows represent the selected alternative for each service area.
The on-shore alternative for Newport South is infeasible and therefore not included in the summary table.

2.4.3 Factor Weighting

Following the initial scoring exercise, the consultant team worked to determine a weighting for each factor to better understand how the selected alternatives could change if some factors were considered to have more importance than others. The alternatives could then be numerically scored (red = 1; yellow = 2; green = 3), with this weighting applied to these scores and a revised recommended alternative selected for each service area.

The factor weightings were then discussed with the City and revised at a core team meeting on August 29, 2023, based on input from various City departments, including engineering, O&M, finance, environmental permitting, asset management, and public engagement. Following this meeting, the weighting was again revised to include interpretation of public feedback obtained during outreach activities through the City's Programmatic Environmental Impact Statement process. Table 12 lists the selected weightings at each stage in this process.

Table 12. Proposed Factor Weighting

Factor	Core Meeting (8/29/23) Weighting	Revised Weighting from City and Public Feedback
Permitting	10%	8%
Environmental Impact	15%	17%
ROW and Easement	15%	17%
Performance, O&M	15%	17%
Constructability	10%	12%
Costs	20%	17%
Local Community and Stakeholders	15%	12%

After revising the factor weightings as shown in Table 12, the scoring still aligned with the initially selected alternatives for all six service areas. A sensitivity analysis was then performed on the weightings to determine the level of adjustment necessary to shift the selected alternative.

The sensitivity analysis showed that there would be a shift in the preferred alternatives only by increasing certain factors (such as permitting and environmental impact) a substantial amount, to a weighting of 30 percent or more. The lack of sensitivity in the weighting of the factors reaffirmed that the preferred alternative has been properly selected for each service area.

2.5 Selection of Recommended Alternative

After a thorough alternatives analysis process that included evaluating possible technologies to replace the existing lake lines for each alternative, developing initial recommendations based on comprehensive factors, and revising weightings based on feedback from the City and the public, the selection of the recommended alternatives for the six service areas was completed. Table 13 summarizes the service areas and recommended alternatives.

Table 13. Recommended Alternative by Service Area

Service Area	Recommended Alternative
Hunts Point and Yarrow Point	On-Shore
Evergreen Point	On-Shore
Medina South	Upland
Meydenbauer Bay	Upland
Killarney	Upland
Newport South	Upland

It is notable that the ***in-water*** alternative was not recommended for any of the six service areas. This is due to the difficulties with construction permitting, extensive environmental impacts, O&M challenges, and the overall constructability issues associated with working in Lake Washington.

Selected alternatives do not impact the other service areas as each service area is hydraulically independent from the others. For example, the ***on-shore*** alternative for Medina South would be north of Flush Station No. 4 (in Medina South) and does not impact the selection of an ***upland*** alternative for Meydenbauer Bay, since these flows are conveyed north from Flush Station No. 5 which is the opposite direction.

While a recommended alternative is indicated for each service area, the above recommendations are intended to provide guidance to the Plan and may not represent the final solution in these service areas. As the City moves forward with work in each service area, additional data will be collected and utilized to confirm a proposed design for the area that may include elements of the other alternatives. Nonetheless, although a more detailed assessment of each of these service areas will be completed, the selected alternatives from this current analysis can be used to support the Plan and allow the City to proceed with budgeting and planning for these upcoming projects.

2.6 Next Steps

This Technical Memorandum will be incorporated as an appendix to the Lake Washington Wastewater Lake Line Management Plan to serve as reference for future City projects. The Management Plan will outline next steps for the City regarding Service Area priorities so that future capital projects to replace the lake line system can be planned and delivered.

ATTACHMENT 1
LAKE WASHINGTON SEWER LAKE LINE SERVICE AREA MAP

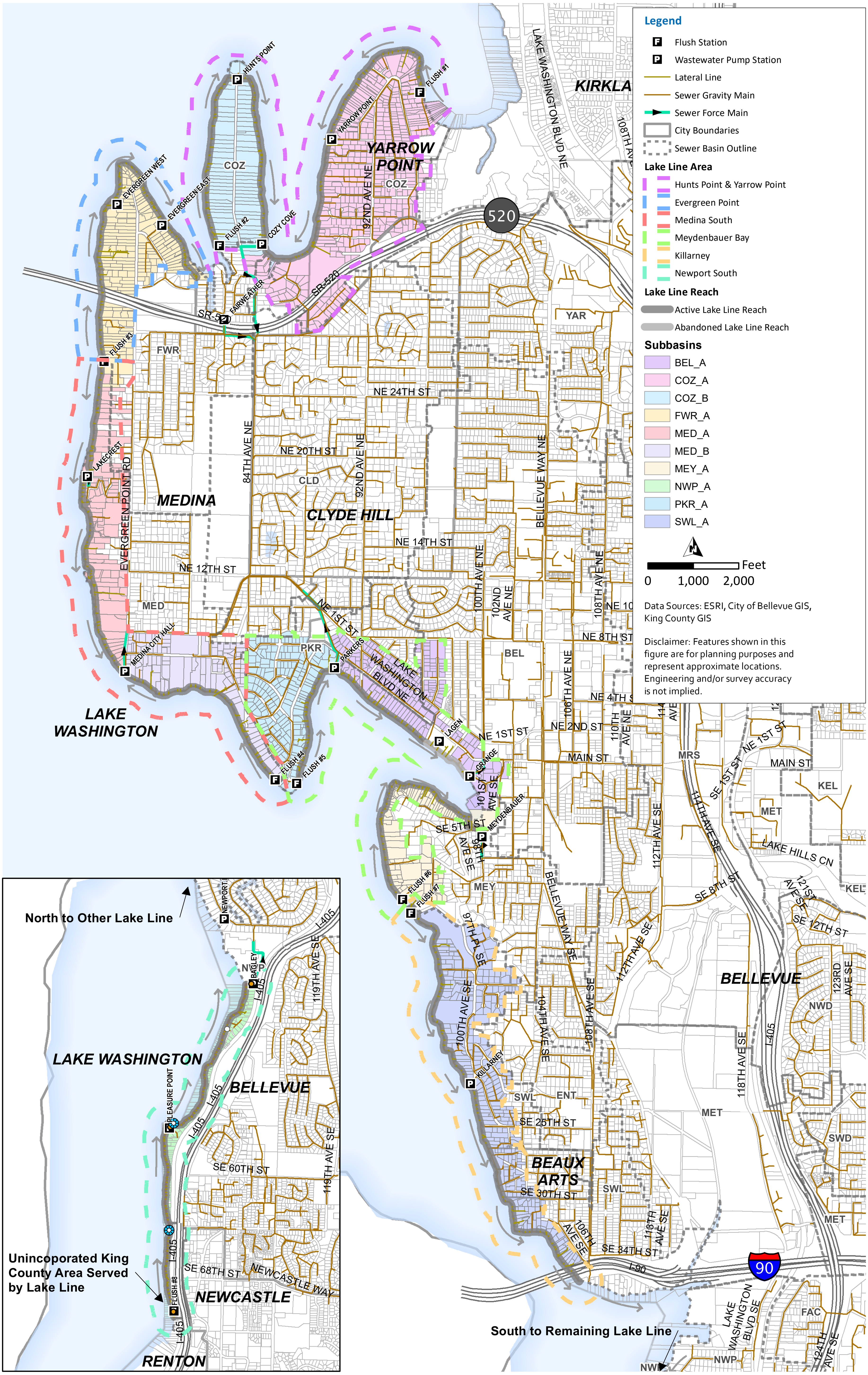


Figure A-1 Lake Washington Wastewater Lake Line Management Plan Areas

ATTACHMENT 2
SERVICE AREA SUMMARY FIGURES

Hunts Point and Yarrow Point

Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	- Gravity Sewer Line via Open Cut Construction - Gravity Sewer Line via Trenchless Construction
Upland	- Grinder Pumps

Pipe Size (in.):	8
Pipe Material:	Mixed / CI / Unknown
Segment Length (ft.):	16,755 Total 2,195 On Land 14,560 In Water
# Parcels Served:	587
# Parcels Adjacent to LL:	155
Location:	In Water

Evergreen Point

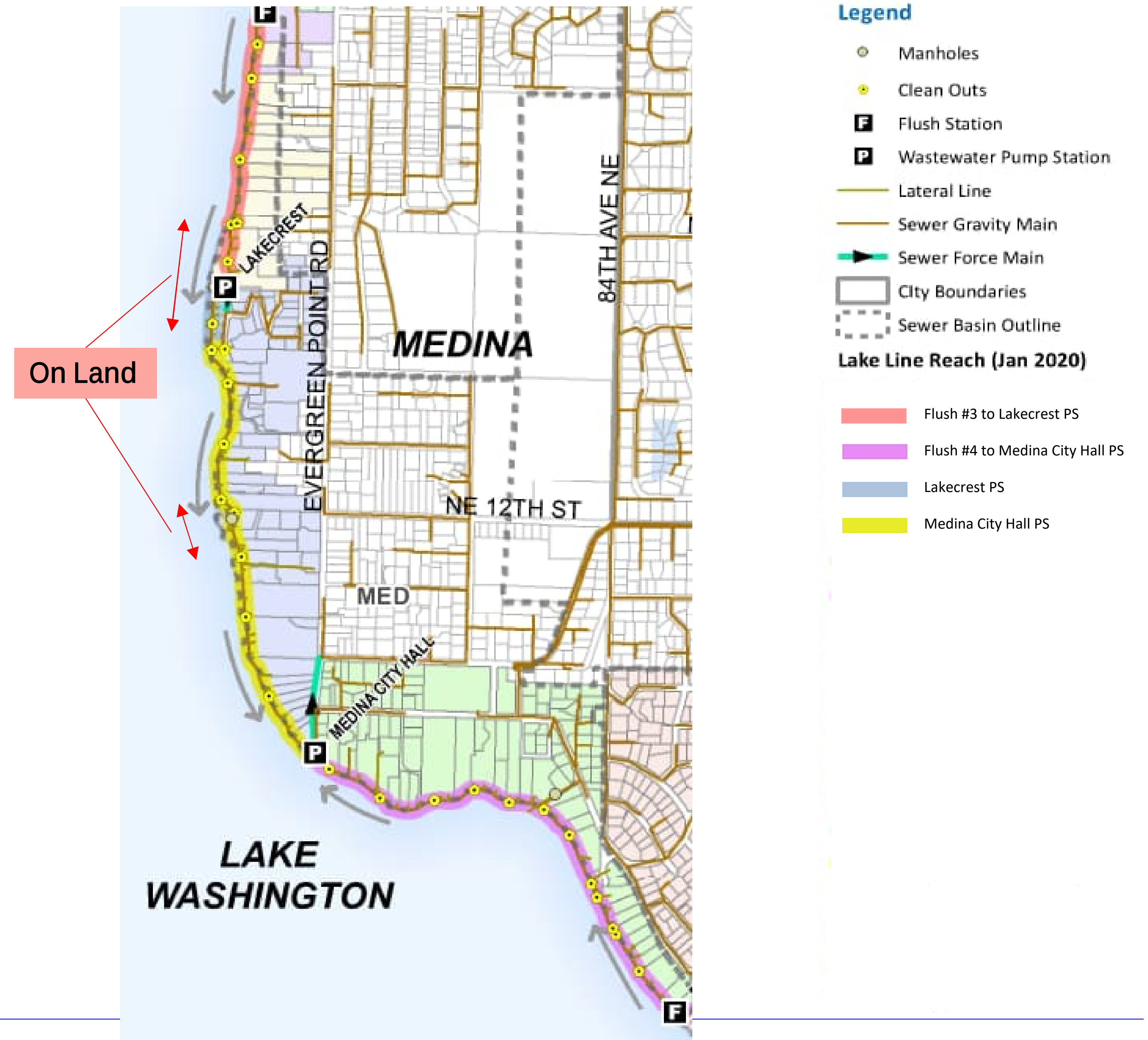
Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	- Gravity Sewer Line via Open Cut Construction - Gravity Sewer Line via Trenchless Construction
Upland	- Grinder Pumps

Pipe Size (in.):	8
Pipe Material:	AC / Mixed / CI
Segment Length (ft.):	8,423 Total 2,900 On Land 5,523 In Water
# Parcels Served:	172
# Parcels Adjacent to LL:	86
Location:	In Water

Medina South

Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	- Gravity Sewer Line via Open Cut Construction - Gravity Sewer Line via Trenchless Construction
Upland	- Grinder Pumps

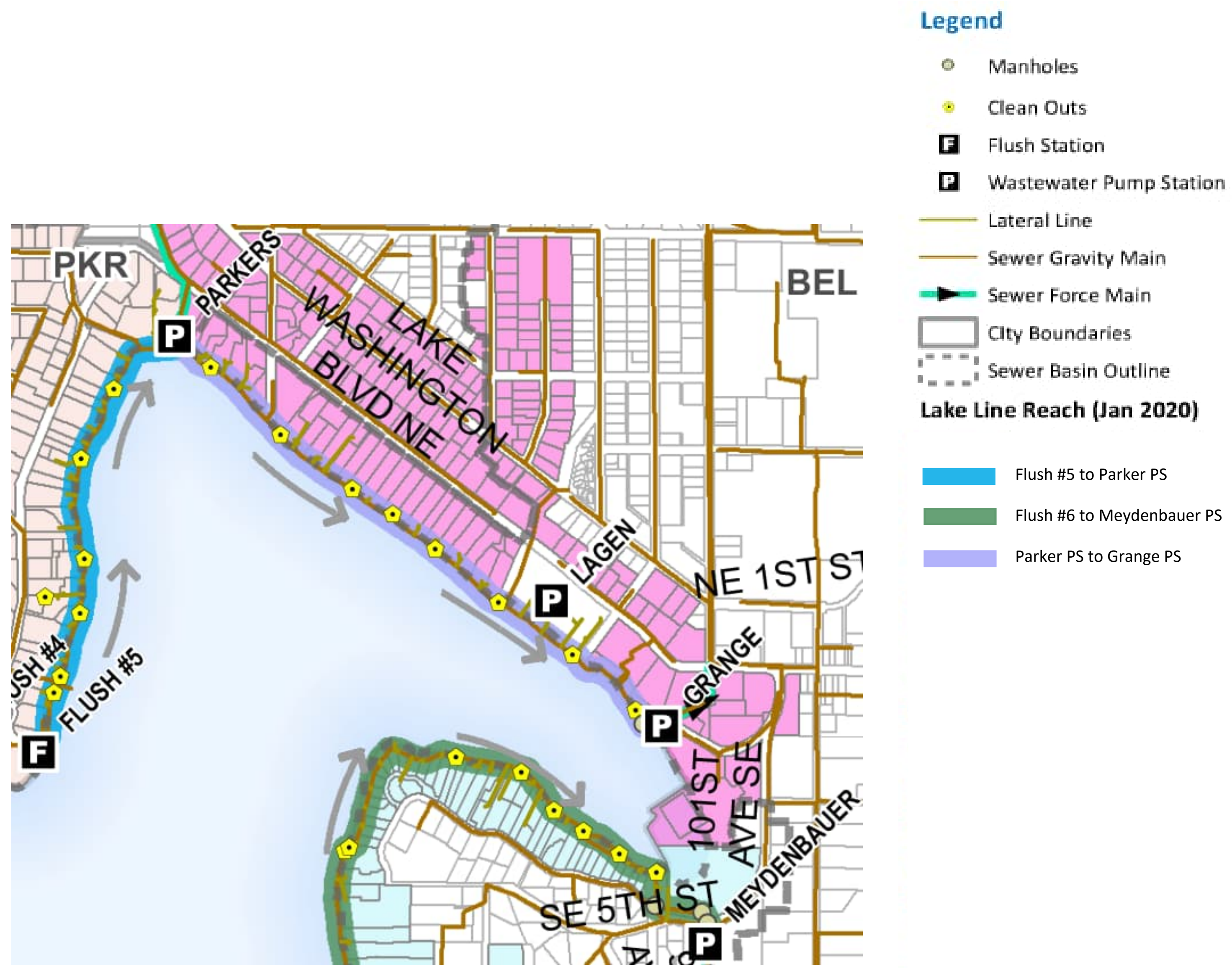
Pipe Size (in.):	8
Pipe Material:	AC / Mixed / CI
Segment Length (ft.):	12,320 Total 586 On Land 11,734 In Water
# Parcels Served:	213
# Parcels Adjacent to LL:	83
Location:	In Water



Meydenbauer Bay

Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	- Gravity Sewer Line via Open Cut Construction - Gravity Sewer Line via Trenchless Construction
Upland	- Grinder Pumps

Pipe Size (in.):	**8**
Pipe Material:	**AC / Mixed / DI Unknown**
Segment Length (ft.):	**9,082 Total** 3,326 On Land* 5,846 In Water
# Parcels Served:	**448**
# Parcels Adjacent to LL:	**112**
Location:	**In Water**

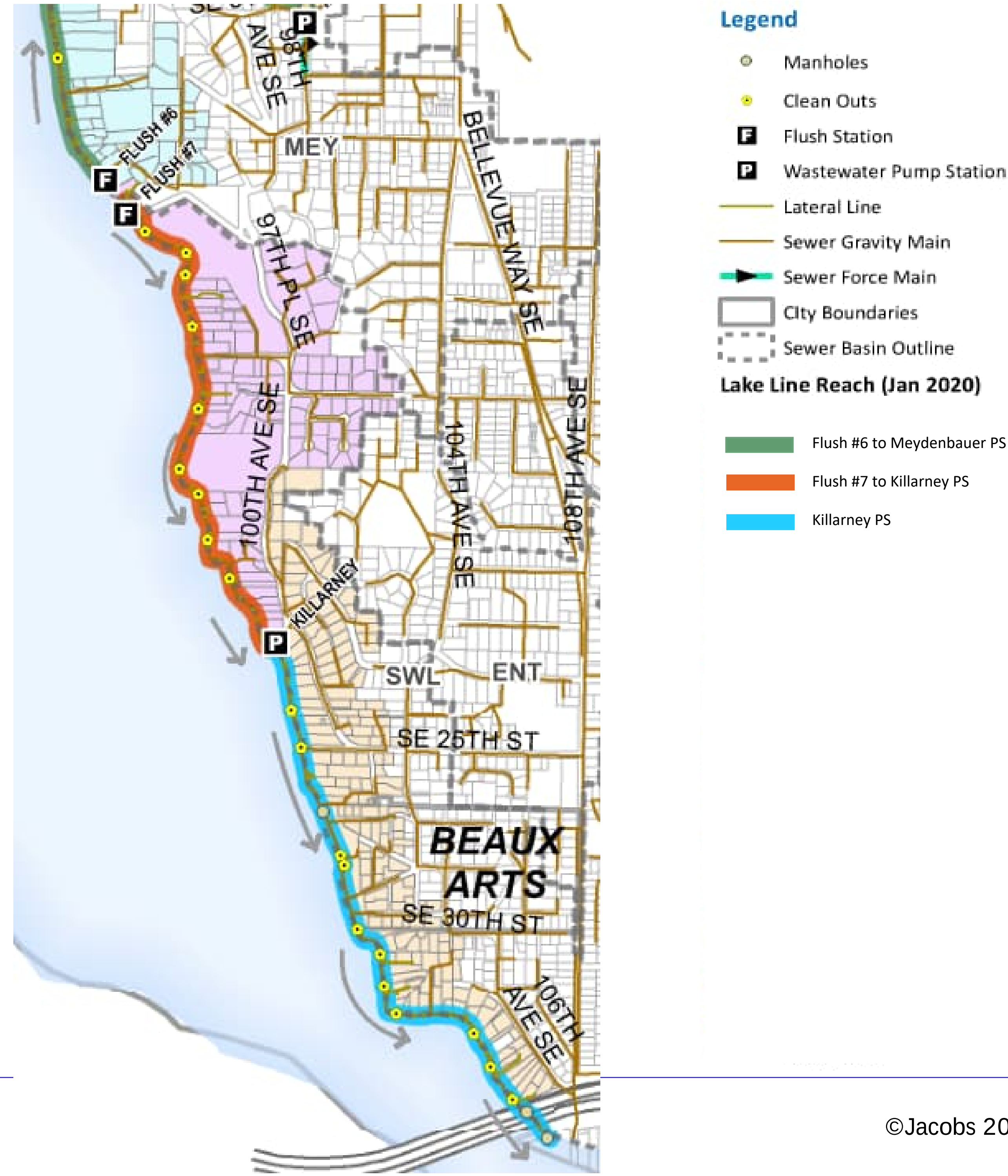


*Ops to confirm that LL is on land

Killarney

Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	- Gravity Sewer Line via Open Cut Construction - Gravity Sewer Line via Trenchless Construction
Upland	- Grinder Pumps

Pipe Size (in.):	**8**
Pipe Material:	**Mixed / DI**
Segment Length (ft.):	**12,965 Total** 2,130 On Land* 10,835 In Water
# Parcels Served:	**336**
# Parcels Adjacent to LL:	**93**
Location:	**In Water**



*Ops to confirm that LL is on land

Newport South

Alternative	Method
Within the Lake	- Gravity Sewer Line via Open Cut Construction
On-Shore	
Upland	- Grinder Pumps

Pipe Size (in.):	8
Pipe Material:	CI
Segment Length (ft.):	10,175
# Parcels Served:	149
# Parcels Adjacent to LL:	131
Location:	In Water

ATTACHMENT 3
SERVICE AREA COLLECTED DATA SUMMARY

City of Bellevue - Lake Washington Lake Line Master Plan

Service Area Collected Data Summary Table

SERVICE AREA	Reach	Reach Name	Length of reach (ft.)	Pipe size (in.)	Pipe material within reach	Segment	Length of segment (ft.)	Parcels Served	Parcels adjacent to the Lake Lines and LS/PS	# of Sewer Laterals in Lake	# of Sewer Laterals on shore	Total # of Sewer Laterals	# of Sewer Line Connections	Total # of sewer connections to Lake Line	Is the existing lakeline within the lake or on shore?
Hunts Points and Yarrow Point			16755	8	Mixed / CI / Unknown		16755	587	155	82	28	110	19	129	In Water
	COZ_A_1	FLUSH #1 TO YARROW PT PS	4122	6 to 8	Mixed	COZ_A_1_1	2195	245	45	0	19	19	4	23	On Shore
						COZ_A_1_2	1927			15	0	15	1	16	In Water
	COZ_A_2	YARROW PT PS TO COZY COVE PS	4144	8	CI	COZ_A_2_1	4144	263	37	11	0	11	10	21	In Water
	COZ_B_1	HUNTS PT PS TO COZY COVE PS	4086	8	CI	COZ_B_1_1	4086	40	38	32	2	34	3	37	In Water
	COZ_B_2	FLUSH #2 TO HUNTS PT PS	4403	Unknown to 8	CI & Unknown	COZ_B_2_1	4403	39	35	24	7	31	1	32	In Water
Evergreen Point			8423	8	AC / Mixed / CI		8423	172	86	45	34	79	7	86	In Water
	FWR_A_1	EVERGREEN EAST PS TO FAIRWEATHER PS	1553	8	AC	FWR_A_1_1	1553	52	21	3	25	28	2	30	On shore
	FWR_A_2	EVERGREEN WEST PS TO EVERGREEN EAST P	3096	8	Mixed	FWR_A_2_1	1347	37	28	0	9	9	0	9	On Shore
						FWR_A_2_2	1749			16	0	16	1	17	In Water
	FWR_A_3	FLUSH #3 TO EVERGREEN WEST PS	3774	8	CI	FWR_A_3_1	3774	83	37	26	0	26	4	30	In Water
Medina South			12320	8	AC / Mixed / CI		12320	213	83	69	11	80	7	87	In Water
	MED_A_1	FLUSH #3 TO LAKECREST PS	2726	8	Mixed	MED_A_1_1	2726	23	15	11	3	14	0	14	In Water
	MED_A_2	LAKECREST PS	586	8	AC	MED_A_1_2	586	30	8	0	8	8	2	10	On shore
	MED_A_3	MEDINA CITY HALL PS	4215	6 to 8	Mixed, CI	MED_A_1_3	4215	45	27	28	0	28	2	30	In Water
	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	4793	8	Mixed, CI	MED_B_1_1	2415	115	33	15	0	15	2	17	In Water
						MED_B_1_2	2378			15	0	15	1	16	In Water
Meydenbauer Bay			11212	8	AC / Mixed / DI / Unknown		9082	448	112	54	13	67	14	81	In Water
	PKR_A_1	FLUSH #5 TO PARKER PS	3221	8	Mixed, AC	PKR_A_1_1	407	185	30	1	0	1	3	4	In Water
						PKR_A_1_2	2814			20	0	20	1	21	In Water
	BEL_A_1	PARKER PS TO GRANGE PS	2625	6 to 10	AC & Unknown	BEL_A_1_1	2625	206	33	19	0	19	7	26	In Water
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	5366	8	Mixed, DI	MEY_A_1_1 & MEY_A_1_2	3236	57	49	14	13	27	3	30	On shore (ops to confirm)
Killarney			12965	8	Mixed / DI		12965	336	93	60	2	62	13	75	In Water
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	2130	8	Mixed / DI	MEY_A_1_3 & MEY_A_1_4	2130	43	11	6	0	6	2	8	On shore (ops to confirm)
	SWL_A_1	FLUSH #7 TO KILLARNEY PS	4756	6 to 8	Mixed	SWL_A_1_1	4756	111	34	26	2	28	4	32	In Water
	SWL_A_2	KILLARNEY PS	6079	8	Mixed	SWL_A_2_1 & SWL_A_2_2	6079	182	48	28	0	28	7	35	In Water
Newport South			10175	8	CI		10175	149	131	99	0	99	4	103	In Water
	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	5007	8	CI	NWP_A_1_1	5007	74	59	42	0	42	3	45	In Water
	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	5168	6 to 8	CI	NWP_A_2_1	5168	75	72	57	0	57	1	58	In Water

City of Bellevue - Lake Washington Lake Line Master Plan
Service Area Collected Data Summary Table

			Existing Conditions					Typical Elevation Change					
SERVICE AREA	Reach	Reach Name	Is there an existing sewer in the roadway?	Does it feed back into the lakeline reach?	Difficulty accessing lakeline via existing easements	Any open or undeveloped parcels along the lake line?	Any public parcels along the lakeline?	Back of House (Shoreline)-Road Elevation Change	Greatest House-to-Road Elevation Change	Avg. House-to-Road Elevation Change	Least House-to-Road Elevation Change	Back of house to lake (Steepness > 2:1)	Lake-Road Elevation Change
			Yes | No	Yes | No	Low | Medium | High	Yes | No	Yes | No	0-20 | 0 - 40 | 0 - 60 | 0 - >60	ft.	ft.	ft.	0-10% | 10-30% | 30-60% | >60%	0-20 | 20-60 | > 60
Hunts Points and Yarrow Point								0-60	150	47	2	0-10%	20-60
	COZ_A_1	FLUSH #1 TO YARROW PT PS	Yes	No	Low	Yes	No	0-60	60	45	6	0-10%	20-60
								0-60	50	40	4	0-10%	20-60
	COZ_A_2	YARROW PT PS TO COZY COVE PS	Yes	Yes	Medium	Yes	Yes	0 - >60	150	90	4	0-10%	> 60
	COZ_B_1	HUNTS PT PS TO COZY COVE PS	No	No	High	Yes	No	0-40	40	25	2	0-10%	20-60
	COZ_B_2	FLUSH #2 TO HUNTS PT PS	No	No	High	Yes	No	0-40	40	35	2	0-10%	20-60
Evergreen Point								0-60	120	51	2	10-30%	20-60
	FWR_A_1	EVERGREEN EAST PS TO FAIRWEATHER PS	Yes	Yes	Low	No	No	0-60	60	45	4	10-30%	20-60
	FWR_A_2	EVERGREEN WEST PS TO EVERGREEN EAST P	No	No	Low	No	No	0-60	50	40	2	0-10%	20-60
								0-60	50	30	4	0-10%	20-60
	FWR_A_3	FLUSH #3 TO EVERGREEN WEST PS	No	No	Medium	Yes	Yes	0 - >60	120	90	4	30-60%	>60
Medina South								0-60	160	61	6	0-10%	20-60
	MED_A_1	FLUSH #3 TO LAKECREST PS	Yes	No	Medium	Yes	No	0 - >60	130	100	8	>60%	>60
	MED_A_2	LAKECREST PS	Yes	Yes	Medium	Yes	No	0-40	30	10	6	0-10%	20-60
	MED_A_3	MEDINA CITY HALL PS	Partly yes	No	High	Yes	Yes	0 - >60	160	110	6	30-60%	>60
	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	Mostly yes	No	High	Yes	Yes	0-60	50	35	6	0-10%	20-60
			Yes	No	Medium	No	No	0-60	60	50	15	0-10%	20-60
Meydenbauer Bay								0 - >60	100	63	10	10-30%	>60
	PKR_A_1	FLUSH #5 TO PARKER PS	Yes	No	High	No	No	0-60	60	40	10	10-30%	20-60
			Partly yes	No	High	No	No	0 - >60	100	70	10	10-30%	>60
	BEL_A_1	PARKER PS TO GRANGE PS	Yes	No	Low	No	Yes	0 - >60	75	50	12	10-30%	>60
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	Yes	No	Medium	No	No	0 - >60	100	90	10	>60%	>60
Killarney								0 - >60	100	78	10	10-30%	>60
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	No	No	High	Yes	No	0 - >60	100	63	20	>60%	>60
	SWL_A_1	FLUSH #7 TO KILLARNEY PS	Partly yes	No	Low	No	Yes	0 - >60	100	80	10	10-30%	>60
	SWL_A_2	KILLARNEY PS	Partly yes	No	Low	Yes	No	0 - >60	100	90	20	10-30%	>60
Newport South								0-20	20	15	8	>60%	20-60
	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	No	No	High	Yes	No	0-20	20	15	10	>60%	0-20
	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	No	No	High	No	No	0-20	20	15	8	>60%	20-60

City of Bellevue - Lake Washington Lake Line Master Plan

Service Area Collected Data Summary Table

			Typical Distance Change						Density of Structures		
SERVICE AREA	Reach	Reach Name	Min. Structure to Lake Distance	Avg. Structure to Lake Distance	Max. Structure to Lake Distance	Min Lake-Road Distance	Average Lake-Road Distance	Max. Lake-Road Distance	High	Med	Low
			ft.	ft.	ft.		ft.				
Hunts Points and Yarrow Point			60	319	1241	375	648	1241	X		X
	COZ_A_1	FLUSH #1 TO YARROW PT PS	68	283	569	492	555	761	X		
			63	260	520	487	506	622	X		
	COZ_A_2	YARROW PT PS TO COZY COVE PS	64	639	1241	950	1110	1241	X		
	COZ_B_1	HUNTS PT PS TO COZY COVE PS	100	202	339	404	530	665			X
	COZ_B_2	FLUSH #2 TO HUNTS PT PS	60	214	220	375	539	612			X
Evergreen Point			40	329	580	232	560	824	X		
	FWR_A_1	EVERGREEN EAST PS TO FAIRWEATHER PS	59	341	570	518	582	661	X		
	FWR_A_2	EVERGREEN WEST PS TO EVERGREEN EAST P	50	241	580	247	450	658	X		
			40	230	560	232	445	663	X		
	FWR_A_3	FLUSH #3 TO EVERGREEN WEST PS	75	503	560	676	765	824		X	
Medina South			75	374	1000	152	625	1109		X	
	MED_A_1	FLUSH #3 TO LAKECREST PS	250	538	1000	718	929	1105	X		
	MED_A_2	LAKECREST PS	75	100	119	152	175	189			X
	MED_A_3	MEDINA CITY HALL PS	125	488	785	634	881	1109			X
	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	180	507	700	529	735	824		X	
			160	238	550	299	403	707		X	
Meydenbauer Bay			35	175	410	179	374	685	X		
	PKR_A_1	FLUSH #5 TO PARKER PS	145	137	410	330	457	685	X		
			100	198	290	287	380	607		X	
	BEL_A_1	PARKER PS TO GRANGE PS	115	238	300	309	401	587	X		
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	35	126	315	179	257	372	X		
Killarney			50	356	680	172	418	891		X	
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	60	192	215	172	233	335		X	
	SWL_A_1	FLUSH #7 TO KILLARNEY PS	50	477	680	199	479	891		X	X
	SWL_A_2	KILLARNEY PS	60	398	675	267	543	864	X		
Newport South			20	123	350	80	193	633	X		
	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	20	135	350	80	237	633	X		
	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	30	111	325	90	149	387	X		

ATTACHMENT 4
CAPITAL IMPROVEMENTS TOOLBOX TECHNOLOGY SUMMARY

Capital Improvements Toolbox Alternative Technology Descriptions

Applicable Alternative(s)			Technology	Description of Technology	Technical Envelope/Design Considerations
In-water	On-shore	Upland			
X	X	X	Gravity Sewer Line via Open Cut Construction (NI)	Traditional method for the installation of new sanitary sewer pipe via open cut trenches.	• 8-inch to 144-inch diameter (note Department of Ecology does provide exceptions for 6-inch pipe if the criteria can be met) • Pipe materials ductile iron, poly-vinyl chloride (PVC) • Side sewers need to be reconnected via open cut • Bypassing not required
X	X		Gravity Sewer Line via Trenchless Construction (guided auger boring) (NI)	Trenchless rehabilitation by installing a new sewer between two locations via a guided boring system. A steel casing is pushed and guided along a straight path between a launch pit and a reception pit. Depending on the soil, the casing is either augured into place in a single step or there is an initial pilot tube installed by displacing native soil which is then followed by the steel casing. Best suited for steel casing (with PE pipe inside) or VCP.	• 12-inch to 48-inch diameter • Installation lengths average 350 feet, future manholes are required at each launch or reception location • Side sewers need to be reconnected via open cut • Method is not applicable for soils with cobbles or boulders • Bypassing not required • Requires relatively large footprint/excavation for installation pit (12'x20' minimum) • For plastic pipe installations, requires steel casing installation
X	X		Cured in Place Pipe (CIPP) (R)	Trenchless rehabilitation method to repair existing sanitary sewer pipe by installing a structural felt liner impregnated with resin in the existing pipe. Robotic cutting tools reconnect existing side sewers from the main line.	• 8-inch to 96-inch in diameter (sizes up to 144” have been installed) • 6-inch liner can be installed but requires special lateral cutting equipment and techniques • Robotic cutting tools reconnect existing side sewers from the main line. • Cleaning the sanitary sewer is required, grease and debris could impact liner installation • Installation lengths could range from 300 to 3,000 feet depending upon existing pipe configuration. • Liner can be installed around bends but will result in wrinkling (preferably smaller than 45-degree bends). • Liner configuration will reflect existing pipe conditions including sags and off-set joints • Dewatering/Bypassing required • Requires access points at each end of the rehabilitation, typically a manhole.
X	X		SPR (Spiral Wound Pipe) (R)	Is a trenchless lining process installing a specialty PVC profile strip which is continuously wound into the host pipe. The PVC profile edges lock into the previous spiral thereby creating a tight seal. Depending on the host pipe diameter, the liner is either pushed into place as it is wound or pulled into place using a specialty machine. The liner is restrained until reaching the termination manhole and then expanded for a tight fit.	• Pipe sizes from 6” to 200” inch diameter • Cleaning the sanitary sewer is required, grease and debris could impact liner installation • Installation lengths generally range from 300 to 800 feet of straight pipe • Robotic cutting tools reconnect existing side sewers from the main line. • Minimal bypassing required – 25% to 30% flow can remain in pipe • Requires access points at each end of the rehabilitation, typically a manhole.
X	X		Slip lining (R)	Install a smaller diameter pipe (PVC or HDPE) into the existing pipe. Excavation pits are required to	• Typical pipe sizes range from 2 inches to 48-inches • Pipe needs to be straight (no bends), round enough to allow the new pipe through, and clean

Capital Improvements Toolbox Alternative Technology Descriptions

Applicable Alternative(s)			Technology	Description of Technology	Technical Envelope/Design Considerations
In-water	On-shore	Upland			
				pull the new pipe into the existing host pipe. New pipe is generally 1-2 inches smaller than host pipe.	• Pulling and insertion pits required • Annular space between the host pipe and new pipe is typically grouted • Cleaning the sanitary sewer is required • Side sewers need to be reconnected via open cut • Capacity reduction due to insertion of smaller sized pipe
X	X		Pipe bursting (R)	Trenchless method for replacement of sewer pipes using an oversized bursting head to forcibly break / fracture and displace the existing pipe while simultaneously pulling in the new pipe, typically polyethylene (PE). Requires a pulling pit and in insertion pit.	• Pipe diameter sizes ranges from 2 to 36-inches. • Typical pipe upsizing is 2 pipe diameter sizes (for example from 6-inch to 10-inch or 8-inch to 12-inch diameter) depending on the depth of the existing pipe • Asbestos cement (AC) and cast-iron (CI) materials can be burst with special environmental considerations • Ductile iron pipe is not suitable for pipe bursting, but can be replaced via pipe splitting (a similar trenchless method) • Bursting lengths depend upon equipment but typically range from 300 ft to 500 feet • Side sewers need to be reconnected via open cut • New pipe configuration will reflect existing pipe conditions including sags, humps, and alignment • Cleaning should be done to remove as much debris as necessary • Repair bands on existing pipe need to be removed prior to bursting.
X	X		Fiber-reinforced Flexible Hose (R)	Pressure rated fiber-reinforced flexible hose installed in the existing pipe. Pipe deflates if not full and if host pipe fails could impact structural integrity and sewer blockages. Pipe would need to be cleaned to install. Technology is mostly used in the oil and gas industry.	• Pipe diameter sizes range from 6 to 18-inches • Continuous installations up to 2,500 linear feet • Semi-structural (collapsible hose) • Requires excavation to install tee-connections to side sewers • Liner can be installed around bends • Cleaning should be done to remove as much debris as possible • New pipe configuration will reflect existing pipe conditions including sags • Bypassing is required
X	X		Platelet technologies (R)	Platelet Technology is a new method to seal and locate leaks in pipelines. Particles or “platelets” are injected into the sewer and when the platelets reach the leak the fluid forces entrain them at the leak spot and hold them at the leak to seal the leak.	• Experimental technology to work in pressurized systems and could potentially work in semi-pressurized systems. • No connection to the side sewers and unknown if this technology could potentially seal the side sewer • Does not provide a structural fix and consequently doesn’t restore / extend the life of the pipe system • Bypassing not required
X	X		Spray-applied polymer (R)	Spray applied polymers are applied via spray machines installed in manholes or access points.	• Pipe diameter sizes range from 1 ¼ inches to 72 inches in diameter • Typically used for water quality issues (reduce rust/leaching from pressure drinking water pipes) • Limited service life • Cannot be installed in the wet • Side sewers are not impacted by this technology

Capital Improvements Toolbox Alternative Technology Descriptions

Applicable Alternative(s)			Technology	Description of Technology	Technical Envelope/Design Considerations
In-water	On-shore	Upland			
					• Bypass required • Extensive cleaning and surface prep required
	X	X	Vacuum Sewer System (NI)	A vacuum sewer or pneumatic sewer system is a method of transporting sewage from its source to a sewage treatment plant at flat or reverse grades. It maintains a partial vacuum, with an air pressure below atmospheric pressure inside the pipe network and vacuum station collection vessel. Valves open and reseal automatically when the system is used, so differential pressure can be maintained without expending much energy pumping. A single central vacuum station can collect the wastewater of several thousand individual homes, depending on terrain and the local situation.	• Size as necessary for lateral connection to the mainline (typically 6-inch) • PVC pipe material • Vertical dynamic head change needs to be less than 13 feet • Bypassing not required
		X	Grinder Pump System (NI)	A grinder pump is a wastewater conveyance system that directs sewage to a grinder pump holding tank. Once the wastewater inside the tank reaches a specific level, the pump will turn on, grind the waste into a fine slurry, and pump it to the central sewer system or septic tank. Grinder pumps convey sewerage from lower elevation at the property to a higher elevation main line.	• Size as necessary for lateral connection to the mainline (typically 6-inch) • Small diameter discharge to the mainline (2-inch) • Pumps sized as necessary based on total system head • Multiple side sewers could be connected to a single grinder pump • Bypassing not required

Notes

1. (R) = rehabilitation technology; (NI) = new installation technology
2. Rehabilitation technologies listed as applicable for On-Shore Alternatives would only be feasible where existing lake line sewers are currently on shore
3. The technical envelope is based on the most common technical envelope. This does not mean that this technology cannot be used outside this range, but additional design or construction requirements may be required to ensure that this envelope can be stretched.
4. This table is meant to be used along with Task 3.3 Capital Improvements Options Toolbox

ATTACHMENT 5
SERVICE AREA INITIAL ALTERNATIVES IDENTIFICATION SUMMARY

City of Bellevue - Lake Washington Lake Line Master Plan
Service Area Initial Alternatives Identification Summary Table

SERVICE AREA	Reach	Reach Name	Possible Alternatives															
			Within the Lake Alternatives									On-Shore Alternatives				Upland Alternatives		
			Low Pressure Sewer Line via Open Cut Construction	Low Pressure Sewer Line via Trenchless work	Cured in Place Pipe (CIPP)	SPR (Spiral Wound Pipe)	Slip lining	Pipe bursting	Fiber-reinforced Flexible Hose	Platelet technologies	Spray-applied polymer	Low Pressure / Gravity Sewer Line via Open Cut Construction	Low Pressure / Gravity Sewer Line via Trenchless work	Pipe Rehab* (CIPP, Pipe Bursting**)	Vacuum Sewer System	Gravity Line	Vacuum Sewer	Grinder Pumps
Hunts Points and Yarrow Point			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	COZ_A_1	FLUSH #1 TO YARROW PT PS	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	No	No	No	Yes
			Yes	No	No	No	No	NO	No	No	No	Yes	Yes	No	No	No	No	Yes
	COZ_A_2	YARROW PT PS TO COZY COVE PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
	COZ_B_1	HUNTS PT PS TO COZY COVE PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	COZ_B_2	FLUSH #2 TO HUNTS PT PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
Evergreen Point			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
	FWR_A_1	EVERGREEN EAST PS TO FAIRWEATHER PS	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes
	FWR_A_2	EVERGREEN WEST PS TO EVERGREEN EAST P	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes
			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	FWR_A_3	FLUSH #3 TO EVERGREEN WEST PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
Medina South			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	MED_A_1	FLUSH #3 TO LAKECREST PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	MED_A_2	LAKECREST PS	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	No	No	No	Yes
	MED_A_3	MEDINA CITY HALL PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
Meydenbauer Bay			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	PKR_A_1	FLUSH #5 TO PARKER PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	BEL_A_1	PARKER PS TO GRANGE PS	Yes	No	No	No	Yes	No	No	No	No	Yes	Yes	No	No	No	No	Yes
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes
Killarney			Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes
	SWL_A_1	FLUSH #7 TO KILLARNEY PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
	SWL_A_2	KILLARNEY PS	Yes	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	Yes
Newport South			Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes

NOTES: * Could consider slip lining existing pipe if grinder pumps are considered
** AC pipe may have concerns over asbestos materials with pipe bursting. Confirm with policy / community

ATTACHMENT 6
KEY COST ESTIMATING ASSUMPTIONS

Construction Hard Cost Estimate Key Assumptions by Alternative. See estimate details for additional information.

	Applicable to All Alternatives	In-Water	On-Shore (Open Cut)	On-Shore (Trenchless)	Upland
Additional Work Windows and Additional Mobilizations/ Demobilizations	• Work window for Points and Evergreen is between 7/16 to 3/15 • Work window for Medina South, Meydenbauer Bay, and Killarney is between 7/16 to 4/30 • Work window for Newport South is between 7/16 to 12/31	Assumed pipeline production rate - 25 LF/day	Assumed pipeline production rate - 50 LF/day	Assumed pipeline production rate - 30 LF/day	Assumed that some grinder pumps are located close to the shoreline and will still need to adhere to fish/work windows during construction.
Clearing/Demolition for New Lateral and Sewer Line Connections		Disturbed area for connections assumed to be 20 ft x 20 ft, unit cost assumes 35% of areas require minimal demolition and 65% of areas require moderate demolition. Location of new connections assumed to avoid areas with maximum demolition.	Connections assumed within cleared areas for new sewer mains; no additional clearing or demo required.	Work will be done in 20 ft x 20 ft areas; unit cost assumes 35% of areas require minimal demolition and 65% of areas require moderate demolition. New connections will avoid areas with maximum demolition.	No new lateral and sewer line connections needed since alternative technology is to install grinder pumps (see item below on grinder pumps).
Clearing/Demolition for New Sewer Main, Grinder Pumps, Grinder Pump Discharge Pipe		N/A	Sewer Main: 20 ft wide area along pipe alignment, unit cost assumes 35% of area requires minimal demolition and 60% of area requires moderate demolition, and 5% of area requires maximum demolition. Assumes alignment would attempt to avoid maximum demolition areas.	Trenchless Access Pits: 50 ft by 30 ft area, access pits located every 250 ft along alignment, assume locate pits to avoid maximum clearing and demolition areas.	Grinder Pumps: 30 ft by 30 ft area, unit cost assumes 35% of area requires minimal demolition and 60% of area requires moderate demolition. Discharge Pipe: 15 ft wide area along pipe alignment, unit cost assumes 50% of area requires minimal demolition and 50% of area requires moderate demolition. Assume grinder pump locations and pipe alignments designed to avoid maximum demolition areas.
Tree Removal / Mitigation	Assumed percentages of tree removal for each area based on review of Google aerial images, varies by location.				
Temporary Erosion and Sediment Control	Minimal to moderate TESC assumed for all alternatives				
Permitting	Assumed 4% permitting soft costs in the "Engineering / Design" component of the estimate to	Permit costs are excluded from estimate of construction hard costs.	Permits are excluded from estimate of construction hard costs.	Permits are excluded from estimate of construction hard costs.	Permits are excluded from estimate of construction hard costs.

	Applicable to All Alternatives	In-Water	On-Shore (Open Cut)	On-Shore (Trenchless)	Upland
	cover permit work during design. Estimates do not account for permitting costs that will be required during construction.	Is assumed permits can be obtained for in-water work.			
Sewer Pipe		Pipe material and size for new sewer pipe is 8” epoxy lined ductile iron; anchor blocks 10 ft on center, sloped trench excavation, imported backfill. Divers support pipe installation. Access maintenance holes (MHs) spaced at 1,000 ft.	Pipe material and size for new sewer pipe is 8” SDR35 PVC, average cut depth of 10 ft assumed, imported backfill. Assume contractor access to work area is from lake. MHs spaced at 400 ft.	Pipe material and size for new sewer pipe is SDR35 PVC pipe in steel casing, trenchless pits spaced every 250 ft. Assume contractor access to work area is from lake. MHs spaced at 250 ft.	Pipe material and size for new sewer pipe is 8” SDR35 PVC pipe. Pipe installed by open cut methods, MHs spaced at 400 ft. Upland system will be gravity-fed.
Sewer Lateral Connection / Cleanout		City of Bellevue (CoB) Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection and cleanout located on shore, assume 100 ft pipe per lateral installed from connection to new lake line, with anchor blocks 10 ft on center, 2 ft cover over anchor blocks, sloped trench excavation,100% imported backfill.	CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection and cleanout located on shore, assume 10 ft pipe per lateral connection.	CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection and cleanout located on shore, assume 75 ft pipe per lateral connection to extend to new MHs in lieu of connecting to sewer pipe inside trenchless casing.	N/A
Grinder Discharge Pipe		N/A	N/A	N/A	Open cut installation from new grinder pump to sewer pipe, 6-inch max diameter PVC pipe assumed, 3 ft cover, 100% imported backfill, etc.
Restoration	Minimal restoration assumes sod, moderate restoration assumes landscape with minimal hardscape, maximum restoration assumes landscape and hardscape/structures. Assumed percentages for each area based on review of Google aerial images. Assume work areas and alignments would minimize work in maximum impact areas.				
Pavement Restoration		Not applicable for in water alternative	Not applicable for on shore (open cut) alternative	Not applicable for on shore (trenchless) alternative	8” Sewer Line – 4 ft wide Temporary pavement patch (2” AC, 4” CSBC) and 6 ft wide permanent pavement patch (2” AC, 4” CSBC). Mill and resurface 1 lane only.

	Applicable to All Alternatives	In-Water	On-Shore (Open Cut)	On-Shore (Trenchless)	Upland
Pump Station Rehab	Full replacement of pumps, pipe, valves. No change in pump capacity unless noted otherwise for Upland alternative. Full replacement of electrical, instrumentation and controls, and generator (if applicable). Temporary pumped bypass assumed during equipment replacement. Full replacement of PS structures is excluded. Rehabilitation scope varies by PS and is based on findings in 2015 Wastewater Pump Station Evaluation Report prepared by Murray, Smith & Associates. Rehab scope generally includes recoating interior of wet well, installation of dry well exhaust fan and replacement of blower components for area classification requirements, installation of connection to enable pumped bypass of PS, and ancillary PS and site improvements noted in 2015 report.				Abandonment of pump station is assumed only if collected flows are mostly directed along existing lake lines; otherwise pump station rehab will be similar to that of in-water and on-shore alternative. New force mains required in some circumstances to redirect flows from lake line system back up to mainline gravity sewer.
Flush Station Rehab	Full replacement of pumps, pipe, valves, electrical and instrumentation and controls. Two constant speed pumps assumed at each Flush Station. Excludes replacement of Flush Station structure. Excludes temporary bypass, assume no flushing occurs during construction. Replace existing lake intake pipe with 8-inch or smaller pipe. Length varies by location.				Flush stations assumed to be abandoned

ATTACHMENT 7
FLUSH STATION COST ESTIMATING ASSUMPTIONS

City of Bellevue Lake Washington Lake Line Master Plan - Flushing Stations
Flush Stations Scope / Assumptions / Cost - Class 5 OPCC
June 2023

Area	**Points**				**Evergreen Point**		**Medina**	
	Flush Station No. 1		**Flush Station No. 2**		**Flush Station No. 3**		**Flush Station No. 4**	
FS Description								
Construction Year	1960s		1960s		1960s		1960s	
Rehab Year	2004		2004		1999		2004	
Configuration	Self-Priming Station		Self-Priming Station		Dry Pit Station		Self-Priming Station	
Capacity	240 gpm		240 gpm		240 gpm		240 gpm	
Recommended Work								
Scope ID	**Description**	**2023 OPCC**		**2023 OPCC**		**2023 OPCC**		**2023 OPCC**
1	Replace pumps motors and motor drivers		Replace pumps motors and motor drivers		Replace pumps motors and motor drivers		Replace pumps motors and motor drivers	
	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$180,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000
2	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000
3	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000
4	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000
5	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$990,000	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$2,310,000	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$198,000	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$231,000
	L = 900 LF		L = 2,100 LF		L = 180 LF		L = 210 LF	
	EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation	
	EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.	
	EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)	
	Subtotal	**$1,390,000**	**Subtotal**	**$2,710,000**	**Subtotal**	**$613,000**	**Subtotal**	**$631,000**
	WA State Sales Tax - 10.1%	$140,000	WA State Sales Tax - 10.1%	$270,000	WA State Sales Tax - 10.1%	$60,000	WA State Sales Tax - 10.1%	$60,000
	Subtotal with Tax	$1,530,000	Subtotal with Tax	$2,980,000	Subtotal with Tax	$673,000	Subtotal with Tax	$691,000
	Contingency - 30%	$460,000	Contingency - 30%	$890,000	Contingency - 30%	$200,000	Contingency - 30%	$210,000
	Total	**$1,990,000**	**Total**	**$3,870,000**	**Total**	**$873,000**	**Total**	**$901,000**

City of Bellevue Lake Washington Lake Line Master Plan - Flushing Stations
Flush Stations Scope / Assumptions / Cost - Class 5 OPCC
June 2023

Area	**Meydenbauer Bay**		**Killarney**				**Newport South**	
	Flush Station No. 5		**Flush Station No. 6**		**Flush Station No. 7**		**Flush Station No. 8**	
FS Description								
Construction Year	1955		1960s		1960s		1960s	
Rehab Year	2012		2004		2004		2004	
Configuration	Self-Priming Station		Self-Priming Station		Self-Priming Station		Self-Priming Station	
Capacity	240 gpm		240 gpm		240 gpm		240 gpm	
Recommended Work								
Scope ID		**2023 OPCC**		**2023 OPCC**		**2023 OPCC**		**2023 OPCC**
1	Replace pumps motors and motor drivers		Replace pumps motors and motor drivers		Replace pumps motors and motor drivers		Replace pumps motors and motor drivers	
	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000	Assume two pumps (constant speed?) per station, incl. pump starter panel, valves and piping (material allowance)	$165,000
2	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000	Rehab Structure - Allowance	$30,000
3	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000	Replace electrical equipment - Assume includes main panelboard, conduit, wire. No change to power meter/service entrance.	$70,000
4	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000	Replace telemetry equipment - Assume control panel and primary and secondary level measurement, RTU, telephone modem and network interface	$135,000
5	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$247,500	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$110,000	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$99,000	Replace intake pipe @ $1,100 / LF - Assume 8-inch or smaller, installed into the Lake, incl. barge access, TESC, bathymetric survey, 8" DI pipe, 4 ft cut, imported backfill, minimal on-shore TESC and restoration.	$660,000
	L = 225 LF		L = 100 LF		L = 90 LF		L = 600 LF	
	EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation		EXCLUDES Temporary Construction / Bypass - assumes Flush Station out of service during rehabilitation	
	EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.		EXCLUDES generator receptacle or generator replacement.	
	EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)		EXCLUDES - interior lining of flushing station, HVAC rehab (if any at existing stations)	
	Subtotal	**$647,500**	**Subtotal**	**$510,000**	**Subtotal**	**$499,000**	**Subtotal**	**$1,060,000**
	WA State Sales Tax - 10.1%	$70,000	WA State Sales Tax - 10.1%	$50,000	WA State Sales Tax - 10.1%	$50,000	WA State Sales Tax - 10.1%	$110,000
	Subtotal with Tax	$717,500	Subtotal with Tax	$560,000	Subtotal with Tax	$549,000	Subtotal with Tax	$1,170,000
	Contingency - 30%	$220,000	Contingency - 30%	$170,000	Contingency - 30%	$160,000	Contingency - 30%	$350,000
	Total	**$937,500**	**Total**	**$730,000**	**Total**	**$709,000**	**Total**	**$1,520,000**

CITY OF BELLEVUE - LAKE LINES - FLUSH STAION (xx)
OPINION OF PROBABLE CONSTRUCTION COST - CLASS 5

JUNE 2023
ENR CCI: xxxxx

No.	Spec. Sect.	Description	Unit	Qty	Burdened Labor $$ Unit	Burdened Labor $$ Total	Material $$ Unit	Material $$ Total	Equipment $$ Unit	Equipment $$ Total	Subcontractor $$ Unit	Subcontractor $$ Total	Total	Bid Item
Flush Station - Intake Pipe														
		Div 01 - General Requirements												
1		General Conditions	LS	1	$32,000	$32,000	$26,500	$26,500	$32,000	$32,000		$0	$90,500	
2		Bathymetric Survey - 20 ft wide assumed	SF	18,000		$0		$0		$0	$7.09	$127,559	$127,559	
3		On Shore TESC (Allowance) - see turbidity curtain for in water TESC	LS	1		$0		$0		$0	$5,000.00	$5,000	$5,000	
4		Fish Exclusion / Salvage (Allowance) - Intial and daily checks, from above water surface, no divers	LS	1		$0		$0		$0	$15,000.00	$15,000	$15,000	
		Div 02 - Existing Conditions												
5		Remove Existing Lake Line	LF	900	$8.27	$7,440		$0	$10.00	$9,000	$3.06	$2,750	$19,190	
		Div 31 - Earthwork												
		Div 32 - Exterior Improvements												
6		On Shore - Property Restoration (Allowance)	LS	1		$0		$0		$0	$20,000.00	$20,000	$20,000	
		Div 40												
7		8 - inch DI CL 350 cement lined	LF	900	$17.00	$15,300	$96.53	$86,880	$10.00	$9,000		$0	$111,180	
8		Turbidity Curtain - Type 2, Anchored, 14 ft Deep, Installed / Removed	LF	1820		$0		$0		$0	$7.87	$14,330	$14,330	
9		Earthwork - Pipe												
10		Excavation - by hand, 10% of total	CY	40	$270.00	$10,800		$0		$0		$0	$10,800	
11		Excavation - 4 ft cut, excavate into dewatering sacks / tanks	CY	360	$95.00	$34,200	$43.75	$15,750	$25.70	$9,250		$0	$59,200	
12		Staging - unload from barge	CY	400	$30.50	$12,200		$0	$25.70	$10,280		$0	$22,480	
13		Haul-off site, 20 mi RT, Recycle Excavated Material	CY	460		$0		$0		$0	$51.00	$23,460	$23,460	
14		Bedding / Backfill - incl. divers	CY	400	$105.00	$42,000	$107.00	$42,800	$26.00	$10,400	$67.50	$27,000	$122,200	
15		Barge Mobilization, Demobilization (Allowance) - 1 barge, 1 pusher	LS	1		$0		$0		$0	$35,000.00	$35,000	$35,000	
16		Movable Barge / Pusher - Rental, incl. Pusher Operator	MTH	1		$0		$0		$0	$114,200.00	$114,200	$114,200	
17						$0		$0		$0		$0	$0	
		Subtotals				$153,940		$171,930		$79,930		$384,299	$790,099	

WA Gross Receipts Sales Tax @ Applied to Estimate Total	**0.00%**	$0
Labor Burden @	**45.0%**	$69,300
Bonds On Subs @	**1.5%**	$5,800
Subtotal		$865,200
Fee @	**12.0%**	$103,800
Insurance & Bonds @	**2.0%**	$19,400
Estimated Construction Cost (without Contingency)		**$988,400**
AFI @		$0
WA Gross Receipts Sales Tax @		$0
Estimated Construction Cost (with Contingency)		**$988,400**

Assumptions

Basis is Flush Station No. 1

UOM	LF
Qty	900
Unit Cost	$1,100

ATTACHMENT 8
PUMP STATION COST ESTIMATING ASSUMPTIONS

City of Bellevue Lake Washington Lake Line Master Plan - Pump Stations
Pump Stations Scope / Assumptions / Cost - Class 5 OPCC
June 2023

	Area	Points						Evergreen Point			
		Yarrow Pt PS	2023 costs	Cozy Cove PS	2023 costs	Hunts Point	2023 costs	Evergreen East PS	2023 costs	Evergreen West	2023 costs
1	**Pump Station - Wet Well**										
	Class 1, Div 1										
	Dimensions. concrete, coated	*12 x 8.5 ft*		*15 x 10 ft*		*12 x 8.5 x 12.5 ft deep*		*12 x 8.5 ft*		*12 x 8.5 ft*	
	Misc.	*MH access lid, ladder, internal FRP platform with railing, no fall protection, lighting, supply fan*		*MH access lid, ladder, internal FRP platform with railing, no fall protection, lighting, supply fan*		*lift access hatch (H-20), ladder, internal FRP platform with railing, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*	
a	**Recoat Interior** - *costs in line with 2015 estimate, system used for recoating is not indicated in report*	Recoat interior	$75,000	Recoat interior, exposed aggregate	$130,000	Recoat interior	$70,000	Recoat interior	$75,000	Recoat interior	$75,000
b	**New Hatch**	N/A				hatch is fatiguing due to truck traffic	$25,000				
c	**Repair FRP rails / grading**										
d	**Replace corroded overflow**										
2	**Pump Station - Dry Pit**										
	Class 1, Div 2										
	Dimensions. Concrete	*12 x 8.5 ft (coated?)*		*15 x 8.5 ft*		*12 x 8.5, concrete*		*12 x 8.5*		*12 x 8.5, concrete*	
	Misc.	*access hatch, spiral staircase, no fall protection, lighting, supply fan*		*access hatch, spiral staircase, no fall protection, lighting, supply fan - metal grating to access stair case deflects under*		*access hatch, spiral staircase, one side fall protection, lighting, supply fan*		*access hatch, spiral staircase, no fall protection, lighting, supply fan*		*access hatch, spiral staircase, no fall protection, lighting, supply fan*	
	Lifting	*chain hoist / trolley*		*trolley chain hoist and rail*		*chain hoist / trolley*		*trolley chain hoist and rail*		*chain hoist / trolley*	
	Dry pit sump pump										
	Supply fan	*centrifugal 820 cfm, near ceiling in dry pit*		*centrifugal 975 cfm, near ceiling in dry pit*		*10 ft AFF, 820 cfm*		*unknown*		*10 ft AFF , unknown cfm*	
a	**Install exhaust fan** (Classified space requires ventilation or explosion proof equipment)	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000
b	**Recoat Interior**	N/A		N/A		N/A					
c	**New Hatch**	N/A		N/A		hatch is fatiguing due to truck traffic	$25,000				
d	**Upgrade HVAC**										
3	**Wet Well Blower Vault (houses supply fan for wet well)**										
	Class 1, Div 2										
	Dimensions. Concrete	*6.33 x 6.33 x 4 ft*		*5.5 x 3.5 x ?*		*5 x 5 x 5 ft*		*9.17 x 3.5 x 4 ft*		*4 x 8 x 5, concrete*	
	access hatch, ladder, no fall protection, no lighting, no ventilation										
	Centrifugal fan	*560 cfm, 2 speed fan*		*975 cfm*		*560 cfm*		*unknown*		*unknown*	
a	**Not built to area Classification** - replace components to meet classification	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000
b	**relocate wet well vent** to prevent future corrosion of new electrical service cabinet	N/A		relocate wet well vent to prevent future corrosion of new electrical service cabinet - duct and new vent/hood (Allowance)	$15,000	N/A		N/A		N/A	
c	**New Hatch**	N/A		N/A		hatch is fatiguing due to truck traffic	$25,000	N/A		N/A	
4	**Mechanical**										
a	**Replace pumps**	Replace 2 pumps (existing - 325 gpm, 18 ft TDH) - incl. piping, valves	$240,000	Replace 3 pumps (600 gpm, 65 ft TDH) - incl. piping, valves	$360,000	Replace 2 pumps (300 gpm, 17 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (250 gpm, 14 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (250 gpm, 16 ft TDH) - incl. piping, valves	$240,000
b	**Boom Truck to support pump replacement**										
c	**Bypass pumping during construction - Allowance**		$150,000		$150,000		$150,000		$150,000		$150,000
5	**Electrical**										
	System Description	*315 kva, 3 phase, overhead*									
	Service meter	*on pole adjacent to dry pit*		*metal service cabinet, panelboard in dry pit, utility transformer in generator vault*		*utility transform underground, service meter on wood pole base*		*pad mounted utility transformer, outdoor pedestal mount service meter*			
	Panelboard	*120/208/3 phase, in dry pit*				*in dry pit*					
	Starters	*120/208, two FVNR starters*		*klockner-moeller starter and circuit breakers are obsolete*		*2 FVNR starters*					
a	**Replace electrical equipment**	Replace all electrical equipment	$150,000	Replace electrical equipment	$225,000	Replace all electrical equipment	$150,000	Replace electrical equipment	$150,000	Replace electrical equipment	$150,000
	Panelboard										
	Starters										
	Wire and conduit										
	City Owned Meter Base	Replace Galvanized Conduit				replace city owned meter base					
	Fused Disconnect	Replace fused disconnect				replace service entrance disconnect					
b	**Service Cabinet Work**	N/A		replace service cabinet- on concrete pad	$20,000						

	Area	Medina				Meydenbauer Bay					
		Lake Crest	2023 costs	Medina Pump Station	2023 costs	Parker PS (No info. on PS)	2023 costs	Grange PS	2023 costs	Meydenbauer	2023 costs
1	**Pump Station - Wet Well**										
	Class 1, Div 1										
	Dimensions. concrete, coated	*12 x 8.5 x 12 ft*				No info - assume avg costs in line with other PS		*8 ft diam, 20 ft deep, concrete, PVC liner*		*12 x 8.5 x 13.5 ft*	
	Misc.	*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*								*access hatch, ladder, platform grating, no fall protection, lighting, supply fan*	
a	**Recoat Interior** - *costs in line with 2015 estimate, system used for recoating is not indicated in report*	Recoat interior	$85,000	recoat interior - assume	$95,000	Recoat interior	$95,000	NO RECOATING		Recoat interior	$95,000
b	**New Hatch**										
c	**Repair FRP rails / grading**			repair FRP rails / grading	$15,000						
d	**Replace corroded overflow**			replace corroded overflow pipe	$5,000						
2	**Pump Station - Dry Pit**										
	Class 1, Div 2									*no equipment access hatch*	
	Dimensions. Concrete	*12 x 8.5 x 12 ft, concrete*						*8 ft diam, 20 ft deep*		*12 x 10 x 13.5 ft*	
	Misc.	*step over open space to reach stair landing, access hatch, spiral stair case, no fall protection, lighting, supply fan*								*access hatch, spiral stair case, has fall protection, lighting, supply fan, no equipment access hatch*	
	Lifting	*chain hoist / trolley*		*unknown*				*boom truck*			
	Dry pit sump pump										
	Supply fan	*12 ft AFF, 820 cfm*								*5 ft AFF, 1300 cfm*	
a	**Install exhaust fan** (Classified space requires ventilation or explosion proof equipment)	Install Exhaust Fan	$35,000			assumed part of scope	$40,000	Install Exhaust Fan	$40,000	Install Exhaust Fan	$40,000
b	**Recoat Interior**							Recoat interior	$75,000		
c	**New Hatch**										
d	**Upgrade HVAC**			upgrade HVAC in dry pit - supply and exhaust fan	$60,000						
3	**Wet Well Blower Vault (houses supply fan for wet well)**										
	Class 1, Div 2										
	Dimensions. Concrete	*5 x 5 x 5 ft*						*5 x 5 x 5, concrete*		*4 x 5 x 4 ft*	
	access hatch, ladder, no fall protection, no lighting, no ventilation										
	Centrifugal fan	*560 cfm*								*400 xfm*	
a	**Not built to area Classification** - replace components to meet classification	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	assume this is needed - need to confirm	$14,000	assume this is needed - need to confirm	$14,000	component replacement not mentioned in report - assume not needed bc components meet area classification -		component replacement not mentioned in report - assume not needed bc components meet area classification -	
b	**relocate wet well vent** to prevent future corrosion of new electrical service cabinet	N/A		N/A		N/A		N/A		N/A	
c	**New Hatch**	N/A		N/A		N/A		N/A		N/A	
4	**Mechanical**										
a	**Replace pumps**	Replace 2 pumps (300 gpm, 17 ft TDH) - incl. piping, valves	$240,000	Replace Pumps - two 15 hp pumps, ~350 gpm at 67.5 ft	$240,000	assumed 2 pumps, confirm	$240,000	Replace 2 pumps (350 gpm, 84 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (300 gpm, 57 ft TDH) - incl. piping, valves	$240,000
b	**Boom Truck to support pump replacement**							need boom truck to remove pumps	$10,000		
c	**Bypass pumping during construction - Allowance**		$150,000		$150,000		$150,000		$150,000		$150,000
5	**Electrical**										
	System Description										
	Service meter	*pad mount utility transformer, service meter on steel rack near gate*						*pad mounted utility transformer,*		*transformer unknown, service meter outside of service cabinet*	
	Panelboard									*in dry pit*	
	Starters	*2 FVNR Starters*								*2 FVNR Starters*	
a	**Replace electrical equipment**	Replace electrical equipment	$150,000	Replace electrical equipment	$175,000	Replace electrical equipment	$150,000	Replace electrical equipment	$175,000	Replace electrical equipment	$150,000
	Panelboard										
	Starters										
	Wire and conduit			Class 1 Div 2 (no continuous ventilation)							
	City Owned Meter Base										
	Fused Disconnect	needs replacement		none of electrical equipment rated for classified area							
b	**Service Cabinet Work**									Electrical service cabinet - repair bottom of cabinet	$4,500

	Area	Killarney		Newport South			
		Killarney	2023 costs	Pleasure Point	2023 costs	Bagley	2023 costs
1	**Pump Station - Wet Well**						
	Class 1, Div 1						
	Dimensions. concrete, coated	*12 x 8.5 x 13.5 ft*		*12 x 8.5 x 13.5 ft*		*12 x 8.5 x 13.5 ft*	
	Misc.	*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*		*access hatch, ladder, platform grating, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, no lighting, supply and exhaust (odor control) fans*	
a	**Recoat Interior** - *costs in line with 2015 estimate, system used for recoating is not indicated in report*	Recoat interior	$95,000	Recoat interior	$95,000	Recoat interior	$95,000
b	**New Hatch**						
c	**Repair FRP rails / grading**						
d	**Replace corroded overflow**						
2	**Pump Station - Dry Pit**						
	Class 1, Div 2	*no equipment access hatch*		*no equipment access hatch*		*no equipment access hatch*	
	Dimensions. Concrete	*12 x 8.5 x 13.5 ft*		*12 x 10 x 17 ft, 8.5 ft first level*		*12 x 10 x 13.5 ft*	
	Misc.	*access hatch, spiral stair case, has fall protection, lighting, supply fan, no equipment access hatch*		*access hatch, ladder to first level, spiral stair case, no fall protection, lighting, supply fan, no equipment access hatch*		*access hatch, spiral stair case, with fall protection, lighting, supply fan, no equipment access hatch*	
	Lifting						
	Dry pit sump pump						
	Supply fan	*5 ft AFF, 1300 cfm*		*5 ft AFF, 1450 cfm*		*5 ft AFF, 1,300 cfm*	
a	**Install exhaust fan** (Classified space requires ventilation or explosion proof equipment)	Install Exhaust Fan	$40,000	Install Exhaust Fan	$40,000	Install Exhaust Fan	$40,000
b	**Recoat Interior**						
c	**New Hatch**						
d	**Upgrade HVAC**						
3	**Wet Well Blower Vault (houses supply fan for wet well)**						
	Class 1, Div 2						
	Dimensions. Concrete	*4 x 4 x 4 ft*		*5 x 5 x 5 ft*		*4 x 4 x 4 ft*	
	access hatch, ladder, no fall protection, no lighting, no ventilation	*has fall protection*				*has fall protection*	
	Centrifugal fan	*400 cfm*		*685 cfm*		*400 cfm supply, 400 cfm wet well exhaust (odor control fan in vault)*	
a	**Not built to area Classification** - replace components to meet classification	component replacement not mentioned in report - assume not needed bc components meet area classification -		component replacement not mentioned in report - assume not needed bc components meet area classification -		component replacement not mentioned in report - assume not needed bc components meet area classification -	
b	**relocate wet well vent** to prevent future corrosion of new electrical service cabinet	N/A		N/A		N/A	
c	**New Hatch**	N/A		N/A		N/A	
4	**Mechanical**						
a	**Replace pumps**	Replace 2 pumps (350 gpm, 15.5 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (125 gpm, 12 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (300 gpm, 36 ft TDH) - incl. piping, valves	$240,000
b	**Boom Truck to support pump replacement**						
c	**Bypass pumping during construction - Allowance**		$150,000		$150,000		$150,000
5	**Electrical**						
	System Description						
	Service meter	*transformer unknown, service meter outside of service cabinet*		*overhead, 2 utility transformers, service meter on side of service cabinet*		*pad mount utility transformer, service meter on side of service cabinet*	
	Panelboard	*in dry pit*		*in dry pit*		*in dry pit*	
	Starters	*2 FVNR Starters*		*2 FVNR Starters*		*2 FVNR Starters*	
a	**Replace electrical equipment**	Replace electrical equipment	$150,000	Replace electrical equipment	$150,000	Replace electrical equipment	$150,000
	Panelboard						
	Starters						
	Wire and conduit						
	City Owned Meter Base						
	Fused Disconnect					needs replacement	
b	**Service Cabinet Work**	Electrical service cabinet - repair bottom of cabinet	$4,500	Electrical service cabinet - repair bottom of cabinet	4500	Electrical service cabinet - assume replace cabinet	$20,000

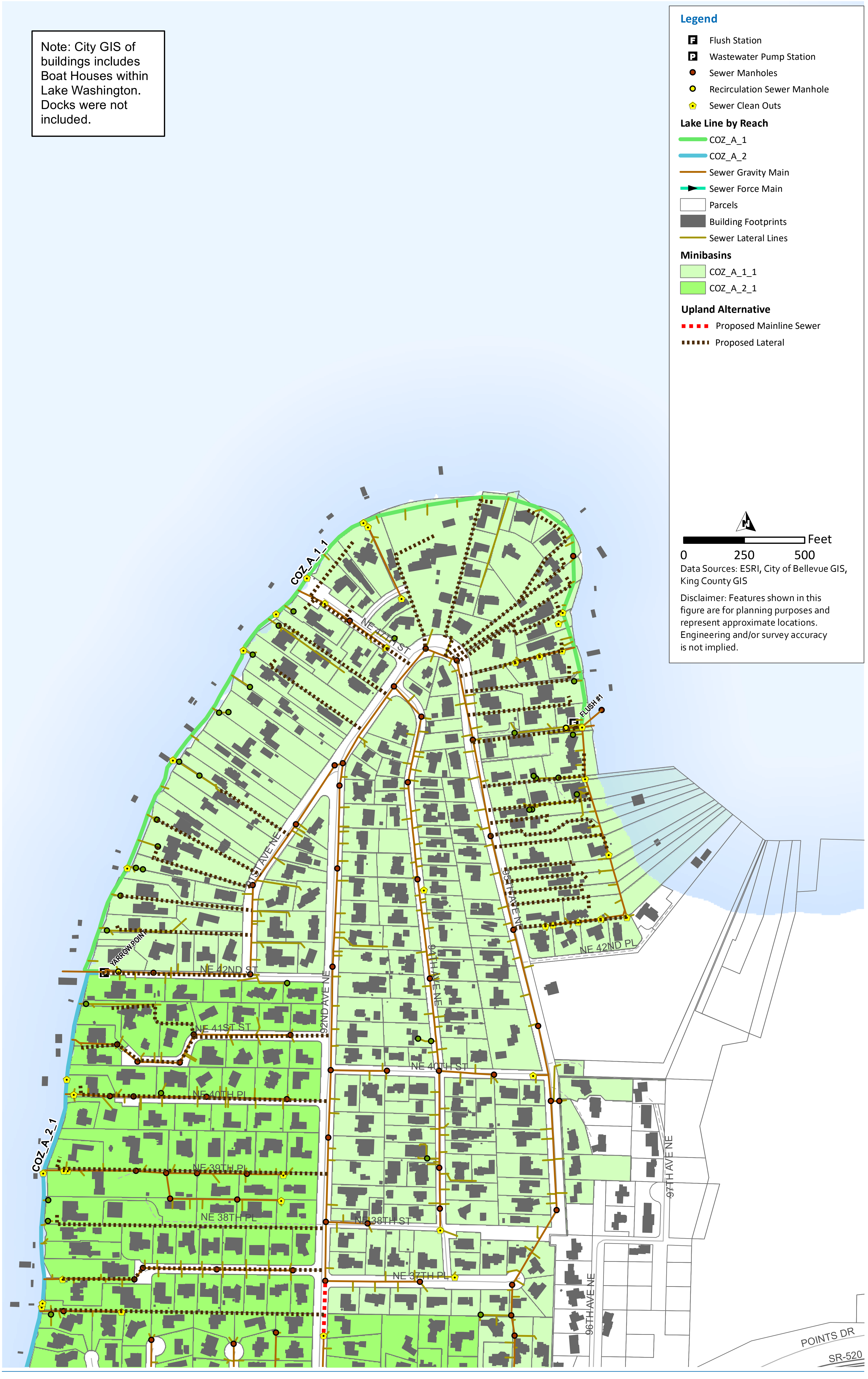
City of Bellevue Lake Washington Lake Line Master Plan - Pump Stations
Pump Stations Scope / Assumptions / Cost - Class 5 OPCC
June 2023

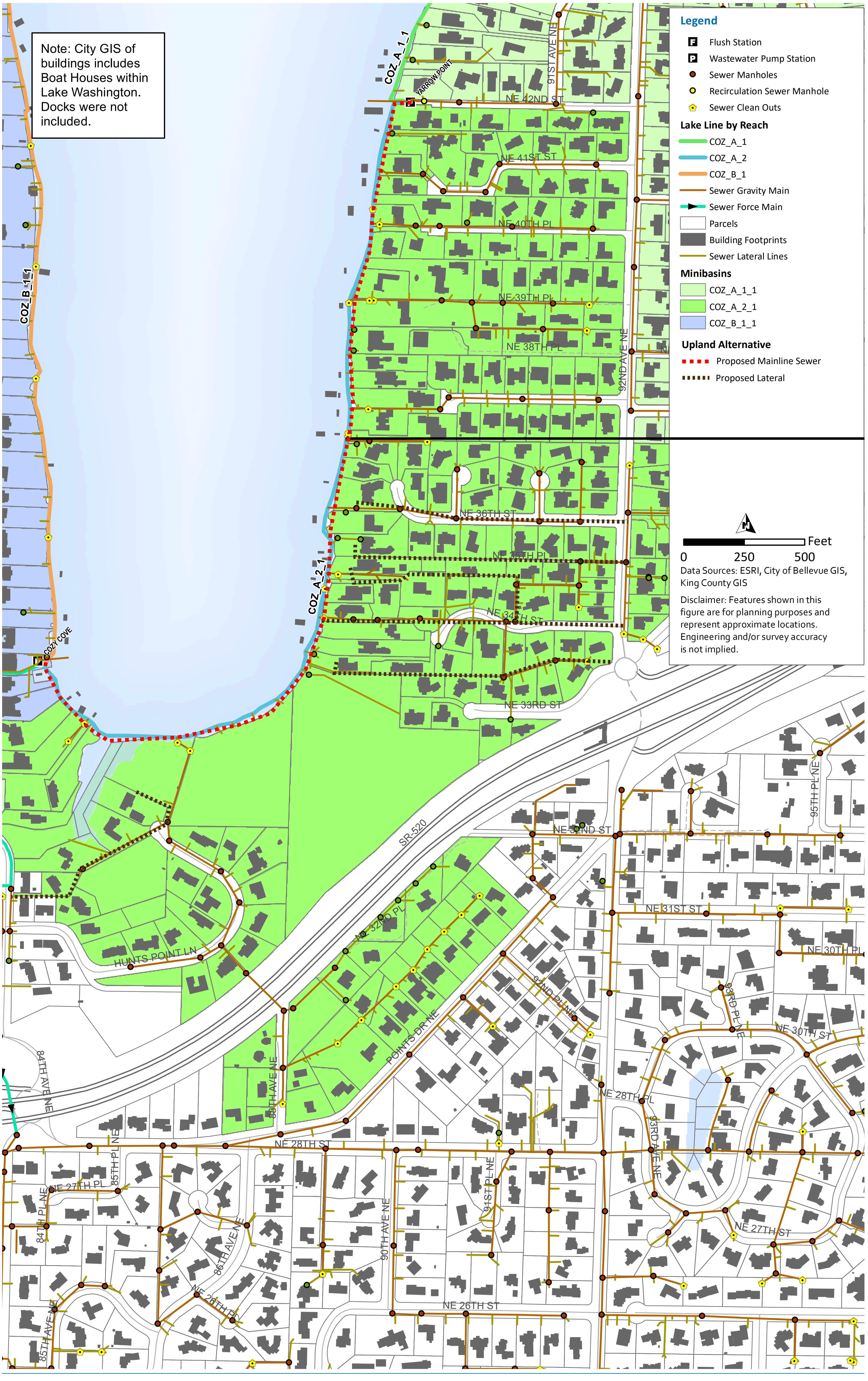
	Area	Points					
		Yarrow Pt PS	2023 costs	Cozy Cove PS	2023 costs	Hunts Point	2023 costs
6	**Generator**						
	Back up power source	*generator receptacle, manual transfer*		*generator 55kW, diesel in vault*		*generator receptacle, manual transfer switch*	
	Generator Vault	*N/A*		*Generator vault (8 x 14 x 8)*		*N/A*	
a	Replace standby generator, 55 kW, diesel	N/A		Replace standby generator, 55 kW, diesel	$210,000	N/A	
b	Replace vault dehumidifier	N/A		N/A		N/A	
c	install automatic primer on drain line to wet well	N/A		N/A		N/A	
d	Replace sound-proof insulation material in generator vault	N/A		N/A		N/A	
7	**Instrumentation and Control / Telemetry**						
	telemetry control panel	*in dry pit*		*in dry pit*		*in dry pit*	
	primary level	*ultrasonic siemens multiranger*		*ultrasonic siemens multiranger 100*		*ultrasonic siemens multiranger*	
	secondary level	*high level float*		*high level float*		*high level float*	
	RTU/PLC	*siemens/simatic s7-200*		*siemens/simatic S7-200*		*siemens/simatic S7-200*	
	telephone modem	*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*	
	telephone network interface	*overhead, top of qwest pole*		*in dry pit*		*oversized outdoor panel*	
a	Replace I&C system	Replace all	$135,000	Replace all	$135,000	Replace all	$135,000
b	telephone network interface	replace / relocate lower on existing pole	included with replace all			replace	included with replace all
8	**Washdown water**						
	System descriptions	*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*	
	Device	*RPBF*		*RPBF*		*RPBF*	
	Enclosure / Freeze protection	*below ground water meter box, insulation box, bags*		*in generator vault, heat tape for freeze protection*		*existing is above grade in two stacked meter boxes between supply vents*	
a	**Install backflow assembly above grade in an enclosure, install drain**	Install backflow assembly above grade in an enclosure, install drain	$8,500	N/A		N/A	
9	**Miscellaneous PS Work**						
a	**Install Connections to enable Pumped Bypass of PS** (cost basis Newport Shores PS - Pump Suction and Discharge	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000
b	**ancillary components**						
b1	Access Hatch Fall Protection for dry pit and wet well blower vault	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000
b2	Raise cover (operator) for FM isolation valve	N/A		FM isolation valve buried, need to excavate and raise	$5,000	N/A	
b3	clear brush at intake	N/A		N/A		N/A	
10	**Site / Access**						
	Vehicle access - MOT	*public access path to lake, removable bollards*	$10,000	*gravel pull off for generator vault, use property driveway to access PS*	$5,000	*end of Hunts Pt Rd cul de sac, parking adjacent to station*	$25,000
	Landscaping - Restoration	*grass*	$10,000	*landscaped, service cabinet overgrown with bushes*	$20,000	*concrete pavement*	$0
	Sight Lighting - no changes	*none*		*none*		*none*	$0
	Fence / Security - no changes	*lockable hatch - dry pit, lockable MH - wet well*		*raised hatch over wetwell and dry well with lock*		*none*	$0
	Public Accessibility	*full access / public access to lake*		*PS on private lot, generator vault and service cabinet accessible on side of road*		*full access to site*	$0
		subtotal - direct costs	$877,500		$1,374,000		$944,000
	10.10%	sales tax	$89,000		$139,000		$95,000
	0%	ELA	$0		$0		$0
	30%	Contingency	$27,000		$42,000		$29,000
		Total	$990,000		$1,560,000		$1,070,000

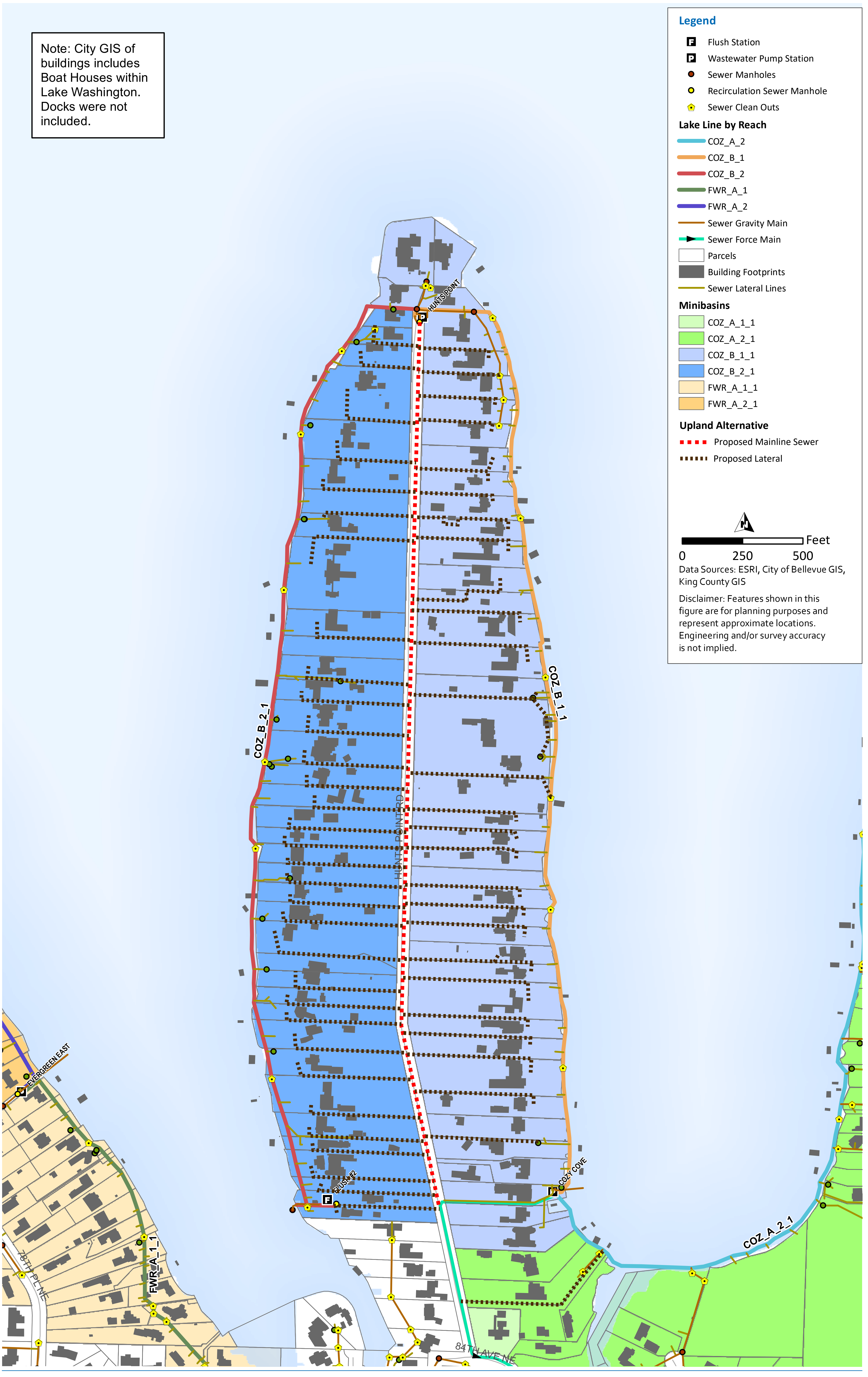
	Area	Evergreen Point				Medina			
		Evergreen East PS	2023 costs	Evergreen West	2023 costs	Lake Crest	2023 costs	Medina Pump Station	2023 costs
6	**Generator**								
	Back up power source	*generator receptacle, manual transfer switch*		*generator receptacle, manual transfer switch*		*generator receptacle, on steel rack near gate, manual transfer switch*		*54 kW generator, in vault*	
	Generator Vault	*N/A*		*N/A*		*N/A*		*vault dimension unknown*	
a	Replace standby generator, 55 kW, diesel	N/A		N/A		N/A		need to confirm if replacing generator	$210,000
b	Replace vault dehumidifier	N/A		N/A		N/A		replace dehumidifier for vault	$5,000
c	install automatic primer on drain line to wet well	N/A		N/A		N/A			
d	Replace sound-proof insulation material in generator vault	N/A		N/A		N/A			
7	**Instrumentation and Control / Telemetry**								
	telemetry control panel	*in dry pit, Siemens CDP-7 Series 8*		*in outdoor junction box*		*in dry pit, integral panel with starters*			
	primary level	*ultrasonic siemens hydroranger 100*		*ultrasonic siemens hydroranger 100*		*ultrasonic siemens multiranger 100*			
	secondary level	*high level float*		*high level float*		*high level float*			
	RTU/PLC	*siemens/simatic S7-200*		*siemens/simatic S7-200*		*siemens/simatic S7-200*			
	telephone modem	*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*			
	telephone network interface	*in dry pit, Siemens CDP-7 Series*		*in outdoor junction box*		*none*			
a	Replace I&C system	Replace all	$135,000	Replace all	$135,000	Replace all	$135,000	Replace I&C equipment	$135,000
b	telephone network interface			replace	included with replace all	none found			
8	**Washdown water**								
	System descriptions	*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*			
	Device	*RPBF*		*RPBF*		*RPBF*			
	Enclosure / Freeze protection	*adjacent to dry pit above ground in concrete meter box*		*in dry pit near opening*		*in dry pit near opening*			
a	**Install backflow assembly above grade in an enclosure, install drain**	N/A		N/A		N/A		Install device above grade in an enclosure	$8,500
9	**Miscellaneous PS Work**								
a	**Install Connections to enable Pumped Bypass of PS** (cost basis Newport Shores PS - Pump Suction and Discharge	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000
b	**ancillary components**								
b1	Access Hatch Fall Protection for dry pit and wet well blower vault	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000		$20,000	assumed similar repairs to other pump stations	$20,000
b2	Raise cover (operator) for FM isolation valve	N/A		N/A					
b3	clear brush at intake	N/A		N/A					
10	**Site / Access**							replace dehumidifier	3000
	Vehicle access - MOT	*back down narrow one lane street, no turn around*	$0	*one lane steep driveway, parking adjacent to pump station*	$0	*narrow paved road, parking adjacent to station*	$0	*shares common access road with wheel chair access to City Haul Bldg. vehicles obstruct access*	$20,000
	Landscaping - Restoration	*gravel*	$0	*laurel bushes surround station*	$10,000	*shrubs, maintained by others, trim trees to provide clearance and access, revise landscaping*	$20,000	*in grassed area*	$10,000
	Sight Lighting - no changes	*none*	$0	*none*	$0	*none*	$0	*unknown*	$0
	Fence / Security - no changes	*vault hatches locked*	$0	*none - in residents garden, consider installing fence*	$5,000	*none*	$0	*appears none from photos*	$0
	Public Accessibility	*public path to dock*	$0	*full access to site*	$0	*full access to site*	$0	*full access to site*	$0
	subtotal - direct costs		$849,000		$864,000		$879,000		$1,195,500
	10.10% sales tax		$86,000		$87,000		$89,000		$121,000
	0% ELA		$0		$0		$0		$0
	30% Contingency		$26,000		$26,000		$27,000		$36,000
	Total		$960,000		$980,000		$1,000,000		$1,350,000

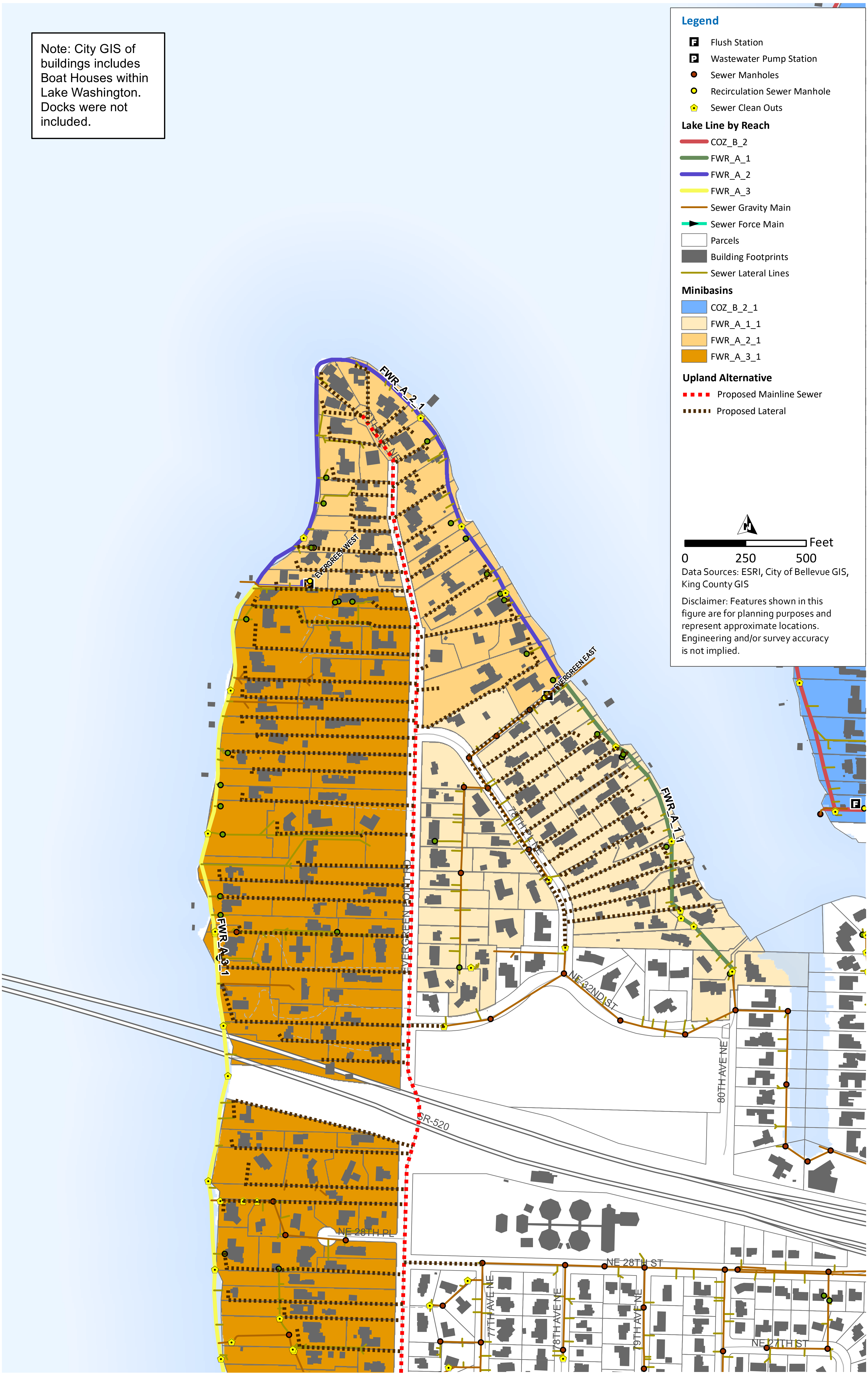
	Area	Meydenbauer Bay						Killarney		Newport South			
		Parker PS (No info. on PS)	2023 costs	Grange PS	2023 costs	Meydenbauer	2023 costs	Killarney	2023 costs	Pleasure Point	2023 costs	Bagley	2023 costs
6	**Generator**												
	Back up power source	*need to know if PS has generator or receptacle*		*generator, 60 kW, diesel*		*generator receptacle, manual transfer switch*		*generator receptacle, manual transfer switch*		*generator receptacle, manual transfer switch*		*generator receptacle, manual transfer switch*	
	Generator Vault			*Generator vault (14 x 8 x 8)*		*N/A*		*N/A*		*N/A*		*N/A*	
a	Replace standby generator, 55 kW, diesel			Replace standby generator, 60 kW, diesel	$210,000	N/A		N/A		N/A		N/A	
b	Replace vault dehumidifier					N/A		N/A		N/A		N/A	
c	install automatic primer on drain line to wet well			install automatic primer on drain line to wet well	$6,000	N/A		N/A		N/A		N/A	
d	Replace sound-proof insulation material in generator vault			Replace sound-proof insulation material in generator vault	$8,000	N/A		N/A		N/A		N/A	
7	**Instrumentation and Control / Telemetry**												
	telemetry control panel			*in dry pit*		*in dry pit, integral panel with starters*		*in dry pit, integral panel with starters*		*in dry pit, integral panel with starters*		*in dry pit, integral panel with starters*	
	primary level			*ultrasonic siemens hydroranger 100*		*ultrasonic siemens multiranger 100*		*ultrasonic siemens multiranger 100*		*ultrasonic siemens multiranger 100*		*ultrasonic siemens multiranger 100*	
	secondary level			*high level float*		*high level float*		*high level float*		*high level float*		*high level float*	
	RTU/PLC			*siemens/simatic S7-200*		*siemens/simatic S7-200*		*siemens/simatic S7-200*		*siemens/simatic S7-200*		*siemens/simatic S7-200*	
	telephone modem			*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*		*control microsystems/series 5000 option F*	
	telephone network interface			*in dry pit*		*in service cabinet*		*in service cabinet*		*in service cabinet*		*in service cabinet*	
a	Replace I&C system	Replace I&C equipment	$135,000	Replace I&C equipment	$135,000	Replace all	$135,000	Replace all	$135,000	Replace all	$135,000	Replace all	$135,000
b	telephone network interface												
8	**Washdown water**												
	System descriptions			*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*		*domestic/metered, hose bibb in dry pit*	
	Device			*RPBF*		*RPBF*		*RPBF*		*RPBF*		*RPBF*	
	Enclosure / Freeze protection			*in generator vault*		*two stacked water meter boxes / heat tape*		*below grade box*		*12-inch above floor of air intake underground vault*		*underground meter box / heat tap*	
a	**Install backflow assembly above grade in an enclosure, install drain**	need confirmation if needed for this PS	$8,500	Install backflow assembly above grade in an enclosure, install drain	$8,500	N/A		Install backflow assembly above grade in an enclosure, install drain	$8,500	Install backflow assembly above grade in an enclosure, install drain	$8,500	Install backflow assembly above grade in an enclosure, install drain	$8,500
9	**Miscellaneous PS Work**												
a	**Install Connections to enable Pumped Bypass of PS** (cost basis Newport Shores PS - Pump Suction and Discharge	Allowance	$30,000	Allowance	$30,000	Has pig launch but no bypass	$30,000	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000
b	**ancillary components**												
b1	Access Hatch Fall Protection for dry pit and wet well blower vault	assumed similar repairs to other pump stations	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault, incl. add grating between wall and staircase	$25,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000
b2	Raise cover (operator) for FM isolation valve												
b3	clear brush at intake			clear brush at intake	$5,000								
10	**Site / Access**												
	Vehicle access - MOT			*easily accessible, two parking spots reserved for CoB, future City park area*	$0	*two way street, parking adjacent to site*	$0	*steep driveway, switch back pavement driveway, parking 20 ft from station*	$0	*paved one lane path, dead end, parking adjacent to station*	$0	*located in grassy area adjacent to lake and Newcastle Beach Park, access via gravel drive, narrow path to PS*	$0
	Landscaping - Restoration			*rock retaining wall along 1 side, landscape bushes*	$5,000	*paved space - prune bushes near site*	$2,000	*heavy cover - fir trees*	$2,000	*between two residences surrounded by foliage and bushes maintained by others*	$20,000	*grass, city mows grass and takes care of driveway - grass restoration only*	$5,000
	Sight Lighting - no changes			*none*	$0	*none*	$0	*none*	$0	*none*	$0	*none*	$0
	Fence / Security - no changes			*all vaults locked*	$0	*none*	$0	*none*	$0	*none*	$0	*none*	$0
	Public Accessibility			*near marina, public access to site*	$0	*public access, adjacent to sidewalk*	$0	*within unmarked / unimproved public ROW*	$0	*full access to site*	$0	*full access to site*	$0
	subtotal - direct costs		$882,500		$1,117,500		$871,500		$875,000		$893,000		$893,500
		confirm if station has generator or generator receptacle											
	10.10% sales tax		$89,000		$113,000		$88,000		$88,000		$90,000		$90,000
	0% ELA		$0		$0		$0		$0		$0		$0
	30% Contingency		$27,000		$34,000		$26,000		$26,000		$27,000		$27,000
	Total		$1,000,000		$1,260,000		$990,000		$990,000		$1,010,000		$1,010,000

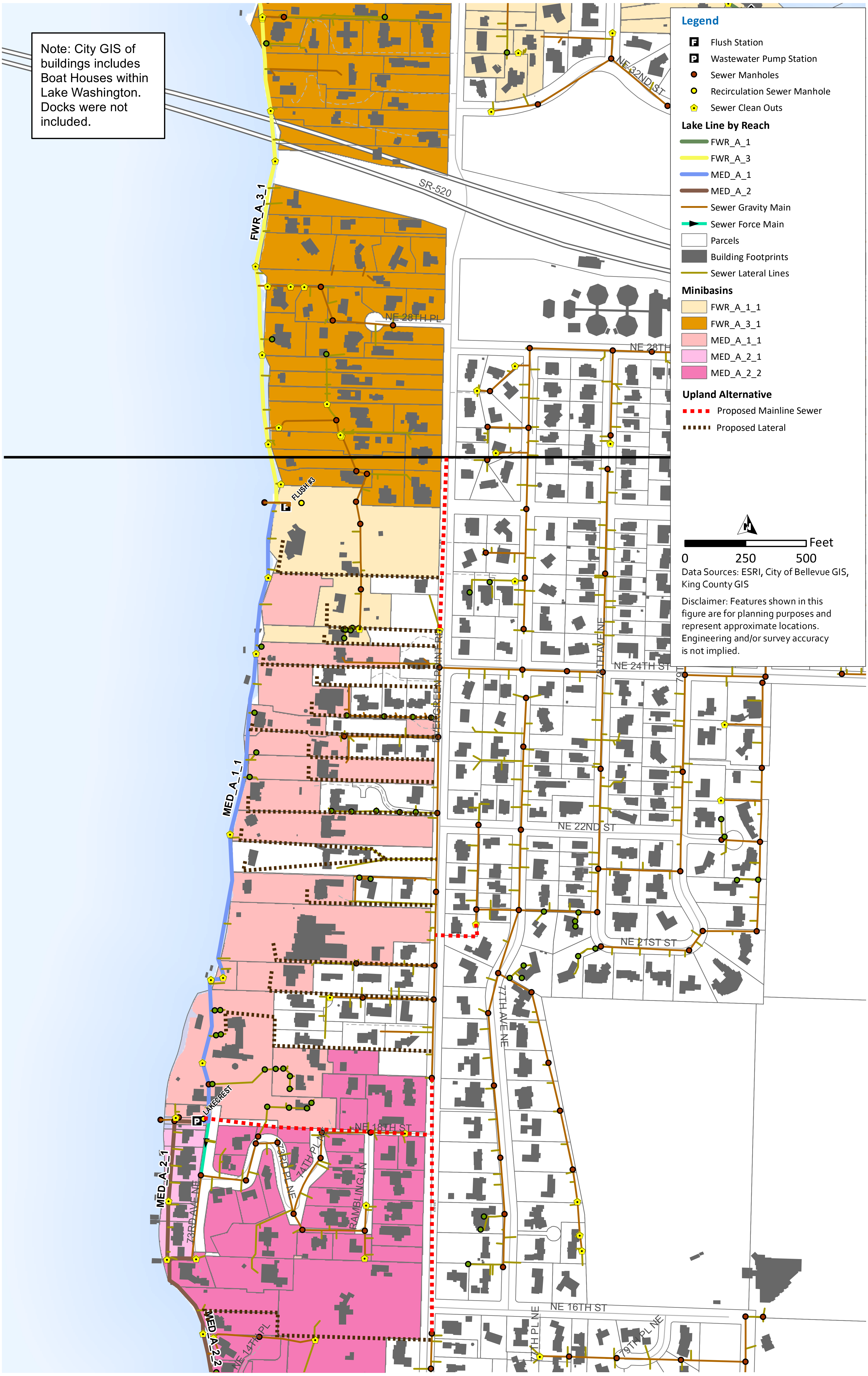
ATTACHMENT 9
UPLAND ALTERNATIVE ESTIMATED NEW SEWER MAPS

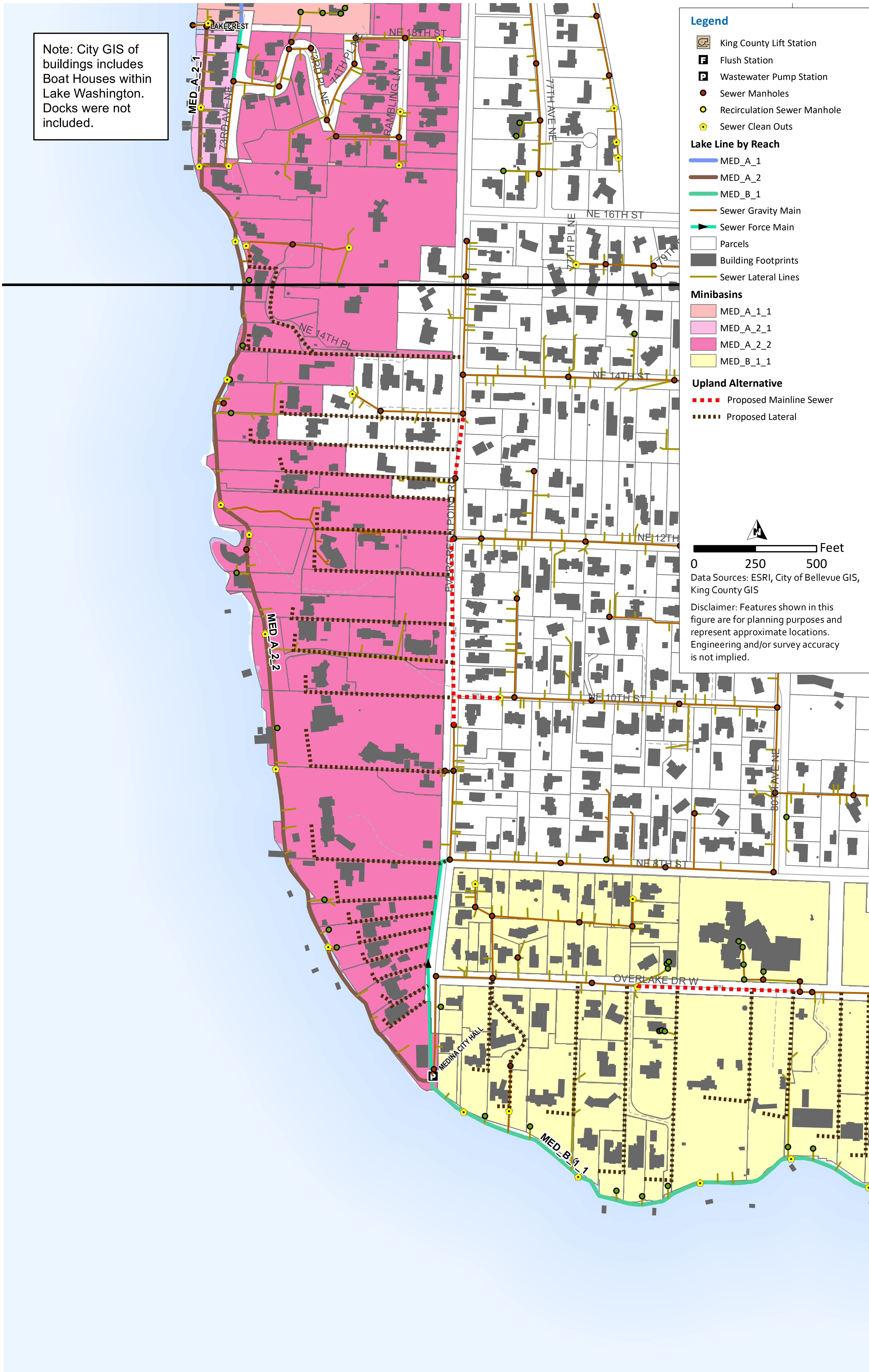

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
COZ_A_1
COZ_A_2
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
COZ_A_1_1
COZ_A_2_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
COZ_A_1_1
COZ_A_2_1
FLUSH #1
YARROW POINT
NE 42ND ST
NE 41ST ST
NE 40TH PL
NE 39TH PL
NE 38TH PL
NE 38TH ST
NE 37TH PL
NE 40TH ST
NE 42ND PL
92ND AVE NE
94TH AVE NE
96TH AVE NE
97TH AVE NE
POINTS DR
SR-520

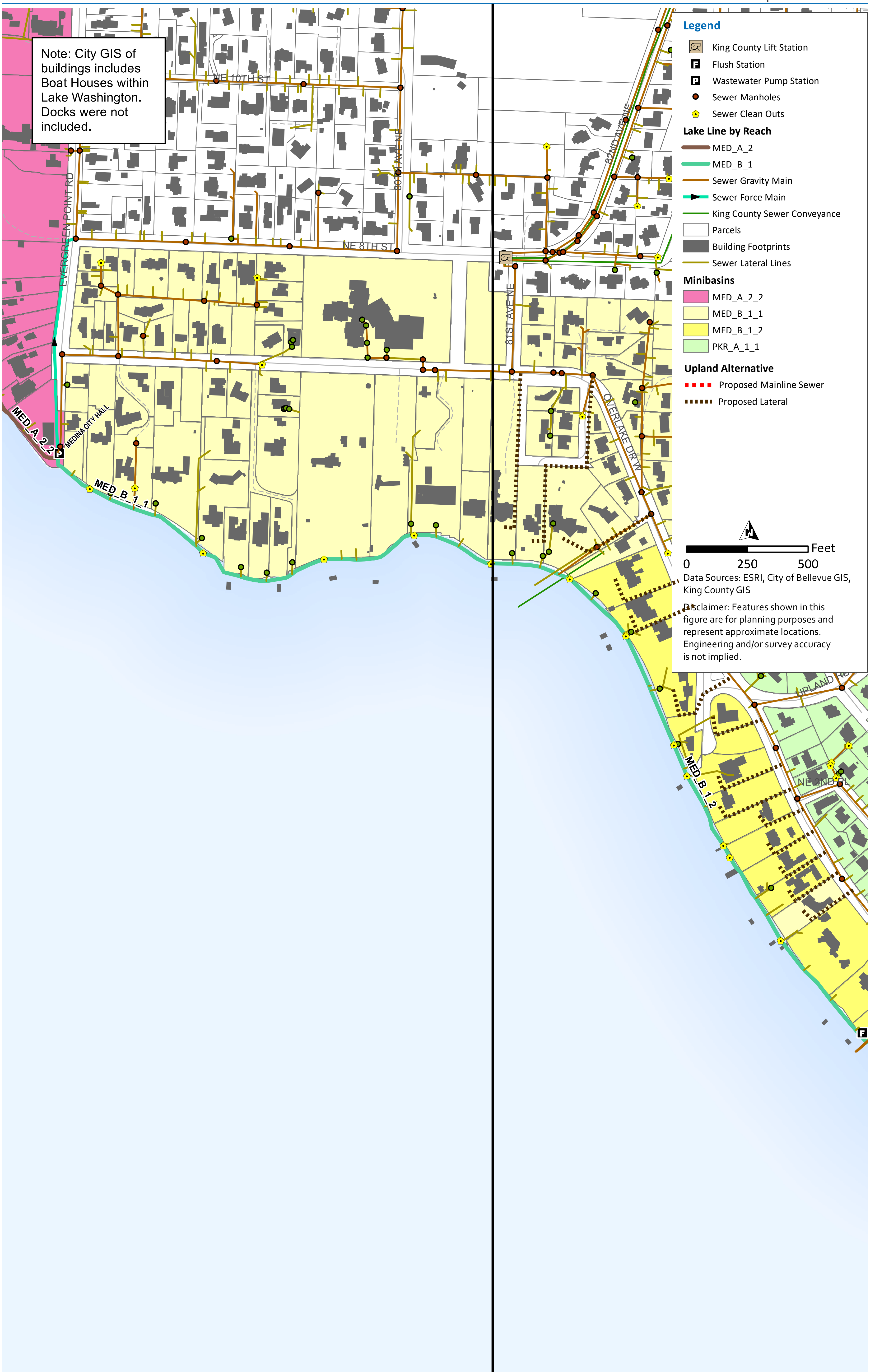

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
COZ_A_1
COZ_A_2
COZ_B_1
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
COZ_A_1_1
COZ_A_2_1
COZ_B_1_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
0 250 500 Feet
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
COZ_A_1_1
YARROW POINT
NE 42ND ST
91ST AVE NE
NE 41ST ST
NE 40TH PL
NE 39TH PL
NE 38TH PL
92ND AVE NE
COZ_B_1_1
COZ_A_2_1
COZY COVE
NE 36TH ST
NE 35TH PL
NE 34TH ST
NE 33RD ST
SR-520
NE 32ND ST
95TH PL NE
NE 31ST ST
NE 30TH PL
NE 32ND PL
HUNTS POINT LN
92ND PL NE
93RD PL NE
NE 30TH ST
POINTS DR NE
84TH AVE NE
88TH AVE NE
NE 28TH PL
93RD AVE NE
NE 28TH ST
85TH PL NE
NE 27TH PL
84TH PL NE
86TH AVE NE
90TH AVE NE
91ST PL NE
NE 27TH ST
NE 26TH PL
NE 26TH ST
85TH AVE NE


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
COZ_A_2
COZ_B_1
COZ_B_2
FWR_A_1
FWR_A_2
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
COZ_A_1_1
COZ_A_2_1
COZ_B_1_1
COZ_B_2_1
FWR_A_1_1
FWR_A_2_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
HUNTS POINT
HUNTS POINT RD
COZ_B_2_1
COZ_B_1_1
COZ_A_2_1
FWR_A_1_1
EVERGREEN EAST
COZY COVE
FLUSH2
78TH PL NE
84TH AVE NE

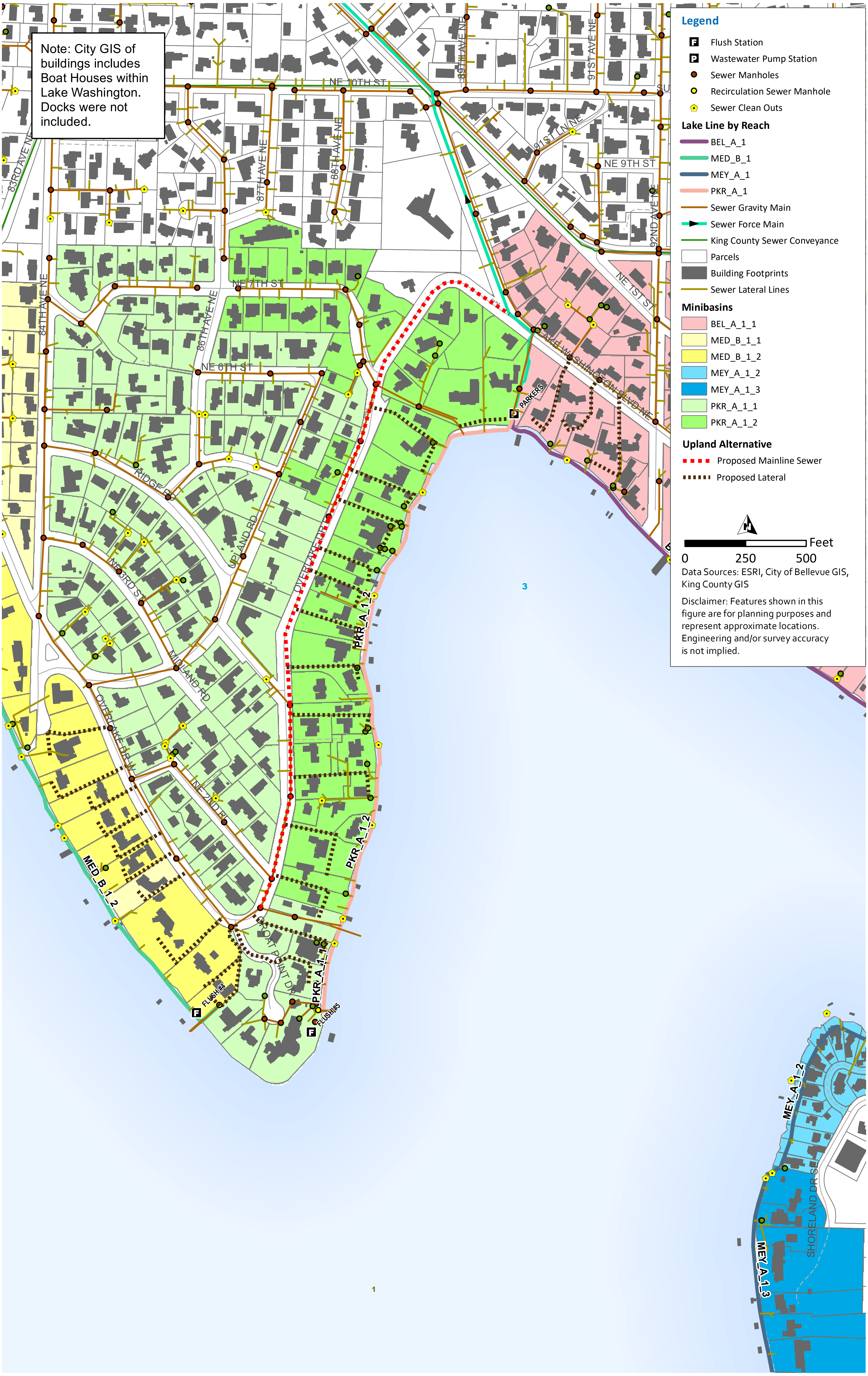

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
COZ_B_2
FWR_A_1
FWR_A_2
FWR_A_3
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
COZ_B_2_1
FWR_A_1_1
FWR_A_2_1
FWR_A_3_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
FWR_A_2_1
EVERGREEN WEST
EVERGREEN EAST
FWR_A_1_1
FWR_A_3_1
EVERGREEN POINT RD
78TH PL NE
NE 32ND ST
80TH AVE NE
SR-520
NE 28TH PL
NE 28TH ST
77TH AVE NE
78TH AVE NE
79TH AVE NE
NE 27TH ST

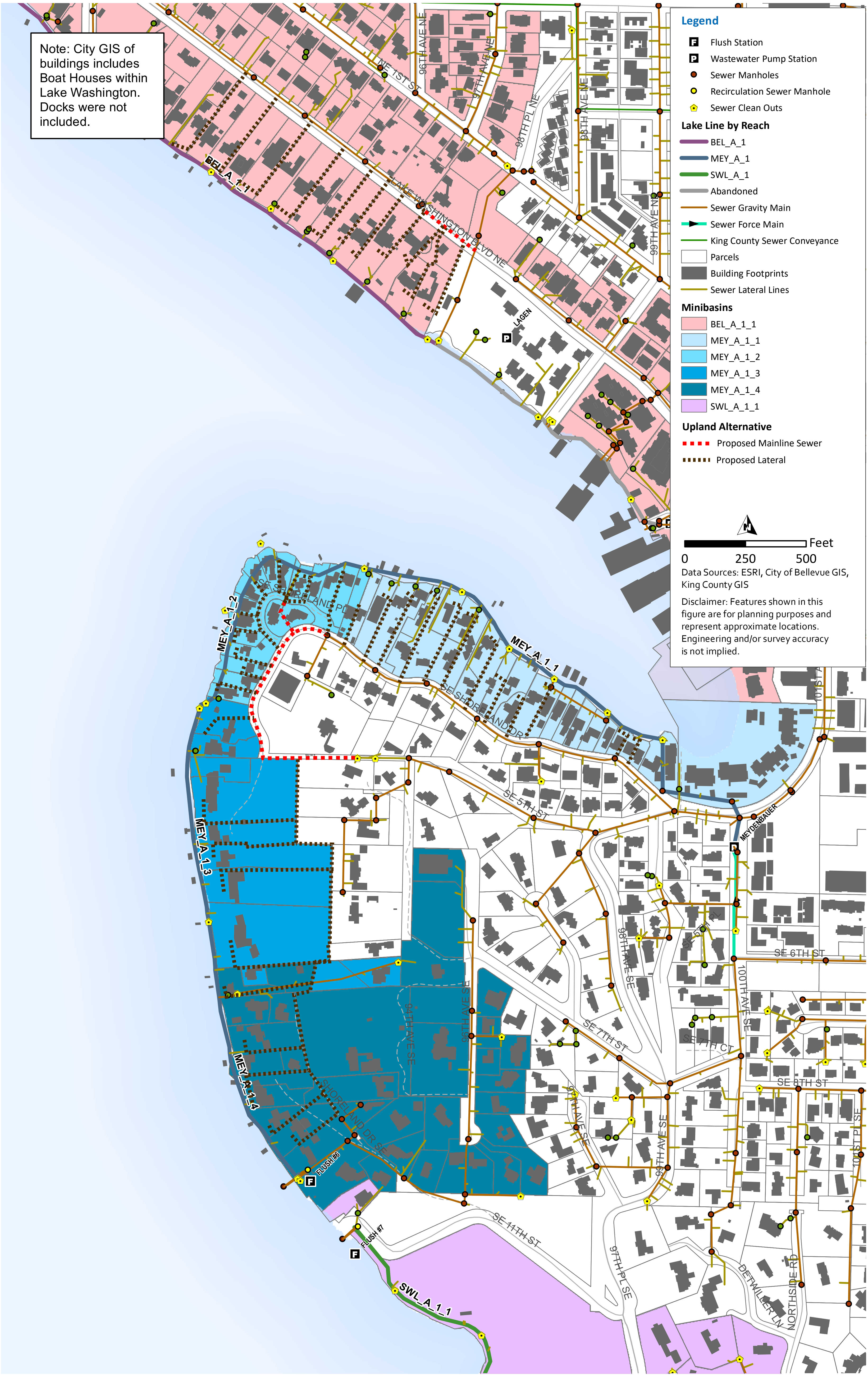

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
FWR_A_1
FWR_A_3
MED_A_1
MED_A_2
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
FWR_A_1_1
FWR_A_3_1
MED_A_1_1
MED_A_2_1
MED_A_2_2
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
SR-520
NE 32ND ST
NE 28TH PL
NE 28TH
FWR_A_3_1
FLUSH #3
NE 24TH ST
NE 22ND ST
NE 21ST ST
77TH AVE NE
MED_A_1_1
LAKECREST
NE 18TH ST
73RD PL NE
74TH PL
RAMBLING LN
73RD AVE NE
MED_A_2_1
MED_A_2_2
NE 14TH PL
NE 16TH ST
77TH PL NE
79TH PL NE

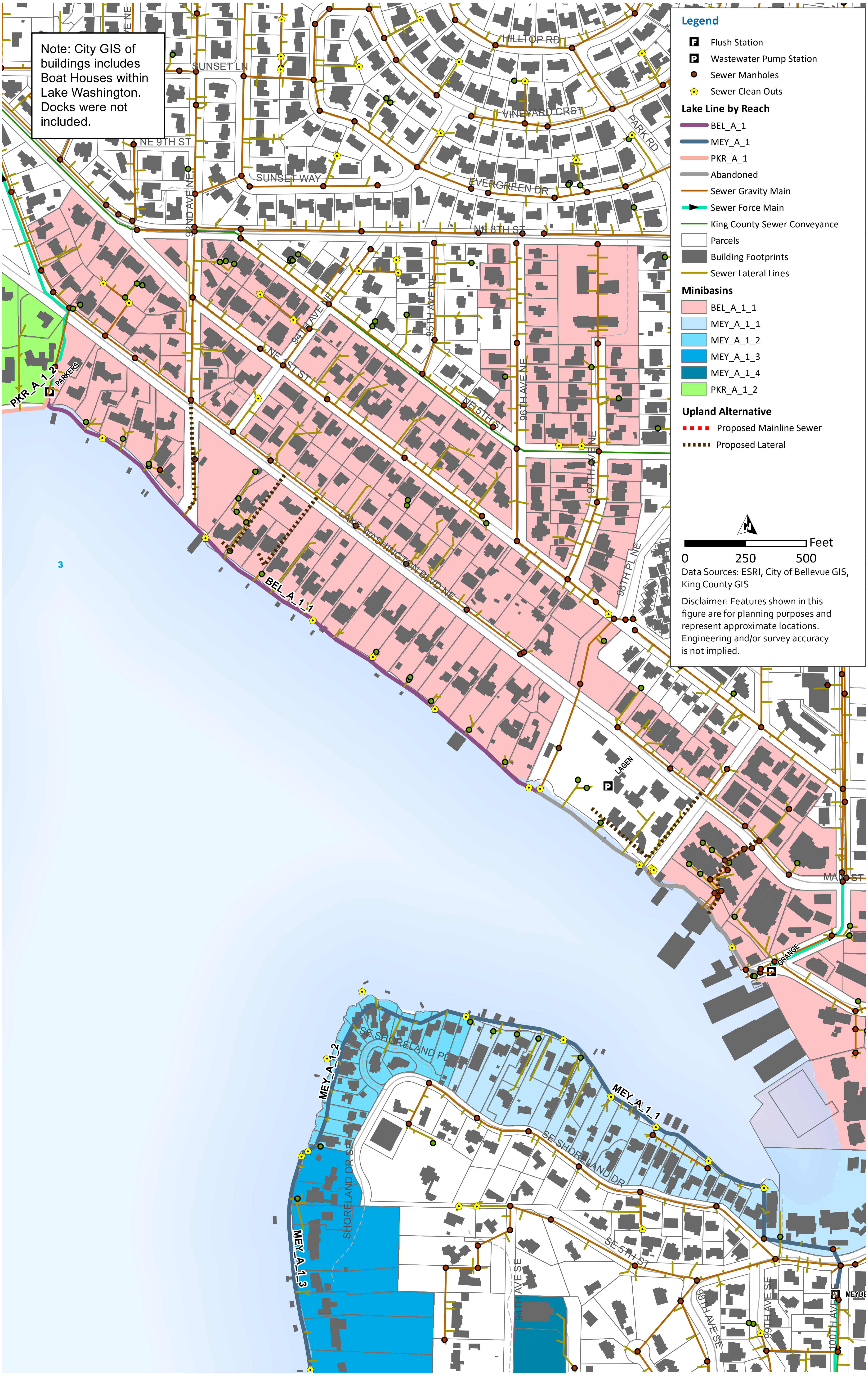

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
King County Lift Station
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
MED_A_1
MED_A_2
MED_B_1
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
MED_A_1_1
MED_A_2_1
MED_A_2_2
MED_B_1_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
LAKECREST
NE 18TH ST
MED_A_2_1
73RD AVE NE
73RD PL NE
74TH PL NE
RAMBLING LN
77TH AVE NE
NE 16TH ST
77TH PL NE
NE 14TH PL
NE 14TH ST
EVERGREEN POINT RD
NE 12TH
MED_A_2_2
NE 10TH ST
80TH AVE NE
NE 8TH ST
OVERLAKE DR W
MEDINA CITY HALL
MED_B_1_1

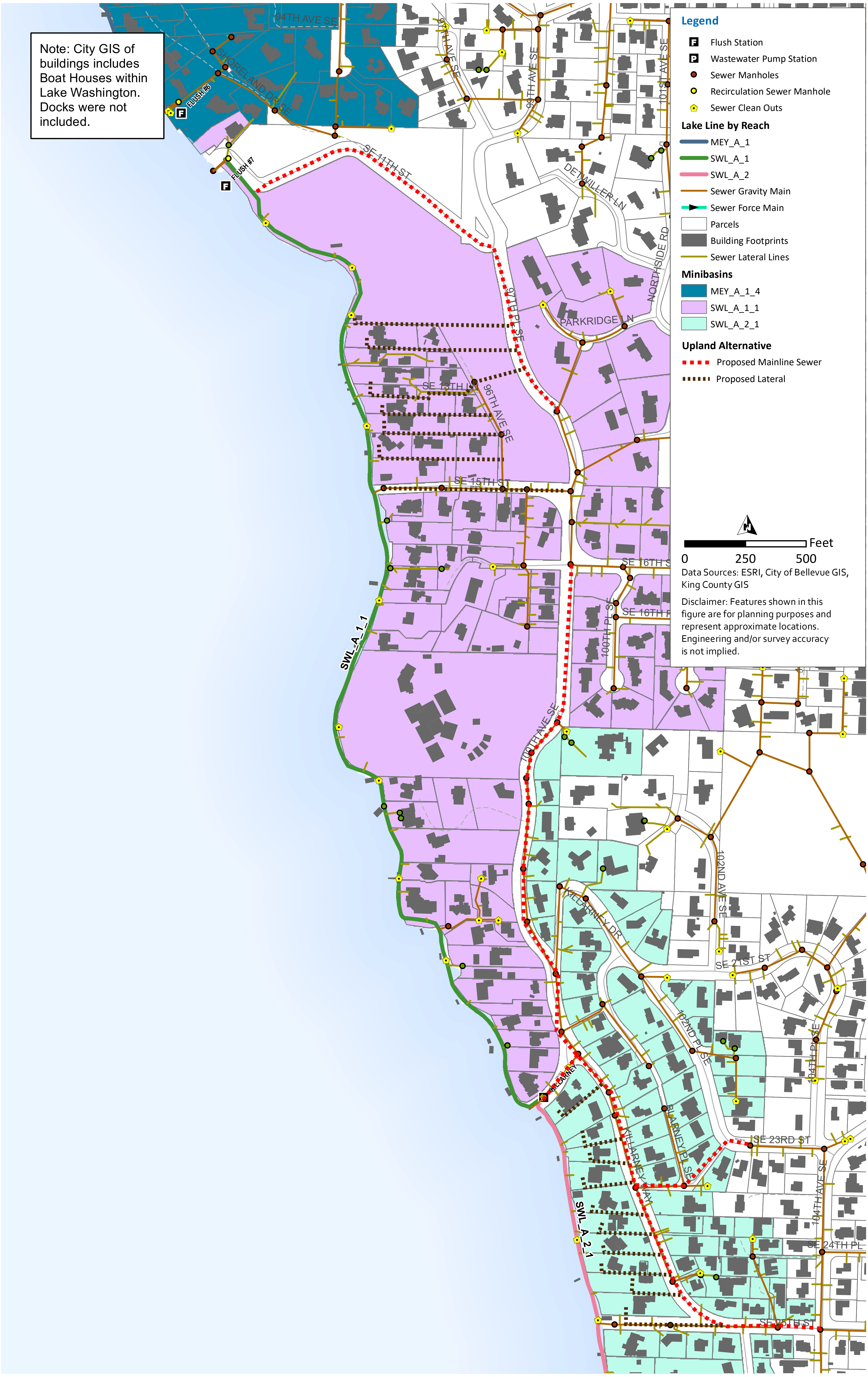


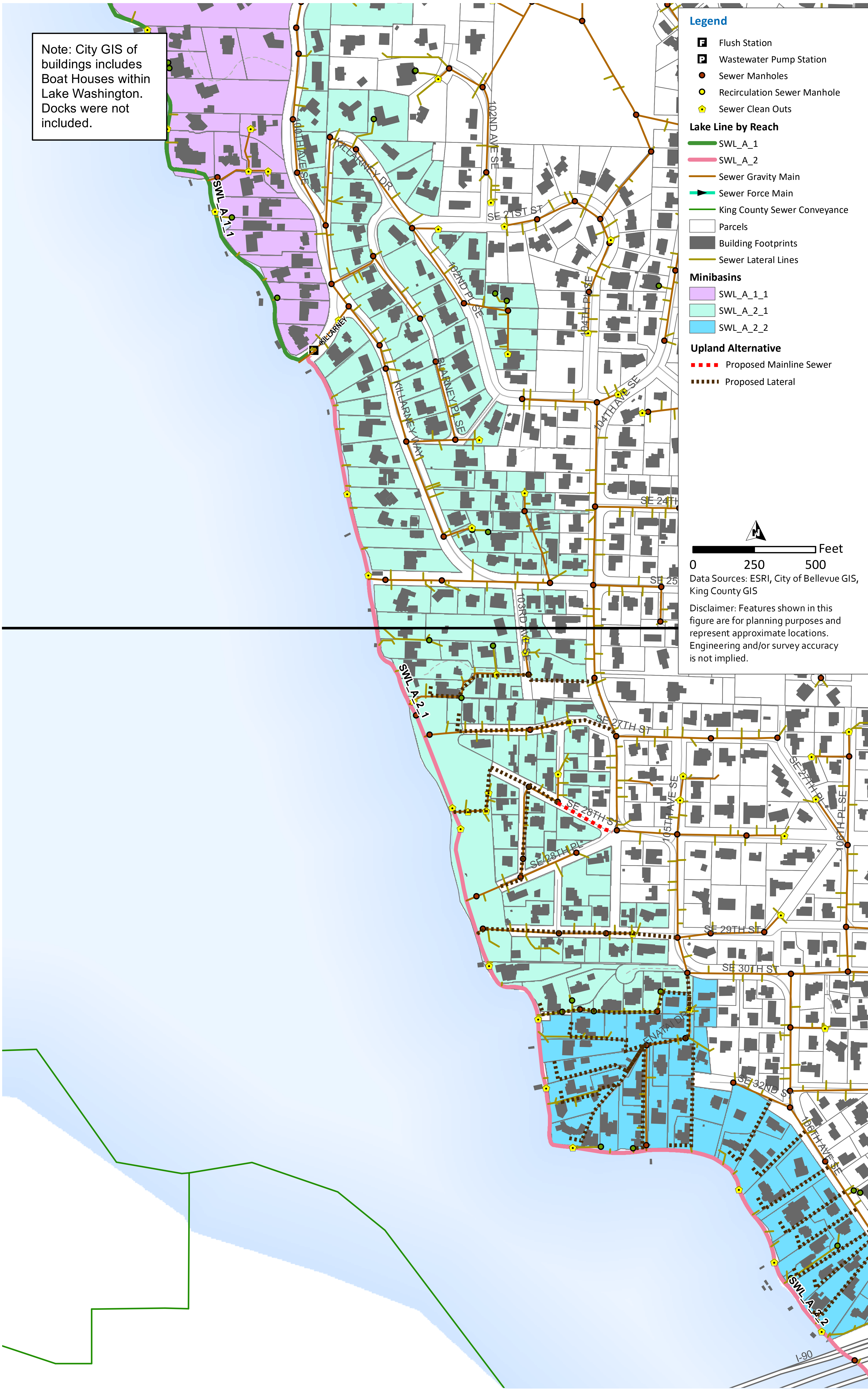
Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
NE 10TH ST
NE 8TH ST
EVERGREEN POINT RD
80TH AVE NE
81ST AVE NE
82ND AVE NE
OVERLAKE DR W
UPLAND RD
NE 2ND PL
MEDINA CITY HALL
MED_A_2_2
MED_B_1_1
MED_B_1_2
Legend
King County Lift Station
Flush Station
Wastewater Pump Station
Sewer Manholes
Sewer Clean Outs
Lake Line by Reach
MED_A_2
MED_B_1
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
MED_A_2_2
MED_B_1_1
MED_B_1_2
PKR_A_1_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
N
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

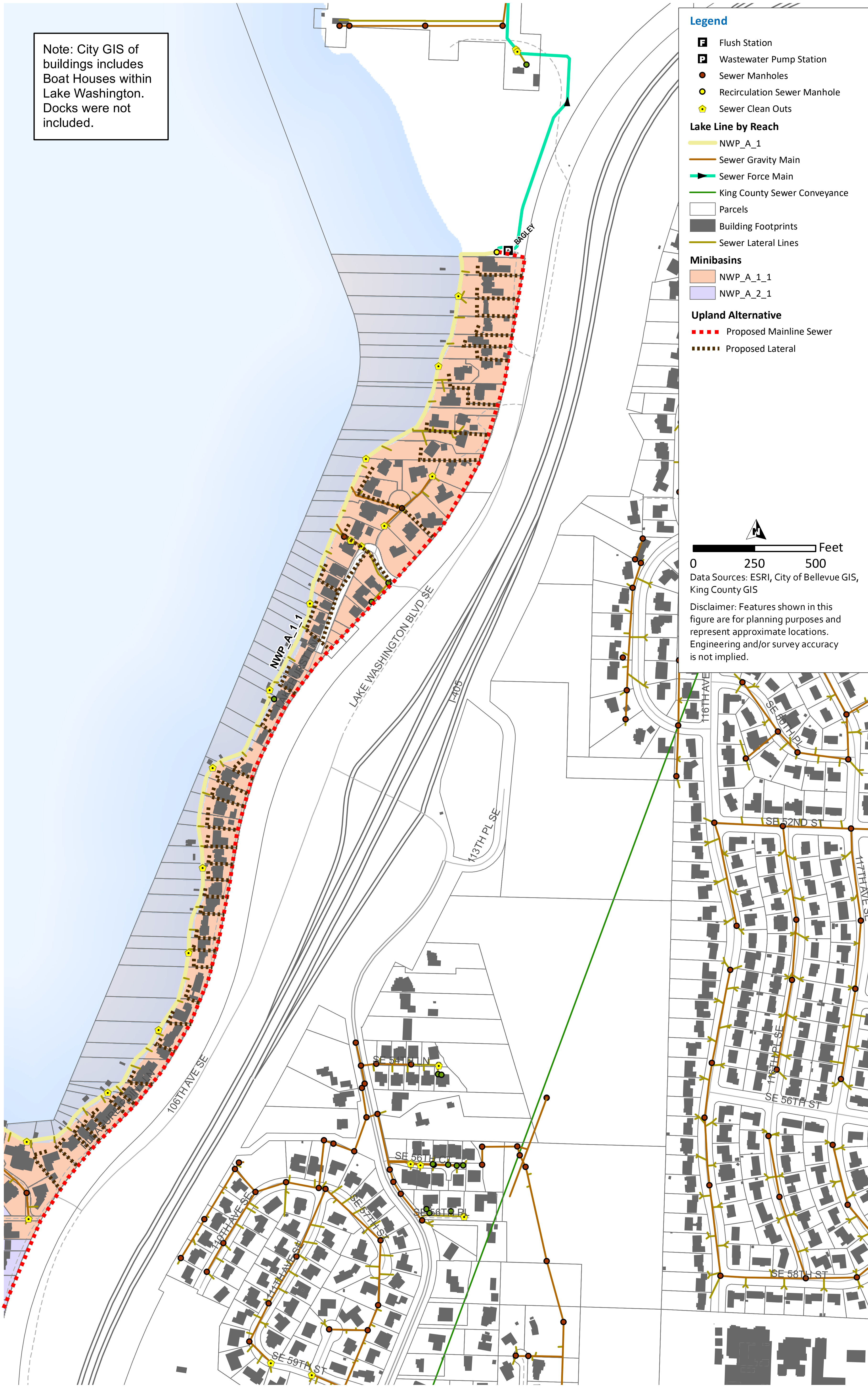

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
BEL_A_1
MED_B_1
MEY_A_1
PKR_A_1
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
BEL_A_1_1
MED_B_1_1
MED_B_1_2
MEY_A_1_2
MEY_A_1_3
PKR_A_1_1
PKR_A_1_2
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
NE 10TH ST
NE 9TH ST
NE 7TH ST
NE 6TH ST
NE 1ST ST
83RD AVE NE
84TH AVE NE
86TH AVE NE
87TH AVE NE
88TH AVE NE
89TH AVE NE
91ST AVE NE
92ND AVE NE
91ST LN NE
RIDGE RD
UPLAND RD
OVERLAKE DR
MIDLAND RD
NE 3RD ST
NE 2ND PL
OVERLAKE DR W
LAKE WASHINGTON BLVD NE
SHORELAND DR SE
PARKERS
FLUSH#4
FLUSH#5
PKR_A_1_2
PKR_A_1_1
MED_B_1_2
MEY_A_1_2
MEY_A_1_3
3
1

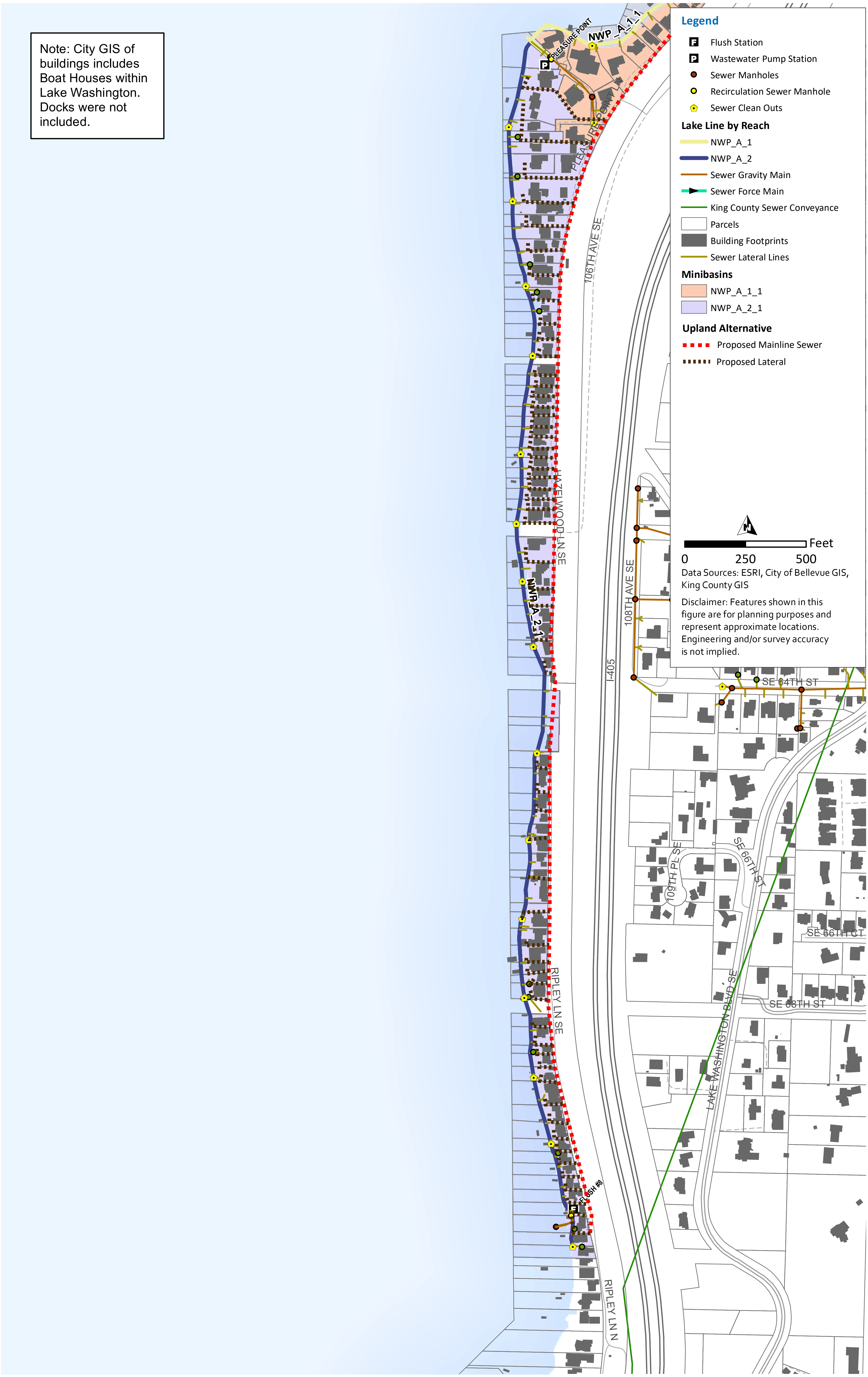

Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
BEL_A_1
MEY_A_1
SWL_A_1
Abandoned
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
BEL_A_1_1
MEY_A_1_1
MEY_A_1_2
MEY_A_1_3
MEY_A_1_4
SWL_A_1_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
BEL_A_1_1
MEY_A_1_1
MEY_A_1_2
MEY_A_1_3
MEY_A_1_4
SWL_A_1_1
NE 1ST ST
96TH AVE NE
97TH AVE NE
98TH PL NE
98TH AVE NE
99TH AVE NE
LAKE WASHINGTON BLVD NE
LAGEN
SHORELAND DR
SE 5TH ST
SE 6TH ST
SE 7TH ST
SE 7TH CT
SE 8TH ST
SE 11TH ST
98TH AVE SE
99TH AVE SE
100TH AVE SE
97TH AVE SE
97TH PL SE
94TH AVE SE
95TH AVE SE
MEYDENBAUER
NORTHSIDE RD
DETWILER LN
101ST PL SE
FLUSH #6
FLUSH #7


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Sewer Clean Outs
Lake Line by Reach
BEL_A_1
MEY_A_1
PKR_A_1
Abandoned
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
BEL_A_1_1
MEY_A_1_1
MEY_A_1_2
MEY_A_1_3
MEY_A_1_4
PKR_A_1_2
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
HILLTOP RD
SUNSET LN
VINEYARD CRST
PARK RD
NE 9TH ST
SUNSET WAY
EVERGREEN DR
NE 8TH ST
92ND AVE NE
94TH AVE NE
95TH AVE NE
96TH AVE NE
97TH AVE NE
98TH PL NE
NE 5TH ST
NE 1ST ST
LAKE WASHINGTON BLVD NE
PKR_A_1_2
PARKERS
BEL_A_1_1
3
LAGEN
MAIN ST
GRANGE
SE SHORELAND PL
SE SHORELAND DR
SHORELAND DR SE
MEY_A_1_1
MEY_A_1_2
MEY_A_1_3
SE 5TH ST
94TH AVE SE
98TH AVE SE
99TH AVE SE
100TH AVE SE
MEYDE


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
MEY_A_1
SWL_A_1
SWL_A_2
Sewer Gravity Main
Sewer Force Main
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
MEY_A_1_4
SWL_A_1_1
SWL_A_2_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
SWL_A_1_1
SWL_A_2_1
SE 11TH ST
SHORELAND DR SE
94TH AVE SE
97TH PL SE
96TH AVE SE
SE 15TH ST
SE 16TH ST
100TH PL SE
100TH AVE SE
PARKRIDGE LN
DETWILLER LN
NORTHSIDE RD
KILLARNEY DR
KILLARNEY WAY
102ND AVE SE
102ND PL SE
SE 21ST ST
SE 23RD ST
SE 24TH PL
SE 25TH ST
104TH AVE SE
FLUSH #7
FLUSH #6
KILLARNEY


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
SWL_A_1
SWL_A_2
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
SWL_A_1_1
SWL_A_2_1
SWL_A_2_2
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
SWL_A_1_1
SWL_A_2_1
SWL_A_2_2
KILLARNEY
100TH AVE SE
KILLARNEY DR
102ND AVE SE
SE 21ST ST
102ND PL SE
104TH PL SE
KILLARNEY PL SE
KILLARNEY WAY
104TH AVE SE
SE 24TH
SE 25
103RD AVE SE
SE 27TH ST
SE 28TH ST
SE 28TH PL
105TH AVE SE
SE 27TH PL
106TH PL SE
SE 29TH ST
SE 30TH ST
SE 32ND S
106TH AVE SE
I-90


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
NWP_A_1
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
NWP_A_1_1
NWP_A_2_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0
250
500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
BAGLEY
NWP_A_1_1
LAKE WASHINGTON BLVD SE
I-405
113TH PL SE
106TH AVE SE
116TH AVE
SE 52ND ST
117TH AVE SE
SE 56TH ST
SE 58TH ST
SE 54TH LN
SE 56TH CT
SE 56TH PL
SE 57TH ST
119TH AVE SE
SE 59TH ST


Note: City GIS of buildings includes Boat Houses within Lake Washington. Docks were not included.
Legend
Flush Station
Wastewater Pump Station
Sewer Manholes
Recirculation Sewer Manhole
Sewer Clean Outs
Lake Line by Reach
NWP_A_1
NWP_A_2
Sewer Gravity Main
Sewer Force Main
King County Sewer Conveyance
Parcels
Building Footprints
Sewer Lateral Lines
Minibasins
NWP_A_1_1
NWP_A_2_1
Upland Alternative
Proposed Mainline Sewer
Proposed Lateral
Feet
0 250 500
Data Sources: ESRI, City of Bellevue GIS, King County GIS
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.
NWP_A_1_1
PLEASURE POINT
106TH AVE SE
108TH AVE SE
I-405
HAZELWOOD LN SE
NWP_A_2_1
RIPLEY LN SE
RIPLEY LN N
FLUSH #8
SE 64TH ST
SE 66TH ST
109TH PL SE
SE 66TH CT
SE 68TH ST
LAKE WASHINGTON BLVD SE

ATTACHMENT 10
UPLAND ALTERNATIVE PUMP STATION COST ESTIMATES

City of Bellevue Lake Washington Lake Line Master Plan
Alternative 3 - Upland Pump Stations
Scope, Assumptions, Class 5 OPCC
June 2023

	Area	Points					Evergreen Point				Medina				Meydenbauer Bay						Killarney		Newport South		
		Yarrow Pt PS	**2023 Costs**	**Cozy Cove PS**	**2023 Costs**	**Hunts Point**	**Evergreen East PS**	**2023 Costs**	**Evergreen West**	**2023 Costs**	**Lake Crest**	**2023 Costs**	**Medina Pump Station**	**2023 Costs**	**Parker PS**	**2023 Costs**	**Grange PS**	**2023 Costs**	**Meydenbauer**	**2023 Costs**	**Killarney**	**2023 Costs**	**Pleasure Point**	**Bagley**	**2023 Costs**
	Scope Summary	*Increase PS flow rate by 30-40%, 3,916 LF of new 8" force main located onshore connecting to Cozy Cove PS. New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC,*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*Hunts Point PS Abandoned for Alt. 3 Upland*	*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*Double PS flow rate, 934 LF of new 8" force main from Lake Crest PS to Evergreen Point Road. New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site,*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*Information on Parker PS not available for 2023 effort. Assume PS similar in size and configuration of other pump stations, and scope of work same as other pump stations.*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*		*Pleasure Point PS Abandoned for Alt. 3 Upland*	*New pumps, pipe, valves, electrical, and I&C. Rehab existing pump station structure, HVAC, ancillary components, site, etc. as indicated below.*	
1	**Pump Station - Wet Well**																								
	Class 1, Div 1																								
	Dimensions. concrete, coated	*12 x 8.5 ft*		*15 x 10 ft*			*12 x 8.5 ft*		*12 x 8.5 ft*		*12 x 8.5 x 12 ft*						*8 ft diam, 20 ft deep, concrete, PVC liner*		*12 x 8.5 x 13.5 ft*		*12 x 8.5 x 13.5 ft*			*12 x 8.5 x 13.5 ft*	
	Misc.	*MH access lid, ladder, internal FRP platform with railing, no fall protection, lighting, supply fan*		*MH access lid, ladder, internal FRP platform with railing, no fall protection, lighting, supply fan*			*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*								*access hatch, ladder, platform grating, no fall protection, lighting, supply fan*		*MH lid, ladder, platform grating, no fall protection, lighting, supply fan*			*MH lid, ladder, platform grating, no fall protection, no lighting, supply and exhaust (odor control) fans*	
a	**Recoat Interior -** *costs in line with 2015 estimate, system used for recoating is not indicated in 2015 report*	Recoat interior	$75,000	Recoat interior, exposed aggregate	$130,000		Recoat interior	$75,000	Recoat interior	$75,000	Recoat interior	$85,000	recoat interior - assume	$95,000	Recoat interior	$95,000	NO RECOATING	N/A	Recoat interior	$95,000	Recoat interior	$95,000		Recoat interior	$95,000
b	**New Hatch**		N/A		N/A			N/A		N/A		N/A				N/A		N/A		N/A		N/A			N/A
c	**Repair FRP rails / grading**		N/A		N/A			N/A		N/A		N/A	repair FRP rails / grading	$15,000		N/A		N/A		N/A		N/A			N/A
d	**Replace corroded overflow**		N/A		N/A			N/A		N/A		N/A	replace corroded overflow pipe	$5,000		N/A		N/A		N/A		N/A			N/A
2	**Pump Station - Dry Pit**																								
	Class 1, Div 2																		*no equipment access hatch*		*no equipment access hatch*			*no equipment access hatch*	
	Dimensions. Concrete	*12 x 8.5 ft (coated?)*		*15 x 8.5 ft*			*12 x 8.5*		*12 x 8.5, concrete*		*12 x 8.5 x 12 ft, concrete*						*8 ft diam, 20 ft deep*		*12 x 10 x 13.5 ft*		*12 x 8.5 x 13.5 ft*			*12 x 10 x 13.5 ft*	
	Misc.	*access hatch, spiral staircase, no fall protection, lighting, supply fan*		*access hatch, spiral staircase, no fall protection, lighting, supply fan - metal grating to access stair case deflects*			*access hatch, spiral staircase, no fall protection, lighting, supply fan*		*access hatch, spiral staircase, no fall protection, lighting, supply fan*		*step over open space to reach stair landing, access hatch, spiral stair case, no fall protection, lighting, supply fan*								*access hatch, spiral stair case, has fall protection, lighting, supply fan, no equipment access hatch*		*access hatch, spiral stair case, has fall protection, lighting, supply fan, no equipment access hatch*			*access hatch, spiral stair case, with fall protection, lighting, supply fan, no equipment access hatch*	
	Lifting	*chain hoist / trolley*		*trolley chain hoist and rail*			*trolley chain hoist and rail*		*chain hoist / trolley*		*chain hoist / trolley*		*unknown*				*boom truck*								
	Dry pit sump pump																								
	Supply fan	*centrifugal 820 cfm, near ceiling in dry pit*		*centrifugal 975 cfm, near ceiling in dry pit*			*unknown*		*10 ft AFF , unknown cfm*		*12 ft AFF, 820 cfm*								*5 ft AFF, 1300 cfm*		*5 ft AFF, 1300 cfm*			*5 ft AFF, 1,300 cfm*	
a	**Install exhaust fan** (Classified space requires ventilation or explosion proof equipment)	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000		Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000	Install Exhaust Fan	$35,000			Assumed part of scope	$40,000	Install Exhaust Fan	$40,000	Install Exhaust Fan	$40,000	Install Exhaust Fan	$40,000		Install Exhaust Fan	$40,000
b	**Recoat Interior**		N/A		N/A			N/A		N/A		N/A		N/A		N/A	Recoat interior	$75,000		N/A		N/A		N/A	N/A
c	**New Hatch**		N/A		N/A			N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	N/A
d	**Upgrade HVAC**		N/A		N/A			N/A		N/A		N/A	upgrade HVAC in dry pit - supply and exhaust fan	$60,000		N/A		N/A		N/A		N/A		N/A	N/A
3	**Wet Well Blower Vault (houses supply fan for wet well)**																								
	Class 1, Div 2																								
	Dimensions. Concrete	*6.33 x 6.33 x 4 ft*		*5.5 x 3.5 x ?*			*9.17 x 3.5 x 4 ft*		*4 x 8 x 5, concrete*		*5 x 5 x 5 ft*						*5 x 5 x 5, concrete*		*4 x 5 x 4 ft*		*4 x 4 x 4 ft*			*4 x 4 x 4 ft*	
	access hatch, ladder, no fall protection, no lighting, no ventilation																				*has fall protection*			*has fall protection*	
	Centrifugal fan	*560 cfm, 2 speed fan*		*975 cfm*			*unknown*		*unknown*		*560 cfm*								*400 xfm*		*400 cfm*			*400 cfm supply, 400 cfm wet well exhaust (odor control fan in vault)*	
a	**Not built to area Classification** - replace components to meet classification	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000		replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	replace components to meet area classification - install class 1 dive 2 components in wet well blower vault	$14,000	Assume required	$14,000	Assume required	$14,000	Component replacement not mentioned in 2015 report - assume not required, existing components meet area classification.	$0	Component replacement not mentioned in 2015 report - assume not required, existing components meet area classification.	$0	Component replacement not mentioned in 2015 report - assume not required, existing components meet area classification.	$0		Component replacement not mentioned in 2015 report - assume not required, existing components meet area classification.	$0
b	**Relocate wet well vent** to prevent future corrosion of new electrical service cabinet		N/A	relocate wet well vent to prevent future corrosion of new electrical service cabinet - duct and new vent/hood	$15,000			N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A			N/A
c	**New Hatch**		N/A		N/A			N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A			N/A
4	**Mechanical**																								
a	**Replace pumps**	Existing pumps - 325 gpm, 18 ft TDH, install two new pumps 425-455 gpm - incl. new discharge piping, valves, etc.	$265,000	Replace 3 pumps (PS capacity 600 gpm, 65 ft TDH) - incl. piping, valves	$360,000		Replace 2 pumps (250 gpm, 14 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (250 gpm, 16 ft TDH) - incl. piping, valves	$240,000	Existing pumps - 300 gpm, 17 ft TDH, install two new pumps 600 gpm - incl. new discharge piping, valves, etc.	$290,000	Replace Pumps - two 15 hp pumps, ~350 gpm at 67.5 ft	$240,000	Assumed 2 pumps	$240,000	Replace 2 pumps (350 gpm, 84 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (300 gpm, 57 ft TDH) - incl. piping, valves	$240,000	Replace 2 pumps (350 gpm, 15.5 ft TDH) - incl. piping, valves	$240,000		Replace 2 pumps (300 gpm, 36 ft TDH) - incl. piping, valves	$240,000
b	**Boom Truck to support pump replacement**		N/A		N/A			N/A		N/A		N/A		N/A		N/A	need boom truck to remove pumps	$10,000		N/A		N/A			N/A
c	**Bypass pumping during construction - Allowance**		$150,000		$150,000			$150,000		$150,000		$150,000		$150,000		$150,000		$150,000		$150,000		$150,000			$150,000
5	**Electrical**																								
	System Description	*315 kva, 3 phase, overhead*																							
	Service meter	*on pole adjacent to dry pit*		*metal service cabinet, panelboard in dry pit, utility transformer in generator vault*			*pad mounted utility transformer, outdoor pedestal mount service meter*				*pad mount utility transformer, service meter on steel rack near gate*						*pad mounted utility transformer,*		*transformer unknown, service meter outside of service cabinet*		*transformer unknown, service meter outside of service cabinet*			*pad mount utility transformer, service meter on side of service cabinet*	
	Panelboard	*120/208/3 phase, in dry pit*																	*in dry pit*		*in dry pit*			*in dry pit*	
	Starters	*120/208, two FVNR starters*		*klockner-moeller starter and circuit breakers are obsolete*							*2 FVNR Starters*								*2 FVNR Starters*		*2 FVNR Starters*			*2 FVNR Starters*	
a	**Replace electrical equipment**	Replace all electrical	$150,000	Replace electrical equipment	$225,000		Replace electrical equipment	$150,000	Replace electrical equipment	$150,000	Replace electrical equipment	$150,000	Replace electrical equipment	$175,000	Replace electrical equipment	$150,000	Replace electrical equipment	$175,000	Replace electrical equipment	$150,000	Replace electrical equipment	$150,000		Replace electrical equipment	$150,000
	Panelboard																								
	Starters																								
	Wire and conduit												Class 1 Div 2 (no continuous ventilation)												
	City Owned Meter Base	Replace Galvanized Conduit																							
	Fused Disconnect	Replace fused disconnect									needs replacement		none of electrical equipment rated for classified area											needs replacement	
b	**Service Cabinet Work**		N/A	replace service cabinet- on concrete pad	$20,000			N/A		N/A		N/A		N/A		N/A		N/A	Electrical service cabinet - repair bottom of cabinet	$4,500	Electrical service cabinet - repair bottom of cabinet	$4,500		Electrical service cabinet - assume replace cabinet	$20,000

City of Bellevue Lake Washington Lake Line Master Plan
Alternative 3 - Upland Pump Stations
Scope, Assumptions, Class 5 OPCC
June 2023

Area		Points					Evergreen Point				Medina				Meydenbauer Bay						Killarney		Newport South		
		Yarrow Pt PS	2023 Costs	Cozy Cove PS	2023 Costs	Hunts Point	Evergreen East PS	2023 Costs	Evergreen West	2023 Costs	Lake Crest	2023 Costs	Medina Pump Station	2023 Costs	Parker PS	2023 Costs	Grange PS	2023 Costs	Meydenbauer	2023 Costs	Killarney	2023 Costs	Pleasure Point	Bagley	2023 Costs
6	**Generator**																								
	Back up power source	generator receptacle, manual transfer		generator 55kW, diesel in vault			generator receptacle, manual transfer switch		generator receptacle, manual transfer switch		generator receptacle, on steel rack near gate, manual transfer switch		54 kW generator, in vault		Assume no generator at this PS		generator, 60 kW, diesel		generator receptacle, manual transfer switch		generator receptacle, manual transfer switch			generator receptacle, manual transfer switch	
	Generator Vault		N/A	Generator vault (8 x 14 x 8)	N/A			N/A		N/A		N/A	vault dimension unknown	N/A		N/A	Generator vault (14 x 8 x 8)	N/A		N/A		N/A			N/A
a	Replace standby generator, 55 kW, diesel		N/A	Replace standby generator, 55 kW, diesel	$210,000			N/A		N/A		N/A	Assume replacing generator	$210,000		N/A	Replace standby generator, 60 kW, diesel	$210,000		N/A		N/A			N/A
b	Replace vault dehumidifier		N/A		N/A			N/A		N/A		N/A	replace dehumidifier for vault	$5,000		N/A		N/A		N/A		N/A			N/A
c	install automatic primer on drain line to wet well		N/A		N/A			N/A		N/A		N/A		N/A		N/A	install automatic primer on drain line to wet well	$6,000		N/A		N/A			N/A
d	Replace sound-proof insulation material in generator vault		N/A		N/A			N/A		N/A		N/A		N/A		N/A	Replace sound-proof insulation material in generator vault	$8,000		N/A		N/A			N/A
7	**Instrumentation and Control / Telemetry**																								
	telemetry control panel	in dry pit		in dry pit			in dry pit, Siemens CDP-7 Series 8		in outdoor junction box		in dry pit, integral panel with starters						in dry pit		in dry pit, integral panel with starters		in dry pit, integral panel with starters			in dry pit, integral panel with starters	
	primary level	ultrasonic siemens multiranger		ultrasonic siemens multiranger 100			ultrasonic siemens hydroranger 100		ultrasonic siemens hydroranger 100		ultrasonic siemens multiranger 100						ultrasonic siemens hydroranger 100		ultrasonic siemens multiranger 100		ultrasonic siemens multiranger 100			ultrasonic siemens multiranger 100	
	secondary level	high level float		high level float			high level float		high level float		high level float						high level float		high level float		high level float			high level float	
	RTU/PLC	siemens/simatic s7-200		siemens/simatic S7-200			siemens/simatic S7-200		siemens/simatic S7-200		siemens/simatic S7-200						siemens/simatic S7-200		siemens/simatic S7-200		siemens/simatic S7-200			siemens/simatic S7-200	
	telephone modem	control microsystems/series 5000 option F		control microsystems/series 5000 option F			control microsystems/series 5000 option F		control microsystems/series 5000 option F		control microsystems/series 5000 option F						control microsystems/series 5000 option F		control microsystems/series 5000 option F		control microsystems/series 5000 option F			control microsystems/series 5000 option F	
	telephone network interface	overhead, top of qwest pole		in dry pit			in dry pit, Siemens CDP-7 Series		in outdoor junction box		none						in dry pit		in service cabinet		in service cabinet			in service cabinet	
a	Replace I&C system	Replace all	$135,000	Replace all	$135,000		Replace all	$135,000	Replace all	$135,000	Replace all	$135,000	Replace I&C equipment	$135,000	Replace I&C equipment	$135,000	Replace I&C equipment	$135,000	Replace all	$135,000	Replace all	$135,000		Replace all	$135,000
b	telephone network interface	replace / relocate lower on existing pole	included with replace all		N/A			N/A	replace	included with replace	none found	N/A		N/A		N/A		N/A		N/A		N/A			N/A
8	**Washdown water**																								
	System descriptions	domestic/metered, hose bibb in dry pit		domestic/metered, hose bibb in dry pit			domestic/metered, hose bibb in dry pit		domestic/metered, hose bibb in dry pit		domestic/metered, hose bibb in dry pit						domestic/metered, hose bibb in dry pit		domestic/metered, hose bibb in dry pit		domestic/metered, hose bibb in dry pit			domestic/metered, hose bibb in dry pit	
	Device	RPBF		RPBF			RPBF		RPBF		RPBF						RPBF		RPBF		RPBF			RPBF	
	Enclosure / Freeze protection	below ground water meter box, insulation box, bags		in generator vault, heat tape for freeze protection			adjacent to dry pit above ground in concrete meter box		in dry pit near opening		in dry pit near opening						in generator vault		two stacked water meter boxes / heat tape		below grade box			underground meter box / heat tap	
a	**Install backflow assembly above grade in an enclosure, install drain**	Install backflow assembly above grade in an enclosure, install drain	$8,500		N/A			N/A		N/A		N/A	Install device above grade in an enclosure	$8,500	Assume required for this PS	$8,500	Install backflow assembly above grade in an enclosure, install drain	$8,500		N/A	Install backflow assembly above grade in an enclosure, install drain	$8,500		Install backflow assembly above grade in an enclosure, install drain	$8,500
9	**Miscellaneous PS Work**																								
a	**Install Connections to enable Pumped Bypass of PS** (cost basis Newport Shores PS - Pump Suction and Discharge	Allowance	$30,000	Allowance	$30,000		Allowance	$30,000	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000	Allowance	$30,000	Has pig launch but no bypass	$30,000	Allowance	$30,000		Allowance	$30,000
b	**ancillary components**																								
b1	Access Hatch Fall Protection for dry pit and wet well blower vault	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000		Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000		$20,000	assumed similar repairs to other pump stations	$20,000	assumed similar repairs to other pump stations	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000	Access Hatch Fall Protection for dry pit and wet well blower vault, incl. add grating between wall and staircase	$25,000	Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000		Access Hatch Fall Protection for dry pit and wet well blower vault	$20,000
b2	Raise cover (operator) for FM isolation valve		N/A	FM isolation valve buried, need to excavate and raise	$5,000			N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A			N/A
b3	clear brush at intake		N/A		N/A			N/A		N/A		N/A		N/A		N/A	clear brush at intake	$5,000		N/A		N/A			N/A
10	**Site / Access**												replace dehumidifier	3000											
	Vehicle access - MOT	public access path to lake, removable bollards	$10,000	gravel pull off for generator vault, use property driveway to access PS	$5,000		back down narrow one lane street, no turn around	N/A	one lane steep driveway, parking adjacent to pump station	N/A	narrow paved road, parking adjacent to station	N/A	shares common access road with wheel chair access to City Haul Bldg. vehicles obstruct access	$20,000		N/A	easily accessible, two parking spots reserved for CoB, future City park area	N/A	two way street, parking adjacent to site	N/A	steep driveway, switch back pavement driveway, parking 20 ft from station	N/A		located in grassy area adjacent to lake and Newcastle Beach Park, access via gravel drive, narrow path to PS	N/A
	Landscaping - Restoration	grass	$10,000	landscaped, service cabinet overgrown with bushes	$20,000		gravel	N/A	laurel bushes surround station	$10,000	shrubs, maintained by others, trim trees to provide clearance and access, revise landscaping	$20,000	in grassed area	$10,000		N/A	rock retaining wall along 1 side, landscape bushes	$5,000	paved space - prune bushes near site	$2,000	heavy cover - fir trees	$2,000		grass, city mows grass and takes care of driveway - grass restoration only	$5,000
	Sight Lighting - no changes	none	N/A	none	N/A		none	N/A	none	N/A	none	N/A	unknown	N/A		N/A	none	N/A	none	N/A	none	N/A		none	N/A
	Fence / Security	lockable hatch - dry pit, lockable MH - wet well	N/A	raised hatch over wetwell and dry well with lock	N/A		vault hatches locked	N/A	none - in residents garden, consider installing fence	$5,000	none	N/A	appears none from photos	N/A		N/A	all vaults locked	N/A	none	N/A	none	N/A		none	N/A
	Public Accessibility	full access / public access to lake	N/A	PS on private lot, generator vault and service cabinet accessible on side of road	N/A		public path to dock	N/A	full access to site	N/A	full access to site	N/A	full access to site	N/A		N/A	near marina, public access to site	N/A	public access, adjacent to sidewalk	N/A	within unmarked / unimproved public ROW	N/A		full access to site	N/A
		subtotal - direct costs	**$902,500**		**$1,374,000**			**$849,000**		**$864,000**		**$929,000**		**$1,195,500**		**$882,500**		**$1,117,500**		**$871,500**		**$875,000**			**$893,500**

ATTACHMENT 11
DETAILED CLASS 5 COST ESTIMATES BY SERVICE AREA

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Hunts Point and Yarrow Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$4,250,000	$4,250,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$18,500,000	$18,500,000		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 4 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	129	EA	$4,000	$516,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 35% minimal demo, 65% moderate demo. Assume connections avoid areas with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$130,000	$130,000		New lateral and sewer line connections, assume 10% of locations require tree removal.
8	Wetherill Nature Preserve		SF		N/A		Assume work in this area limited to lateral or sewer line connection, costs accounted for in other bid items.
9	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
10	Barge Mob / Demob	4	LS	$350,000	$1,400,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	32	MTH	$235,000	$7,520,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - In Water Turbidity Curtain	16,755	LF	$20	$335,100		
13	TESC (Allowance) - Lateral and Sewer Line Connections	129	EA	$500	$64,500		Minimal TESC assumed
14	Bathymetric Survey	335,100	SF	$9	$3,015,900		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
15	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
16	**8" Sewer Pipe - In Water**	16,755	LF	$1,400	$23,457,000		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, ~3 to 3.5 ft cover over pipe, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees.
17	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
18	Access / Maintenance Hole	17	EA	$45,000	$765,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required, new pipe alignment
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	110	EA	$10,700	$1,177,000		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, In Water	11,000	LF	$1,400	$15,400,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
23	Sewer Line Connection (Allowance)	19	EA	$150,000	$2,850,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**						
27	Minimal - Grass Sod Only	45	EA	$5,000	$225,000		Assumes 35% of lateral and sewer line connections in minimal restoration areas.
28	Moderate - Landscaping, Minimal Hardscape	84	EA	$25,000	$2,100,000		Assumes 65% of lateral and sewer line connections in moderate restoration areas.
29	Maximum - Hardscapes, Structures	0	EA	$50,000	$0		Assume none for this alternate - connections located to avoid maximum surface demolition and restoration.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	16,755	LF	$7.50	$125,663		
34	Abandon Existing Sewer Lake Line	16,755	LF	$11.00	$184,305		clean, flush, cap and abandon, no grout or other fill.
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						EXCLUDES Deepening existing pump stations
37	Yarrow Point Pump Station Rehab	1	LS	$877,500	$877,500		Replace 2 pumps
38	Cozy Cove Pump Station Rehab	1	LS	$1,374,000	$1,374,000		Replace 3 pumps, replace generator
39	Hunts Point Pump Station Rehab	1	LS	$944,000	$944,000		Replace 2 pumps, replace all H20 access hatches
40	**Flush Stations**						
41	Flush Station No. 1 Rehab incl. replace lake intake pipe	1	LS	$1,390,000	$1,390,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 900 LF intake pipe
42	Flush Station No. 2 Rehab, incl. replace lake intake pipe	1	LS	$2,710,000	$2,710,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 2,100 LF intake pipe
					SUBTOTAL =	**$89,311,000**	

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$26,793,300*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$116,104,300**		
WA SALES TAX =	$11,730,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$127,834,300**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$51,140,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$178,974,300**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$57,272,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$5,369,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$8,949,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$895,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$5,369,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$77,854,000**		
SOFT COST CONTINGENCY =	*$31,142,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$108,996,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$287,970,300**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$127,834,300**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$77,854,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$82,282,000**	*29%*
Total Project Cost (TPC) =	**$287,970,300**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Hunts Point and Yarrow Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,790,000	$2,790,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,100,000	$4,100,000		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$4,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	335,100	SF	$8.70	$2,915,370		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 35% min demo, 60% mod demo, 5% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$840,000	$840,000		Sewer Main, assume 10% of length requires tree removal.
8	Wetherill Nature Preserve - Sewer Main	700	LF	$550	$385,000		Approx. 600-700 LF shore line includes Wetherill Nature Preserve. Allowance approximates cost difference to install sewer in water in lieu of on shore.
9	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
10	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	16	MTH	$235,000	$3,760,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - Sewer Main	16,755	LF	$15	$251,325		
13	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
14	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
15	Permits - EXCLUDED				$0		EXCLUDED
16	**8" Sewer Pipe - On Shore**	16,755	LF	$850	$14,241,750		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
17	Trench Dewatering (Allowance)	16,755	LF	$100	$1,675,500		sump dewatering, settling tanks before local discharge
18	4 FT Maintenance Hole	42	EA	$15,000	$630,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	110	EA	$6,700	$737,000		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, On Shore	1,100	LF	$20	$22,000		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
23	Sewer Line Connection (Allowance)	19	EA	$50,000	$950,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**				$0		
27	Minimal - Grass Sod Only	117,285	SF	$15	$1,759,275		Assumes 35% restoration is minimal.
28	Moderate - Landscaping, Minimal Hardscape	201,060	SF	$65	$13,068,900		Assumes 60% restoration is moderate.
29	Maximum - Hardscapes, Structures	16,755	SF	$130	$2,178,150		Assumes 5% restoration is maximum.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	16,755	LF	$7.50	$125,663		
34	Abandon Existing Sewer Lake Line	16,755	LF	$11.00	$184,305		
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						
37	Yarrow Point Pump Station Rehab	1	LS	$877,500	$877,500		Replace 2 pumps
38	Cozy Cove Pump Station Rehab	1	LS	$1,374,000	$1,374,000		Replace 3 pumps, replace generator
39	Hunts Point Pump Station Rehab	1	LS	$944,000	$944,000		Replace 2 pumps, replace all access hatches, H20 rated
40	**Flush Stations**						
41	Flush Station No. 1 Rehab incl. replace lake intake pipe	1	LS	$1,390,000	$1,390,000		replace pumps, pipe, valves, $30,000 structure rehab allowance, replace 900 LF intake pipe
42	Flush Station No. 2 Rehab, incl. replace lake intake pipe	1	LS	$2,710,000	$2,710,000		replace pumps, pipe, valves, $30,000 structure rehab allowance, replace 2,100 LF intake pipe
				SUBTOTAL =	**$58,610,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$17,583,000*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$76,193,000**		
	WA SALES TAX =				$7,700,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$83,893,000**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$33,560,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$117,453,000**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

	Amount	%	Notes
ENGINEERING DESIGN (CONSULTANTS)	$37,585,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,524,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,873,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$587,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,524,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$51,093,000**		
SOFT COST CONTINGENCY =	*$20,437,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$71,530,000**		

EASEMENT /REAL ESTATE COSTS:

	Amount	%
TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =		
PERMANENT EASEMENT =		
REAL PROPERTY STAFF =		
EASEMENT COST SUBTOTAL =	**$0**	
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**	
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$188,983,000**	

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$83,893,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$51,093,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$53,997,000**	*29%*
Total Project Cost (TPC) =	**$188,983,000**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Hunts Point and Yarrow Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$3,470,000	$3,470,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$9,100,000	$9,100,000		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 3 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	129	EA	$4,000	$516,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 35% minimal demo, 65% moderate demo. Assume connections avoid areas with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	68	EA	$16,000	$1,088,000		Pits located every 250 ft, assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$520,000	$520,000		New pits and lateral and sewer line connections, assume 10% of locations require tree removal.
8	Wetherill Nature Preserve	700	LF	$200	$140,000		Approx. 600-700 LF shore line includes Wetherill Nature Preserve. Allowance approximates cost difference to install sewer in water, assuming max bore length of 250 LF and no access pits allowed in nature preserve.
9	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
10	Barge Mob / Demob	4	LS	$350,000	$1,400,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	26	MTH	$235,000	$6,110,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - Trenchless Pits	68	EA	$10,000	$680,000		Minimal TESC assumed
13	TESC (Allowance) - Lateral Connections	129	EA	$500	$64,500		Minimal TESC assumed
14	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
15	Permits - EXCLUDED				$0		EXCLUDED
16	**8" Sewer Pipe - Trenchless**	16,755	LF	$1,200	$20,106,000		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
17	Launch / Retrieval Access Pits	68	EA	$150,600	$10,240,800		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
18	4 FT Maintenance Hole	68	EA	$15,000	$1,020,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	110	EA	$6,700	$737,000		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, On Shore	5,500	LF	$55	$302,500		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
23	Sewer Line Connection (Allowance)	19	EA	$80,000	$1,520,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**				$0		
27	Minimal - Grass Sod Only	56,200	SF	$15	$843,000		Assumes 35% restoration is minimal.
28	Moderate - Landscaping, Minimal Hardscape	96,300	SF	$65	$6,259,500		Assumes 60% restoration is moderate.
29	Maximum - Hardscapes, Structures	8,100	SF	$130	$1,053,000		Assumes 5% restoration is maximum.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	16,755	LF	$7.50	$125,663		
34	Abandon Existing Sewer Lake Line	16,755	LF	$11.00	$184,305		
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						
37	Yarrow Point Pump Station Rehab	1	LS	$877,500	$877,500		Replace 2 pumps
38	Cozy Cove Pump Station Rehab	1	LS	$1,374,000	$1,374,000		Replace 3 pumps, replace generator
39	Hunts Point Pump Station Rehab	1	LS	$944,000	$944,000		Replace 2 pumps, replace all access hatches, H20 rated
40	**Flush Stations**						
41	Flush Station No. 1 Rehab incl. replace lake intake pipe	1	LS	$1,390,000	$1,390,000		replace pumps, pipe, valves, $30,000 structure rehab allowance, replace 900 LF intake pipe
42	Flush Station No. 2 Rehab, incl. replace lake intake pipe	1	LS	$2,710,000	$2,710,000		replace pumps, pipe, valves, $30,000 structure rehab allowance, replace 2,100 LF intake pipe

SUBTOTAL =	**$72,776,000**		
ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$21,832,800*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$94,608,800**		
WA SALES TAX =	$9,560,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$104,168,800**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$41,670,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$145,838,800**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$46,668,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$4,375,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$7,292,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$729,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$4,375,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$63,439,000**		
SOFT COST CONTINGENCY =	*$25,376,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$88,815,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$234,653,800**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$104,168,800**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$63,439,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$67,046,000**	*29%*
Total Project Cost (TPC) =	**$234,653,800**	*100%*

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Hunts Point and Yarrow Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$5,730,000	$5,730,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$16,300,000	$16,300,000		Work Window July 16th to March 15th. Assume Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 3 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	129	EA	$9,000	$1,161,000		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 35% minimal demo, 60% moderate demo. Assume installations avoid areas with maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	54,348	LF	$112.50	$6,114,150		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$2,170,000	$2,170,000		Grinder pump installations and 6" Sewer Line, assume 10% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	1,700	SY	$54	$91,800		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6 inches.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	24	MTH	$235,000	$5,640,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	3,890	LF	$10	$38,900		Work in pavement, minimal TESC
12	TESC (Allowance) - Discharge Main - Grinder Pump	54,348	LF	$15	$815,220		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder pump, Lateral and Sewer Line Connections	129	EA	$750	$96,750		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	3,890	LF	$310	$1,205,900		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	3,890	LF	$100	$389,000		
17	4 FT Maintenance Hole	10	EA	$22,500	$225,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	54,348	LF	$170	$9,239,160		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	54,348	LF	$100	$5,434,800		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	129	EA	$86,000	$11,094,000		Imported backfill materials
25	Electrical (Allowance) for Grinder Pump Installations	129	EA	$30,000	$3,870,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	450,000	SF	$15	$6,750,000		Assumes 35% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	480,000	SF	$65	$31,200,000		Assumes 60% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	10,000	SF	$130	$1,300,000		Assumes 5% restoration is maximum. Grinder pumps, laterals, 6" sewer line
30	Temporary Pavement Patch - 8" Sewer Line	1,700	SY	$25	$42,500		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	2,600	SY	$50	$130,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel	2,667	SY	$600	$1,600,000		Hunt's Point, assume 4,000 LF x 6 ft wide trench patch
33	Mill and Resurface - Asphalt	5,200	SY	$20	$104,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	58,238	LF	$7.50	$436,785		
35	Abandon Existing Sewer Lake Line	16,755	LF	$11.00	$184,305		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$1,160,000	$1,160,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$16,500,000	$165,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Yarrow Point Pump Station Rehab	1	LS	$902,500	$902,500		Increase PS gpm by 30-40% (e.g. new pumps, discharge pipe, valves, etc.), new electrical, new I&C, rehab PS structure consistent with other alternatives (e.g, recoat wet well, upgrades to meet classifiction requirements, etc.)
40	Yarrow Point New 8" Force Main	3,916	LF	$1,040	$4,072,640		Yarrow PS new force main located on shore connecting to Cozy Cove PS - includes clearing / demolition, trench dewatering, restoration, etc.
41	Cozy Cove Pump Station Rehab	1	LS	$1,374,000	$1,374,000		Replace 3 pumps, replace generator
42	Hunts Point Pump Station Rehab	1	LS	$80,000	$80,000		Abandon
43	**Flush Stations**						
44	Flush Station No. 1	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
45	Flush Station No. 2	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.

SUBTOTAL =	**$120,367,000**		
ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$36,110,100*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$156,477,100**		
WA SALES TAX =	$15,810,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$172,287,100**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$68,920,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$241,207,100**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$77,186,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$7,236,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$12,060,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$1,206,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$7,236,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$104,924,000**		
SOFT COST CONTINGENCY =	*$41,970,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$146,894,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$388,101,100**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$172,287,100**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$104,924,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$110,890,000**	*29%*
Total Project Cost (TPC) =	**$388,101,100**	*100%*

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 1/31/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Evergreen Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,040,000	$2,040,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$3,000,000	$3,000,000		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	86	EA	$8,000	$688,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 20% minimal demo, 20% moderate demo. And 60% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$200,000	$200,000		New lateral and sewer line connections, assume 25% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	16	MTH	$235,000	$3,760,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - In Water Turbidity Curtain	8,423	LF	$20	$168,460		
12	TESC (Allowance) - Lateral and Sewer Line Connections	86	EA	$500	$43,000		Minimal TESC assumed
13	Bathymetric Survey	168,460	SF	$9	$1,516,140		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
14	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
15	**8" Sewer Pipe - In Water**	8,423	LF	$1,400	$11,792,200		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees..
16	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
17	Access / Maintenance Hole	9	EA	$45,000	$405,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	79	EA	$10,700	$845,300		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, In Water	7,900	LF	$1,400	$11,060,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
22	Sewer Line Connection (Allowance)	7	EA	$150,000	$1,050,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**						
26	Minimal - Grass Sod Only	17	EA	$5,000	$85,000		Assumes 20% of lateral and sewer line connections in minimal restoration areas.
27	Moderate - Landscaping, Minimal Hardscape	17	EA	$25,000	$425,000		Assumes 20% of lateral and sewer line connections in moderate restoration areas.
28	Maximum - Hardscapes, Structures	52	EA	$50,000	$2,600,000		Assumes 60% of lateral and sewer line connections in maximum restoration areas.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	8,423	LF	$7.50	$63,173		
33	Abandon Existing Sewer Lake Line	8,423	LF	$11.00	$92,653		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Evergreen East Pump Station Rehab	1	LS	$849,000	$849,000		Replace 2 pumps
37	Evergreen West Pump Station Rehab	1	LS	$864,000	$864,000		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 3 Rehab incl. replace lake intake pipe	1	LS	$613,000	$613,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 180 LF intake pipe
				SUBTOTAL =	**$42,860,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$12,858,000*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$55,718,000**		
	WA SALES TAX =				$5,630,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$61,348,000**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$24,540,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$85,888,000**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$27,484,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,577,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$4,294,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$429,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,577,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$37,361,000**		
SOFT COST CONTINGENCY =	*$14,944,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$52,305,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$138,193,000**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$61,348,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$37,361,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$39,484,000**	*29%*
Total Project Cost (TPC) =	**$138,193,000**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 1/31/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Evergreen Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$1,700,000	$1,700,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	0	LS		N/A		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 1 work window.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$4,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	168,460	SF	$18.00	$3,032,280		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 20% min demo, 20% mod demo, 60% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$970,000	$970,000		Sewer Main, assume 25% of length requires tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	1	LS	$350,000	$350,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	8	MTH	$235,000	$1,880,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Sewer Main	8,423	LF	$15	$126,345		
12	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - On Shore**	8,423	LF	$850	$7,159,550		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
16	Trench Dewatering (Allowance)	8,423	LF	$100	$842,300		sump dewatering, settling tanks before local discharge
17	4 FT Maintenance Hole	22	EA	$15,000	$330,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	79	EA	$6,700	$529,300		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	790	LF	$20	$15,800		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
22	Sewer Line Connection (Allowance)	7	EA	$50,000	$350,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	33,700	SF	$15	$505,500		Assumes 20% of lateral and sewer line connections in minimal restoration areas.
27	Moderate - Landscaping, Minimal Hardscape	33,700	SF	$65	$2,190,500		Assumes 20% of lateral and sewer line connections in moderate restoration areas.
28	Maximum - Hardscapes, Structures	101,100	SF	$130	$13,143,000		Assumes 60% of lateral and sewer line connections in maximum restoration areas.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	8,423	LF	$7.50	$63,173		
33	Abandon Existing Sewer Lake Line	8,423	LF	$11.00	$92,653		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Evergreen East Pump Station Rehab	1	LS	$849,000	$849,000		Replace 2 pumps
37	Evergreen West Pump Station Rehab	1	LS	$864,000	$864,000		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 3 Rehab incl. replace lake intake pipe	1	LS	$613,000	$613,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 180 LF intake pipe
				SUBTOTAL =	**$35,606,000**		
				ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$10,681,800*	*30.0%*	See estimate contingency.
				INFLATION =	*$0*	*0.0%*	EXCLUDED
				ESCALATION =	*$0*	*0.0%*	EXCLUDED
				SUBTOTAL (A) =	**$46,287,800**		
				WA SALES TAX =	$4,680,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
				TOTAL BID AMOUNT (B) =	**$50,967,800**		
				CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$20,390,000*	*40.0%*	*Risk based management reserve, High Risk Level*
				TOTAL CONSTRUCTION HARD COST (C) =	**$71,357,800**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$22,834,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,141,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$3,568,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$357,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,141,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$31,041,000**		
SOFT COST CONTINGENCY =	*$12,416,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$43,457,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$114,814,800**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$50,967,800**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$31,041,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$32,806,000**	*29%*
Total Project Cost (TPC) =	**$114,814,800**	*100%*

UTILITIES Project Management

City of Bellevue Utilities

Project: **City of Bellevue - Lake Washington Lake Line Master Plan**

Project Cost Estimate - Alternative Identification CC Index:

Date: 8/7/2023 Revision Date/s 1/31/2024

Prepared by: C. Gallo, Jacobs Date Prepared

Checked by: Date Checked

Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Evergreen Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$1,880,000	$1,880,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$2,800,000	$2,800,000		Work Window July 16th to March 15th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	86	EA	$8,000	$688,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 20% minimal demo, 20% moderate demo. And 60% maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	34	EA	$32,000	$1,088,000		Assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$800,000	$800,000		New pits and lateral and sewer line connections, assume 25% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	14	MTH	$235,000	$3,290,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Trenchless Pits	34	EA	$10,000	$340,000		Minimal TESC assumed
12	TESC (Allowance) - Lateral Connections	86	EA	$500	$43,000		Minimal TESC assumed
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - Trenchless**	8,423	LF	$1,200	$10,107,600		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
16	Launch / Retrieval Access Pits	34	EA	$150,600	$5,120,400		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
17	4 FT Maintenance Hole	34	EA	$15,000	$510,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	79	EA	$6,700	$529,300		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	3,950	LF	$55	$217,250		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
22	Sewer Line Connection (Allowance)	7	EA	$80,000	$560,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	17,800	SF	$15	$267,000		Assumes 20% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	17,800	SF	$65	$1,157,000		Assumes 20% restoration is moderate.
28	Maximum - Hardscapes, Structures	53,300	SF	$130	$6,929,000		Assumes 60% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	8,423	LF	$7.50	$63,173		
33	Abandon Existing Sewer Lake Line	8,423	LF	$11.00	$92,653		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Evergreen East Pump Station Rehab	1	LS	$849,000	$849,000		Replace 2 pumps
37	Evergreen West Pump Station Rehab	1	LS	$864,000	$864,000		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 3 Rehab incl. replace lake intake pipe	1	LS	$613,000	$613,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 180 LF intake pipe
	SUBTOTAL =				**$39,508,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$11,852,400*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$51,360,400**		
	WA SALES TAX =				$5,190,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$56,550,400**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$22,630,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$79,180,400**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$25,338,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,375,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$3,959,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$396,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,375,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$34,443,000**		
SOFT COST CONTINGENCY =	*$13,777,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$48,220,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$127,400,400**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$56,550,400**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$34,443,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$36,407,000**	*29%*
Total Project Cost (TPC) =	**$127,400,400**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 1/31/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Evergreen Point

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$3,120,000	$3,120,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,700,000	$4,700,000		Work Window July 16th to March 15th. Assume Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 2 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	86	EA	$18,000	$1,548,000		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 20% minimal demo, 20% moderate demo, and 60% maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	27,170	LF	$112.50	$3,056,625		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$2,760,000	$2,760,000		Grinder pump installations and 6" Sewer Line, assume 25% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	2,100	SY	$54	$113,400		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6-inches.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	16	MTH	$235,000	$3,760,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	4,633	LF	$10	$46,330		Work in pavement, minimal TESC
12	TESC (Allowance) - Sewer Force Main - Grinder Pump	27,170	LF	$15	$407,550		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder pump, Lateral and Sewer Line Connections	86	EA	$750	$64,500		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	4,633	LF	$310	$1,436,230		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	4,633	LF	$100	$463,300		
17	4 FT Maintenance Hole	12	EA	$22,500	$270,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	27,170	LF	$170	$4,618,900		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	27,170	LF	$100	$2,717,000		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	86	EA	$86,000	$7,396,000		
25	Electrical (Allowance) for Grinder Pump Installations	86	EA	$30,000	$2,580,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	220,000	SF	$15	$3,300,000		Assumes 20% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	220,000	SF	$65	$14,300,000		Assumes 20% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	50,000	SF	$130	$6,500,000		Assumes 60% restoration is maximum for grinder pumps and lateral connections.
30	Temporary Pavement Patch - 8" Sewer Line	2,100	SY	$25	$52,500		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	3,100	SY	$50	$155,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate.
33	Mill and Resurface - Asphalt	6,200	SY	$20	$124,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	31,803	LF	$7.50	$238,523		
35	Abandon Existing Sewer Lake Line	8,423	LF	$11.00	$92,653		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$640,000	$640,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$9,500,000	$95,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Evergreen East Pump Station Rehab	1	LS	$80,000	$80,000		Abandon
40	Evergreen West Pump Station Rehab	1	LS	$80,000	$80,000		Abandon
41							
42	**Flush Stations**						
43	Flush Station No. 3	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
				SUBTOTAL =	**$65,516,000**		
				ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$19,654,800*	*30.0%*	See estimate contingency.
				INFLATION =	*$0*	*0.0%*	EXCLUDED
				ESCALATION =	*$0*	*0.0%*	EXCLUDED
				SUBTOTAL (A) =	**$85,170,800**		
				WA SALES TAX =	$8,610,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
				TOTAL BID AMOUNT (B) =	**$93,780,800**		
				CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$37,520,000*	*40.0%*	*Risk based management reserve, High Risk Level*
				TOTAL CONSTRUCTION HARD COST (C) =	**$131,300,800**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

	Amount	%	Notes
ENGINEERING DESIGN (CONSULTANTS)	$42,016,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,939,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$6,565,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$657,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,939,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$57,116,000**		
SOFT COST CONTINGENCY =	*$22,846,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$79,962,000**		

EASEMENT /REAL ESTATE COSTS:

	Amount	%
TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =		
PERMANENT EASEMENT =		
REAL PROPERTY STAFF =		
EASEMENT COST SUBTOTAL =	**$0**	
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**	
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$211,262,800**	

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$93,780,800**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$57,116,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$60,366,000**	*29%*
Total Project Cost (TPC) =	**$211,262,800**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Medina South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,750,000	$2,750,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$8,100,000	$8,100,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 3 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	87	EA	$7,000	$609,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 25% minimal demo, 25% moderate demo, and 50% maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$520,000	$520,000		New lateral and sewer line connections, assume 60% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	23	MTH	$235,000	$5,405,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - In Water Turbidity Curtain	12,320	LF	$20	$246,400		
12	TESC (Allowance) - Lateral and Sewer Line Connections	87	EA	$500	$43,500		Minimal TESC assumed
13	Bathymetric Survey	246,400	SF	$9	$2,217,600		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
14	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
15	**8" Sewer Pipe - In Water**	12,320	LF	$1,400	$17,248,000		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees..
16	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
17	Access / Maintenance Hole	13	EA	$45,000	$585,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	80	EA	$10,700	$856,000		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, In Water	8,000	LF	$1,400	$11,200,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
22	Sewer Line Connection (Allowance)	7	EA	$150,000	$1,050,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**						
26	Minimal - Grass Sod Only	22	EA	$5,000	$110,000		Assumes 25% of lateral and sewer line connections in minimal restoration areas.
27	Moderate - Landscaping, Minimal Hardscape	22	EA	$25,000	$550,000		Assumes 25% of lateral and sewer line connections in moderate restoration areas.
28	Maximum - Hardscapes, Structures	44	EA	$50,000	$2,200,000		Assumes 50% of lateral and sewer line connections in maximum restoration areas.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,320	LF	$7.50	$92,400		
33	Abandon Existing Sewer Lake Line	12,320	LF	$11.00	$135,520		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Lake Crest Pump Station Rehab	1	LS	$879,000	$879,000		Replace 2 pumps
37	Medina Pump Station Rehab	1	LS	$1,195,500	$1,195,500		Replace 2 pumps, replace generator
38							
39	**Flush Stations**						
40	Flush Station No. 4 Rehab incl. replace lake intake pipe	1	LS	$631,000	$631,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 210 LF intake pipe
				SUBTOTAL =	**$57,674,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$17,302,200*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$74,976,200**		
	WA SALES TAX =				$7,580,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$82,556,200**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$33,030,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$115,586,200**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$36,988,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,468,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,779,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$578,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,468,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$50,281,000**		
SOFT COST CONTINGENCY =	*$20,112,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$70,393,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$185,979,200**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$82,556,200**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$50,281,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$53,142,000**	*29%*
Total Project Cost (TPC) =	**$185,979,200**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: City of Bellevue - Lake Washington Lake Line Master Plan
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Medina South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,620,000	$2,620,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$3,900,000	$3,900,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$7,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	246,400	SF	$16.70	$4,114,880		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 25% min demo, 25% mod demo, 50% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$3,700,000	$3,700,000		Sewer Main, assume 60% of length requires tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	12	MTH	$235,000	$2,820,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Sewer Main	12,320	LF	$15	$184,800		
12	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - On Shore**	12,320	LF	$850	$10,472,000		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
16	Trench Dewatering (Allowance)	12,320	LF	$100	$1,232,000		sump dewatering, settling tanks before local discharge
17	4 FT Maintenance Hole	31	EA	$15,000	$465,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	80	EA	$6,700	$536,000		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	800	LF	$20	$16,000		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
22	Sewer Line Connection (Allowance)	7	EA	$50,000	$350,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	61,600	SF	$15	$924,000		Assumes 25% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	61,600	SF	$65	$4,004,000		Assumes 25% restoration is moderate.
28	Maximum - Hardscapes, Structures	123,200	SF	$130	$16,016,000		Assumes 50% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,320	LF	$7.50	$92,400		
33	Abandon Existing Sewer Lake Line	12,320	LF	$11.00	$135,520		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Lake Crest Pump Station Rehab	1	LS	$879,000	$879,000		Replace 2 pumps
37	Medina Pump Station Rehab	1	LS	$1,195,500	$1,195,500		Replace 2 pumps, replace generator
38							
39	**Flush Stations**						
40	Flush Station No. 4 Rehab incl. replace lake intake pipe	1	LS	$631,000	$631,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 210 LF intake pipe
	SUBTOTAL =				**$54,988,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$16,496,400*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$71,484,400**		
	WA SALES TAX =				$7,220,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$78,704,400**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$31,490,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$110,194,400**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$35,262,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,306,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,510,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$551,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,306,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$47,935,000**		
SOFT COST CONTINGENCY =	*$19,174,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$67,109,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$177,303,400**		

Cost Estimates Summary:

		% of TPC
Total Construction Cost (TCC) w/o Contingency =	**$78,704,400**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$47,935,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$50,664,000**	*29%*
Total Project Cost (TPC) =	**$177,303,400**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Medina South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,560,000	$2,560,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$3,700,000	$3,700,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	87	EA	$7,000	$609,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 25% minimal demo, 25% moderate demo, and 50% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	50	EA	$28,000	$1,400,000		Assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$2,080,000	$2,080,000		New pits and lateral and sewer line connections, assume 60% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	20	MTH	$235,000	$4,700,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Trenchless Pits	50	EA	$10,000	$500,000		Minimal TESC assumed
12	TESC (Allowance) - Lateral Connections	87	EA	$500	$43,500		Minimal TESC assumed
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - Trenchless**	12,320	LF	$1,200	$14,784,000		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
16	Launch / Retrieval Access Pits	50	EA	$150,600	$7,530,000		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
17	4 FT Maintenance Hole	50	EA	$15,000	$750,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	80	EA	$6,700	$536,000		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	4,000	LF	$55	$220,000		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
22	Sewer Line Connection (Allowance)	7	EA	$80,000	$560,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	28,700	SF	$15	$430,500		Assumes 25% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	28,700	SF	$65	$1,865,500		Assumes 25% restoration is moderate.
28	Maximum - Hardscapes, Structures	57,400	SF	$130	$7,462,000		Assumes 50% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,320	LF	$7.50	$92,400		
33	Abandon Existing Sewer Lake Line	12,320	LF	$11.00	$135,520		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Lake Crest Pump Station Rehab	1	LS	$879,000	$879,000		Replace 2 pumps
37	Medina Pump Station Rehab	1	LS	$1,195,500	$1,195,500		Replace 2 pumps, replace generator
38							
39	**Flush Stations**						
40	Flush Station No. 4 Rehab incl. replace lake intake pipe	1	LS	$631,000	$631,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 210 LF intake pipe
	SUBTOTAL =				**$53,714,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$16,114,200*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$69,828,200**		
	WA SALES TAX =				$7,060,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$76,888,200**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$30,760,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$107,648,200**		
	THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.						
	SOFT COSTS:						
	ENGINEERING DESIGN (CONSULTANTS)				$34,447,000	32.0%	Percent of Construction Hard Costs (C)
	PLANNING					4.0%	
	ALTERNATIVE EVALUATION					7.0%	
	DESIGN					14.0%	
	PERMITTING					4.0%	
	OUTREACH					3.0%	
	ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =				$3,229,000	3.0%	Percent of Construction Hard Costs (C)
	CITY LABOR (PM AND PERMITTING SUPPORT) =				$5,382,000	5.0%	Percent of Construction Cost (C), 5% is typical
	PERMITTING, LEGAL & PRINTED MATERIALS =				$538,000	0.5%	
	CONSTRUCTION MANAGEMENT BY THE CITY =				$3,229,000	3.0%	Percent of Construction Cost (C), 3% is typical
	POST CONSTRUCTION PERMIT MONITORING =				$0		For creek projects assume +/- $20K per year for 5 years (2019).
	SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =				**$46,825,000**		
	SOFT COST CONTINGENCY =				*$18,730,000*	*40.0%*	
	TOTAL SOFT COST W/ CONTINGENCY (D) =				**$65,555,000**		
	EASEMENT /REAL ESTATE COSTS:						
	TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =						
	PERMANENT EASEMENT =						
	REAL PROPERTY STAFF =						
	EASEMENT COST SUBTOTAL =				**$0**		
	EASEMENT COST CONTINGENCY =				*$0*	*30.0%*	
	TOTAL EASEMENT COST W/ CONTINGENCY (E) =				**$0**		
	TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)				**$173,203,200**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$76,888,200**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$46,825,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$49,490,000**	*29%*
Total Project Cost (TPC) =	**$173,203,200**	*100%*

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Medina South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,950,000	$2,950,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,800,000	$4,800,000		Assume Work Window July 16th to April 30th Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 2 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	76	EA	$15,750	$1,197,000		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 25% minimal demo, 25% moderate demo, and 50% with maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	21,459	LF	$112.50	$2,414,138		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$5,590,000	$5,590,000		Grinder pump installations and 6" Sewer Line, assume 50% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	1,700	SY	$54	$91,800		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6 inches.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	20	MTH	$235,000	$4,700,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	3,836	LF	$10	$38,360		Work in pavement, minimal TESC
12	TESC (Allowance) - Sewer Force Main - Grinder Pump	21,459	LF	$15	$321,885		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder, Lateral and Sewer Line Connections	76	EA	$750	$57,000		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	3,836	LF	$310	$1,189,160		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	3,836	LF	$100	$383,600		
17	4 FT Maintenance Hole	10	EA	$22,500	$225,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	21,459	LF	$170	$3,648,030		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	21,459	LF	$100	$2,145,900		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	76	EA	$86,000	$6,536,000		
25	Electrical (Allowance) for Grinder Pump Installations	76	EA	$30,000	$2,280,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	180,000	SF	$15	$2,700,000		Assumes 25% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	180,000	SF	$65	$11,700,000		Assumes 25% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	30,000	SF	$130	$3,900,000		Assumes 50% restoration is maximum. Grinder pumps, laterals, 6" sewer line
30	Temporary Pavement Patch - 8" Sewer Line	1,700	SY	$25	$42,500		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	2,600	SY	$50	$130,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate.
33	Mill and Resurface - Asphalt	5,100	SY	$20	$102,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	25,295	LF	$7.50	$189,713		
35	Abandon Existing Sewer Lake Line	12,320	LF	$11.00	$135,520		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$510,000	$510,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$7,600,000	$76,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Lake Crest Pump Station Rehab	1	LS	$929,000	$929,000		Replace 2 pumps, double existing flow rate (e.g. new pumps, discharge pipe, valves, etc.), new electrical, new I&C, rehab PS structure consistent with other alternatives (e.g, recoat wet well, upgrades to meet classification requirements, etc.)
40	Lake Crest New 8" Force Main - Open Cut	934	LF	$1,040	$971,360		Lake Crest PS new force main from PS to Evergreen Point Road - includes clearing / demolition, trench dewatering, restoration, etc.
41	Medina Pump Station Rehab	1	LS	$1,195,500	$1,195,500		Replace 2 pumps, replace generator
42							
43	**Flush Stations**						
44	Flush Station No. 4 Rehab incl. replace lake intake pipe	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
				SUBTOTAL =	**$61,949,000**		
				ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$18,584,700*	*30.0%*	See estimate contingency.
				INFLATION =	*$0*	*0.0%*	EXCLUDED
				ESCALATION =	*$0*	*0.0%*	EXCLUDED
				SUBTOTAL (A) =	**$80,533,700**		
				WA SALES TAX =	$8,140,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
				TOTAL BID AMOUNT (B) =	**$88,673,700**		
				CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$35,470,000*	*40.0%*	*Risk based management reserve, High Risk Level*
				TOTAL CONSTRUCTION HARD COST (C) =	**$124,143,700**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$39,726,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,724,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$6,207,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$621,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,724,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$54,002,000**		
SOFT COST CONTINGENCY =	*$21,601,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$75,603,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$199,746,700**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$88,673,700**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$54,002,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$57,071,000**	*29%*
Total Project Cost (TPC) =	**$199,746,700**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Meydenbauer Bay

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,130,000	$2,130,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$3,100,000	$3,100,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	81	EA	$8,000	$648,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 35% moderate demo, and 55% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$280,000	$280,000		New lateral and sewer line connections, assume 35% of locations require tree removal.
8	Whalers Cove and Bellevue Small Beach Park		SF		N/A		Assume work in this area limited to lateral or sewer line connection, costs accounted for in other bid items.
9	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
10	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	17	MTH	$235,000	$3,995,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - In Water Turbidity Curtain	9,082	LF	$20	$181,640		
13	TESC (Allowance) - Lateral and Sewer Line Connections	81	EA	$500	$40,500		Minimal TESC assumed
14	Bathymetric Survey	181,640	SF	$9	$1,634,760		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
15	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
16	**8" Sewer Pipe - In Water**	9,082	LF	$1,400	$12,714,800		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees..
17	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
18	Access / Maintenance Hole	10	EA	$45,000	$450,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	67	EA	$10,700	$716,900		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, In Water	6,700	LF	$1,400	$9,380,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
23	Sewer Line Connection (Allowance)	14	EA	$150,000	$2,100,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**						
27	Minimal - Grass Sod Only	8	EA	$5,000	$40,000		Assumes 10% of lateral and sewer line connections in minimal restoration areas.
28	Moderate - Landscaping, Minimal Hardscape	28	EA	$25,000	$700,000		Assumes 35% of lateral and sewer line connections in moderate restoration areas.
29	Maximum - Hardscapes, Structures	45	EA	$50,000	$2,250,000		Assumes 55% of lateral and sewer line connections in moderate restoration areas.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	9,082	LF	$7.50	$68,115		
34	Abandon Existing Sewer Lake Line	9,082	LF	$11.00	$99,902		
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						
37	Parker Pump Station Rehab	1	LS	$882,500	$882,500		Replace 2 pumps
38	Grange Pump Station Rehab	1	LS	$1,117,500	$1,117,500		Replace 2 pumps, replace generator
39	Meydenbauer Pump Station Rehab	1	LS	$871,500	$871,500		Replace 2 pumps
40	**Flush Stations**						
41	Flush Station No. 5 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 225 LF intake pipe
					SUBTOTAL =	**$44,749,000**	

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$13,424,700*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$58,173,700**		
WA SALES TAX =	$5,880,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$64,053,700**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$25,630,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$89,683,700**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$28,699,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,691,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$4,484,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$448,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,691,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$39,013,000**		
SOFT COST CONTINGENCY =	*$15,605,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$54,618,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$144,301,700**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$64,053,700**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$39,013,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$41,235,000**	*29%*
Total Project Cost (TPC) =	**$144,301,700**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Meydenbauer Bay

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$1,940,000	$1,940,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	0	LS		N/A		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 1 work window.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$4,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	181,640	SF	$18.50	$3,360,340		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 10% min demo, 35% mod demo, 55% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$1,590,000	$1,590,000		Sewer Main, assume 35% of length requires tree removal.
8	Whalers Cove and Bellevue Small Beach Park		LF		N/A		Assume open cut sewer installation allowed through park and parking lot of Whalers Cover.
9	Pavement Removal		SY		N/A		Limited areas of pavement removal at Whalers Cove included with Sewer Main Clearing and Demolition.
10	Barge Mob / Demob	1	LS	$350,000	$350,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	9	MTH	$235,000	$2,115,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - Sewer Main	9,082	LF	$15	$136,230		
13	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
14	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
15	Permits - EXCLUDED				$0		EXCLUDED
16	**8" Sewer Pipe - On Shore**	9,082	LF	$850	$7,719,700		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
17	Trench Dewatering (Allowance)	9,082	LF	$100	$908,200		sump dewatering, settling tanks before local discharge
18	4 FT Maintenance Hole	23	EA	$15,000	$345,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	67	EA	$6,700	$448,900		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, On Shore	670	LF	$20	$13,400		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
23	Sewer Line Connection (Allowance)	14	EA	$50,000	$700,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**				$0		
27	Minimal - Grass Sod Only	18,164	SF	$15	$272,460		Assumes 10% restoration is minimal.
28	Moderate - Landscaping, Minimal Hardscape	63,574	SF	$65	$4,132,310		Assumes 35% restoration is moderate.
29	Maximum - Hardscapes, Structures	99,902	SF	$130	$12,987,260		Assumes 55% restoration is maximum.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	9,082	LF	$7.50	$68,115		
34	Abandon Existing Sewer Lake Line	9,082	LF	$11.00	$99,902		
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						
37	Parker Pump Station Rehab	1	LS	$882,500	$882,500		Replace 2 pumps
38	Grange Pump Station Rehab	1	LS	$1,117,500	$1,117,500		Replace 2 pumps, replace generator
39	Meydenbauer Pump Station Rehab	1	LS	$871,500	$871,500		Replace 2 pumps
40	**Flush Stations**						
41	Flush Station No. 5 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 225 LF intake pipe
				SUBTOTAL =	**$40,706,000**		

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$12,211,800*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$52,917,800**		
WA SALES TAX =	$5,350,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$58,267,800**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$23,310,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$81,577,800**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$26,105,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,447,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$4,079,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$408,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,447,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$35,486,000**		
SOFT COST CONTINGENCY =	*$14,194,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$49,680,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$131,257,800**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$58,267,800**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$35,486,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$37,504,000**	*29%*
Total Project Cost (TPC) =	**$131,257,800**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Meydenbauer Bay

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,090,000	$2,090,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$3,000,000	$3,000,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	81	EA	$8,000	$648,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 35% moderate demo, and 55% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	37	EA	$32,000	$1,184,000		Assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$1,120,000	$1,120,000		New pits and lateral and sewer line connections, assume 35% of locations require tree removal.
8	Whalers Cove and Bellevue Small Beach Park		LF		N/A		Assume work in this area limited to trenchless pits and lateral or sewer line connection, costs accounted for in other bid items.
9	Pavement Removal		SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
10	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
11	Barge Rental	15	MTH	$235,000	$3,525,000		Fixed and moveable barges, pusher, pusher operator
12	TESC (Allowance) - Trenchless Pits	37	EA	$10,000	$370,000		Minimal TESC assumed
13	TESC (Allowance) - Lateral Connections	81	EA	$500	$40,500		Minimal TESC assumed
14	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
15	Permits - EXCLUDED				$0		EXCLUDED
16	**8" Sewer Pipe - Trenchless**	9,082	LF	$1,200	$10,898,400		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
17	Launch / Retrieval Access Pits	37	EA	$150,600	$5,572,200		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
18	4 FT Maintenance Hole	37	EA	$15,000	$555,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
19	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
20	**Lateral and Sewer Line Connections**						
21	Sewer Lateral Connection w/Cleanout	67	EA	$6,700	$448,900		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
22	Sewer Lateral Pipe, On Shore	3,350	LF	$55	$184,250		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
23	Sewer Line Connection (Allowance)	14	EA	$80,000	$1,120,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
24	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
25	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
26	**Restoration**				$0		
27	Minimal - Grass Sod Only	9,200	SF	$15	$138,000		Assumes 10% restoration is minimal.
28	Moderate - Landscaping, Minimal Hardscape	32,100	SF	$65	$2,086,500		Assumes 35% restoration is moderate.
29	Maximum - Hardscapes, Structures	50,400	SF	$130	$6,552,000		Assumes 55% restoration is maximum.
30	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
31	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
32	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
33	Clean / Test - Sewer Main	9,082	LF	$7.50	$68,115		
34	Abandon Existing Sewer Lake Line	9,082	LF	$11.00	$99,902		
35	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
36	**Pump Stations**						
37	Parker Pump Station Rehab	1	LS	$882,500	$882,500		Replace 2 pumps
38	Grange Pump Station Rehab	1	LS	$1,117,500	$1,117,500		Replace 2 pumps, replace generator
39	Meydenbauer Pump Station Rehab	1	LS	$871,500	$871,500		Replace 2 pumps
40	**Flush Stations**						
41	Flush Station No. 5 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 225 LF intake pipe

SUBTOTAL =	**$43,920,000**		
ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$13,176,000*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$57,096,000**		
WA SALES TAX =	$5,770,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$62,866,000**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$25,150,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$88,016,000**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$28,165,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$2,640,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$4,401,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$440,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$2,640,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$38,286,000**		
SOFT COST CONTINGENCY =	*$15,314,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$53,600,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$141,616,000**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$62,866,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$38,286,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$40,464,000**	*29%*
Total Project Cost (TPC) =	**$141,616,000**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/8/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Meydenbauer Bay

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,910,000	$2,910,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,100,000	$4,100,000		Work Window July 16th to April 30th. Assume Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 2 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	81	EA	$18,000	$1,458,000		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 10% minimal demo, 35% moderate demo, and 55% with maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	21,760	LF	$112.50	$2,448,000		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$2,960,000	$2,960,000		Grinder pump installations and 6" Sewer Line, assume 35% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	2,000	SY	$54	$108,000		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6-inches.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	18	MTH	$235,000	$4,230,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	4,548	LF	$10	$45,480		Work in pavement, minimal TESC
12	TESC (Allowance) - Sewer Force Main - Grinder Pump	21,760	LF	$15	$326,400		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder, Lateral and Sewer Line Connections	81	EA	$750	$60,750		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	4,548	LF	$310	$1,409,880		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	4,548	LF	$100	$454,800		
17	4 FT Maintenance Hole	12	EA	$22,500	$270,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	21,760	LF	$170	$3,699,200		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	21,760	LF	$100	$2,176,000		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	81	EA	$86,000	$6,966,000		
25	Electrical (Allowance) for Grinder Pump Installations	81	EA	$30,000	$2,430,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	170,000	SF	$15	$2,550,000		Assumes 10% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	190,000	SF	$65	$12,350,000		Assumes 35% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	40,000	SF	$130	$5,200,000		Assumes 55% restoration is maximum. Grinder pumps, laterals, 6" sewer line
30	Temporary Pavement Patch - 8" Sewer Line	2,000	SY	$25	$50,000		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	3,000	SY	$50	$150,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate.
33	Mill and Resurface - Asphalt	6,050	SY	$20	$121,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	26,308	LF	$7.50	$197,310		
35	Abandon Existing Sewer Lake Line	9,082	LF	$11.00	$99,902		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$530,000	$530,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$8,000,000	$80,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Parker Pump Station Rehab	1	LS	$882,500	$882,500		Replace 2 pumps
40	Grange Pump Station Rehab	1	LS	$1,117,500	$1,117,500		Replace 2 pumps, replace generator
41	Meydenbauer Pump Station Rehab	1	LS	$871,500	$871,500		Replace 2 pumps
42	Lagen Pump Station	1	LS	$80,000	$80,000		Abandon PS
43	**Flush Stations**						
44	Flush Station No. 5	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
	SUBTOTAL =				**$61,132,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$18,339,600*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$79,471,600**		
	WA SALES TAX =				$8,030,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$87,501,600**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$35,010,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$122,511,600**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$39,204,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,675,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$6,126,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$613,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,675,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$53,293,000**		
SOFT COST CONTINGENCY =	*$21,317,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$74,610,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$197,121,600**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$87,501,600**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$53,293,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$56,327,000**	*29%*
Total Project Cost (TPC) =	**$197,121,600**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Killarney

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,710,000	$2,710,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$8,100,000	$8,100,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 3 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	75	EA	$9,000	$675,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 20% moderate demo, and 70% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$440,000	$440,000		New lateral and sewer line connections, assume 60% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	25	MTH	$235,000	$5,875,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - In Water Turbidity Curtain	12,965	LF	$20	$259,300		
12	TESC (Allowance) - Lateral and Sewer Line Connections	75	EA	$500	$37,500		Minimal TESC assumed
13	Bathymetric Survey	259,300	SF	$9	$2,333,700		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
14	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
15	**8" Sewer Pipe - In Water**	12,965	LF	$1,400	$18,151,000		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees..
16	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
17	Access / Maintenance Hole	13	EA	$45,000	$585,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	62	EA	$10,700	$663,400		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, In Water	6,200	LF	$1,400	$8,680,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
22	Sewer Line Connection (Allowance)	13	EA	$150,000	$1,950,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**						
26	Minimal - Grass Sod Only	8	EA	$5,000	$40,000		Assumes 10% of lateral and sewer line connections in minimal restoration areas.
27	Moderate - Landscaping, Minimal Hardscape	15	EA	$25,000	$375,000		Assumes 20% of lateral and sewer line connections in minimal restoration areas.
28	Maximum - Hardscapes, Structures	53	EA	$50,000	$2,650,000		Assumes 70% of lateral and sewer line connections in minimal restoration areas.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,965	LF	$7.50	$97,238		
33	Abandon Existing Sewer Lake Line	12,965	LF	$11.00	$142,615		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Killarney Pump Station Rehab	1	LS	$875,000	$875,000		Replace 2 pumps
37							
38							
39	**Flush Stations**						
40	Flush Station No. 6 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 100 LF intake pipe
41	Flush Station No. 7 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 90 LF intake pipe
				SUBTOTAL =	**$56,985,000**		

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$17,095,500*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$74,080,500**		
WA SALES TAX =	$7,490,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$81,570,500**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$32,630,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$114,200,500**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$36,544,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,426,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,710,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$571,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,426,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$49,677,000**		
SOFT COST CONTINGENCY =	*$19,871,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$69,548,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$183,748,500**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$81,570,500**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$49,677,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$52,501,000**	*29%*
Total Project Cost (TPC) =	**$183,748,500**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Killarney

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,830,000	$2,830,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	0	LS		N/A		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 1 work window.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$4,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	259,300	SF	$20.30	$5,263,790		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 10% min demo, 20% mod demo, 70% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$3,820,000	$3,820,000		Sewer Main, assume 60% of length requires tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	13	MTH	$235,000	$3,055,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Sewer Main	12,965	LF	$15	$194,475		
12	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - On Shore**	12,965	LF	$850	$11,020,250		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
16	Trench Dewatering (Allowance)	12,965	LF	$100	$1,296,500		sump dewatering, settling tanks before local discharge
17	4 FT Maintenance Hole	33	EA	$15,000	$495,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	62	EA	$6,700	$415,400		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	620	LF	$20	$12,400		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
22	Sewer Line Connection (Allowance)	13	EA	$50,000	$650,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	25,930	SF	$15	$388,950		Assumes 10% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	51,860	SF	$65	$3,370,900		Assumes 20% restoration is moderate.
28	Maximum - Hardscapes, Structures	181,510	SF	$130	$23,596,300		Assumes 70% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,965	LF	$7.50	$97,238		
33	Abandon Existing Sewer Lake Line	12,965	LF	$11.00	$142,615		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Killarney Pump Station Rehab	1	LS	$875,000	$875,000		Replace 2 pumps
37							
38							
39	**Flush Stations**						
40	Flush Station No. 6 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 100 LF intake pipe
41	Flush Station No. 7 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 90 LF intake pipe
				SUBTOTAL =	**$59,519,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$17,855,700*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$77,374,700**		
	WA SALES TAX =				$7,820,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$85,194,700**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$34,080,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$119,274,700**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$38,168,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,578,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,964,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$596,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,578,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$51,884,000**		
SOFT COST CONTINGENCY =	*$20,754,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$72,638,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$191,912,700**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$85,194,700**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$51,884,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$54,834,000**	*29%*
Total Project Cost (TPC) =	**$191,912,700**	*100%*

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Killarney

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,760,000	$2,760,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,100,000	$4,100,000		Work Window July 16th to April 30th, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 2 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	75	EA	$9,000	$675,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 20% moderate demo, and 70% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	52	EA	$36,000	$1,872,000		Assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$1,760,000	$1,760,000		New pits and lateral and sewer line connections, assume 60% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	21	MTH	$235,000	$4,935,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Trenchless Pits	52	EA	$10,000	$520,000		Minimal TESC assumed
12	TESC (Allowance) - Lateral Connections	75	EA	$500	$37,500		Minimal TESC assumed
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - Trenchless**	12,965	LF	$1,200	$15,558,000		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
16	Launch / Retrieval Access Pits	52	EA	$150,600	$7,831,200		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
17	4 FT Maintenance Hole	52	EA	$15,000	$780,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	62	EA	$6,700	$415,400		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	3,100	LF	$55	$170,500		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
22	Sewer Line Connection (Allowance)	13	EA	$80,000	$1,040,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	11,400	SF	$15	$171,000		Assumes 10% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	22,700	SF	$65	$1,475,500		Assumes 20% restoration is moderate.
28	Maximum - Hardscapes, Structures	79,300	SF	$130	$10,309,000		Assumes 70% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	12,965	LF	$7.50	$97,238		
33	Abandon Existing Sewer Lake Line	12,965	LF	$11.00	$142,615		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Killarney Pump Station Rehab	1	LS	$875,000	$875,000		Replace 2 pumps
37							
38							
39	**Flush Stations**						
40	Flush Station No. 6 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 100 LF intake pipe
41	Flush Station No. 7 Rehab incl. replace lake intake pipe	1	LS	$647,500	$647,500		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 90 LF intake pipe
	SUBTOTAL =				**$57,870,000**		

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$17,361,000*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$75,231,000**		
WA SALES TAX =	$7,600,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$82,831,000**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$33,140,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$115,971,000**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$37,111,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,479,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,799,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$580,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,479,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$50,448,000**		
SOFT COST CONTINGENCY =	*$20,179,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$70,627,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$186,598,000**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$82,831,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$50,448,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$53,319,000**	*29%*
Total Project Cost (TPC) =	**$186,598,000**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8.7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Killarney

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,580,000	$2,580,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$4,200,000	$4,200,000		Work Window July 16th to April 30th. Assume Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 2 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	62	EA	$20,250	$1,255,500		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 10% minimal demo, 20% moderate demo, and 70% with maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	16,215	LF	$112.50	$1,824,188		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$4,440,000	$4,440,000		Grinder pump installations and 6" Sewer Line, assume 60% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	3,200	SY	$54	$172,800		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6-inches.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	18	MTH	$235,000	$4,230,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	7,124	LF	$10	$71,240		Work in pavement, minimal TESC
12	TESC (Allowance) - Sewer Force Main - Grinder Pump	16,215	LF	$15	$243,225		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder, Lateral and Sewer Line Connections	62	EA	$750	$46,500		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	7,124	LF	$310	$2,208,440		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	7,124	LF	$100	$712,400		
17	4 FT Maintenance Hole	18	EA	$22,500	$405,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	16,215	LF	$170	$2,756,550		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	16,215	LF	$100	$1,621,500		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	62	EA	$86,000	$5,332,000		
25	Electrical (Allowance) for Grinder Pump Installations	62	EA	$30,000	$1,860,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	130,000	SF	$15	$1,950,000		Assumes 10% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	130,000	SF	$65	$8,450,000		Assumes 20% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	40,000	SF	$130	$5,200,000		Assumes 70% restoration is maximum. Grinder pumps, laterals, 6" sewer line
30	Temporary Pavement Patch - 8" Sewer Line	3,200	SY	$25	$80,000		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	4,700	SY	$50	$235,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate.
33	Mill and Resurface - Asphalt	9,500	SY	$20	$190,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	23,339	LF	$7.50	$175,043		
35	Abandon Existing Sewer Lake Line	12,965	LF	$11.00	$142,615		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$470,000	$470,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$7,700,000	$77,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Killarney Pump Station Rehab	1	LS	$875,000	$875,000		Replace 2 pumps
40	Killarney New 8" Force Main - Open Cut	1,419	LF	$1,040	$1,475,760		Killarney PS new force main from PS to new main line at SE 23rd Street - includes clearing / demolition, trench dewatering, restoration, etc.
41							
42	**Flush Stations**						
43	Flush Station No. 6	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
44	Flush Station No. 7	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.

SUBTOTAL =	**$54,180,000**		
ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$16,254,000*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$70,434,000**		
WA SALES TAX =	$7,120,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$77,554,000**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$31,030,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$108,584,000**		
THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.			
SOFT COSTS:			
ENGINEERING DESIGN (CONSULTANTS)	$34,747,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,258,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,429,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$543,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,258,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$47,235,000**		
SOFT COST CONTINGENCY =	*$18,894,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$66,129,000**		
EASEMENT /REAL ESTATE COSTS:			
TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$174,713,000**		

Cost Estimates Summary:		***% of TPC***
Total Construction Cost (TCC) w/o Contingency =	**$77,554,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$47,235,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$49,924,000**	*29%*
Total Project Cost (TPC) =	**$174,713,000**	*100%*

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 1 - In Water - Newport South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,990,000	$2,990,000		C.O.B. STD. ALLOWANCE
2	Additional Work Windows (Allowance)	1	LS	$13,000,000	$13,000,000		Work Window July 16th to December 31st, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 25/LF day, work in 4 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	103	EA	$9,000	$927,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 10% moderate demo, and 80% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$200,000	$200,000		New lateral and sewer line connections, assume 20% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		Assume no work in paved areas.
9	Barge Mob / Demob	4	LS	$350,000	$1,400,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	19	MTH	$235,000	$4,465,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - In Water Turbidity Curtain	10,175	LF	$20	$203,500		
12	TESC (Allowance) - Lateral and Sewer Line Connections	103	EA	$500	$51,500		Minimal TESC assumed
13	Bathymetric Survey	203,500	SF	$9	$1,831,500		Pre and post surveys of lake bottom, assume 20 ft wide survey along sewer pipe alignment
14	Permits - EXCLUDED				EXCLUDED		Assume permits can be obtained for in water work. Costs unknown / EXCLUDED.
15	**8" Sewer Pipe - In Water**	10,175	LF	$1,400	$14,245,000		Epoxy lined ductile iron, ~2 ft cover over anchor blocks, sloped trench excavation, 100% import backfill, anchor blocks 10 ft OC, includes divers to aid installation, includes connection tees..
16	Trench Dewatering (Allowance)	0	LF		N/A		Not Applicable to this Alternate
17	Access / Maintenance Hole	11	EA	$45,000	$495,000		Access MHs spaced every 1,000 LF, 4 ft diameter, 3/8-inch thick steel pipe, with steel plate cover, ecology block anchors.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	99	EA	$10,700	$1,059,300		CoB Standard S-37, 6-inch epoxy lined ductile iron pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, In Water	9,900	LF	$1,400	$13,860,000		6-inch DI, protecto 401 pipe, assume 100 LF pipe per lateral, ~ 2ft cover over anchor blocks, sloped trench excavation,100% imported backfill, anchor blocks 10 ft OC.
22	Sewer Line Connection (Allowance)	4	EA	$150,000	$600,000		Connection and bypass details unknown, assume 100 LF pipe per connection installed in water.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**						
26	Minimal - Grass Sod Only	10	EA	$5,000	$50,000		Assumes 10% of lateral and sewer line connections in minimal restoration areas.
27	Moderate - Landscaping, Minimal Hardscape	10	EA	$25,000	$250,000		Assumes 10% of lateral and sewer line connections in moderate restoration areas.
28	Maximum - Hardscapes, Structures	82	EA	$50,000	$4,100,000		Assumes 80% of lateral and sewer line connections in maximum restoration areas.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	10,175	LF	$7.50	$76,313		
33	Abandon Existing Sewer Lake Line	10,175	LF	$11.00	$111,925		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Pleasure Point Pump Station Rehab	1	LS	$893,000	$893,000		Replace 2 pumps
37	Bagley Pump Station Rehab	1	LS	$893,500	$893,500		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 8 Rehab incl. replace lake intake pipe	1	LS	$1,060,000	$1,060,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 600 LF intake pipe
					SUBTOTAL =	**$62,763,000**	
					ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$18,828,900*	*30.0%* See estimate contingency.
					INFLATION =	*$0*	*0.0%* EXCLUDED
					ESCALATION =	*$0*	*0.0%* EXCLUDED
					SUBTOTAL (A) =	**$81,591,900**	
					WA SALES TAX =	$8,250,000.00	10.1% Verify whether sales tax applies or not per Rule 171. City to confirm
					TOTAL BID AMOUNT (B) =	**$89,841,900**	
					CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$35,940,000*	*40.0%* *Risk based management reserve, High Risk Level*
					TOTAL CONSTRUCTION HARD COST (C) =	**$125,781,900**	

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

	Amount	%	Notes
ENGINEERING DESIGN (CONSULTANTS)	$40,250,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,773,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$6,289,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$629,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,773,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$54,714,000**		
SOFT COST CONTINGENCY =	*$21,886,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$76,600,000**		

EASEMENT /REAL ESTATE COSTS:

	Amount	%
TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =		
PERMANENT EASEMENT =		
REAL PROPERTY STAFF =		
EASEMENT COST SUBTOTAL =	**$0**	
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**	
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$202,381,900**	

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$89,841,900**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$54,714,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$57,826,000**	*29%*
Total Project Cost (TPC) =	**$202,381,900**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Open Cut - Newport South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,450,000	$2,450,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$3,600,000	$3,600,000		Work Window July 16th to December 31st, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 50/LF day, work in 2 work window.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	0	EA	$9,000	$0		For lateral and side sewer line connections, assume connections are located within area cleared for sewer main and no additional clearing or demolition required.
5	Sewer Main	203,500	SF	$21.60	$4,395,600		Assume clear 20 ft wide along alignment, assume sewer main routed to minimize structure demolition. 10% min demo, 10% mod demo, 80% max demo.
6	Trenchless Pit		EA		N/A		Not Applicable to this Alternate
7	Tree Removal / Mitigation (Allowance)	1	LS	$1,060,000	$1,060,000		Sewer Main, assume 20% of length requires tree removal and approx. 1,000 LF along shore at Newcastle Beach Park.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	2	LS	$350,000	$700,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	10	MTH	$235,000	$2,350,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Sewer Main	10,175	LF	$15	$152,625		
12	TESC (Allowance) - Lateral and Sewer Line Connections	0	EA	$500	$0		Assume connections included with sewer main TESC.
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - On Shore**	10,175	LF	$850	$8,648,750		SDR35 PVC pipe, 10 ft cut on average (5 to 15 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring, includes tees for laterals and side sewer connections. Assume access for on shore pipe installation is from lake - including haul off of excavated materials.
16	Trench Dewatering (Allowance)	10,175	LF	$100	$1,017,500		sump dewatering, settling tanks before local discharge
17	4 FT Maintenance Hole	26	EA	$15,000	$390,000		Access MHs spaced every 400 LF, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	99	EA	$6,700	$663,300		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	990	LF	$20	$19,800		CoB Standard S-17, 6-inch PVC pipe, assume 10 LF pipe per lateral connection, labor and equipment included with sewer lateral connection.
22	Sewer Line Connection (Allowance)	4	EA	$50,000	$200,000		Connection and bypass details unknown, assume 20 LF pipe per connection installed on shore.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	20,350	SF	$15	$305,250		Assumes 10% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	20,350	SF	$65	$1,322,750		Assumes 10% restoration is moderate.
28	Maximum - Hardscapes, Structures	162,800	SF	$130	$21,164,000		Assumes 80% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	10,175	LF	$7.50	$76,313		
33	Abandon Existing Sewer Lake Line	10,175	LF	$11.00	$111,925		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Pleasure Point Pump Station Rehab	1	LS	$893,000	$893,000		Replace 2 pumps
37	Bagley Pump Station Rehab	1	LS	$893,500	$893,500		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 8 Rehab incl. replace lake intake pipe	1	LS	$1,060,000	$1,060,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 600 LF intake pipe
				SUBTOTAL =	**$51,474,000**		

ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$15,442,200*	*30.0%*	See estimate contingency.
INFLATION =	*$0*	*0.0%*	EXCLUDED
ESCALATION =	*$0*	*0.0%*	EXCLUDED
SUBTOTAL (A) =	**$66,916,200**		
WA SALES TAX =	$6,760,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
TOTAL BID AMOUNT (B) =	**$73,676,200**		
CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$29,480,000*	*40.0%*	*Risk based management reserve, High Risk Level*
TOTAL CONSTRUCTION HARD COST (C) =	**$103,156,200**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$33,010,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,095,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,158,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$516,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,095,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$44,874,000**		
SOFT COST CONTINGENCY =	*$17,950,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$62,824,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$165,980,200**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$73,676,200**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$44,874,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$47,430,000**	*29%*
Total Project Cost (TPC) =	**$165,980,200**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 2 - On Shore Trenchless - Newport South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$2,560,000	$2,560,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$7,500,000	$7,500,000		Work Window July 16th to December 31st, allowance for escalation and three additional mob/demob costs to complete in multiple work windows. At 30/LF day, work in 3 work windows.
3	**Clearing / Demolition**						
4	Lateral and Sewer Line Connections	103	EA	$9,000	$927,000		For lateral and side sewer line connections, assume locate new connections to minimize clearing and demolition, 20 ft by 20 ft work area. Unit cost assumes - 10% minimal demo, 10% moderate demo., and 80% with maximum demo.
5	Sewer Main		SF		N/A		Not Applicable to this Alternate
6	Trenchless Pit	41	EA	$36,000	$1,476,000		Assume locate pits to avoid maximum clearing and demolition, 50 ft by 30 ft area assumed.
7	Tree Removal / Mitigation (Allowance)	1	LS	$800,000	$800,000		New pits and lateral and sewer line connections, assume 20% of locations require tree removal.
8	Pavement Removal	0	SY		N/A		New lateral and sewer line connections, Assume no work in paved areas.
9	Barge Mob / Demob	3	LS	$350,000	$1,050,000		Mobilization / demobilization barges and pushers to work areas
10	Barge Rental	16	MTH	$235,000	$3,760,000		Fixed and moveable barges, pusher, pusher operator
11	TESC (Allowance) - Trenchless Pits	41	EA	$10,000	$410,000		Minimal TESC assumed
12	TESC (Allowance) - Lateral Connections	103	EA	$500	$51,500		Minimal TESC assumed
13	Bathymetric Survey	0	SF	$9	N/A		Not Applicable to this Alternate
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Pipe - Trenchless**	10,175	LF	$1,200	$12,210,000		SDR35 PVC pipe in steel casing, CoB Standard S-33, upsize casing to provide flexibility to install gravity sewer to grade.
16	Launch / Retrieval Access Pits	41	EA	$150,600	$6,174,600		Pits located every 250 LF, average depth of 10 feet (assume sewer depth range is 5 to 15 ft), haul off excavated materials, 100% imported backfill. Includes shoring and dewatering allowance. Assume access to trenchless pits is from lake.
17	4 FT Maintenance Hole	41	EA	$15,000	$615,000		Access MHs spaced every 250 LF at each access pit, 4 ft diameter, precast concrete.
18	Temporary Bypass	0	LS		EXCLUDED		EXCLUDED - Not required
19	**Lateral and Sewer Line Connections**						
20	Sewer Lateral Connection w/Cleanout	99	EA	$6,700	$663,300		CoB Standard S-17 and S-16, 6-inch PVC pipe and fittings, lateral connection with cleanout located on shore. Assume 1 cleanout per lateral connection, new connections assumed downstream of individual property connections, individual property cleanouts assumed existing and not in need of replacement.
21	Sewer Lateral Pipe, On Shore	4,950	LF	$55	$272,250		CoB Standard S-17, 6-inch PVC pipe, assume 75 LF pipe per lateral connection, to extend to MH in lieu of connecting to sewer pipe inside casing, includes labor and equipment for installation.
22	Sewer Line Connection (Allowance)	4	EA	$80,000	$320,000		Connection and bypass details unknown, assume 75 LF pipe per connection to extend to MH in lieu of connection to sewer pipe inside casing.
23	Grinder Pump / Tank	0	EA		N/A		Not Applicable to this Alternate
24	Electrical Allowance - Grinder Pumps	0	EA		N/A		Not Applicable to this Alternate
25	**Restoration**				$0		
26	Minimal - Grass Sod Only	10,700	SF	$15	$160,500		Assumes 10% restoration is minimal.
27	Moderate - Landscaping, Minimal Hardscape	10,700	SF	$65	$695,500		Assumes 10% restoration is moderate.
28	Maximum - Hardscapes, Structures	85,500	SF	$130	$11,115,000		Assumes 80% restoration is maximum.
29	Pavement Trench Patch - Asphalt		SY		N/A		Not Applicable to this Alternate
30	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate
31	Mill and Resurface - Asphalt		SY		N/A		Not Applicable to this Alternate
32	Clean / Test - Sewer Main	10,175	LF	$7.50	$76,313		
33	Abandon Existing Sewer Lake Line	10,175	LF	$11.00	$111,925		
34	Utility Conflict Resolution Allowance		LS		N/A		Not Applicable to this Alternate
35	**Pump Stations**						
36	Pleasure Point Pump Station Rehab	1	LS	$893,000	$893,000		Replace 2 pumps
37	Bagley Pump Station Rehab	1	LS	$893,500	$893,500		Replace 2 pumps
38							
39	**Flush Stations**						
40	Flush Station No. 8 Rehab incl. replace lake intake pipe	1	LS	$1,060,000	$1,060,000		replace pumps, pipe, valves, electrical, instrumentation, $30,000 structure rehab allowance, replace 600 LF intake pipe
				SUBTOTAL =	**$53,795,000**		
				ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =	*$16,138,500*	*30.0%*	See estimate contingency.
				INFLATION =	*$0*	*0.0%*	EXCLUDED
				ESCALATION =	*$0*	*0.0%*	EXCLUDED
				SUBTOTAL (A) =	**$69,933,500**		
				WA SALES TAX =	$7,070,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
				TOTAL BID AMOUNT (B) =	**$77,003,500**		
				CONSTRUCTION CONTINGENCY (City Project Manager Controls) =	*$30,810,000*	*40.0%*	*Risk based management reserve, High Risk Level*
				TOTAL CONSTRUCTION HARD COST (C) =	**$107,813,500**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

ENGINEERING DESIGN (CONSULTANTS)	$34,500,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,234,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$5,391,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$539,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,234,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$46,898,000**		
SOFT COST CONTINGENCY =	*$18,759,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$65,657,000**		

EASEMENT /REAL ESTATE COSTS:

TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$173,470,500**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$77,003,500**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$46,898,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$49,569,000**	*29%*
Total Project Cost (TPC) =	**$173,470,500**	*100%*

UTILITIES Project Management

City of Bellevue Utilities
Project: **City of Bellevue - Lake Washington Lake Line Master Plan**
Project Cost Estimate - Alternative Identification CC Index:
Date: 8/7/2023 Revision Date/s 2/9/2024
Prepared by: C. Gallo, Jacobs Date Prepared
Checked by: Date Checked
Basis of Estimate received: Yes ☐ No ☐ Date Received:

City of Bellevue Lake Washington Lake Line Master Plan - Alternate 3 - Upland - Newport South

Item #	Bid Item Description	Quantity	Unit	Unit Cost	Amount		Assumptions/Notes
1	MOBILIZATION (5%)	1	LS	$3,040,000	$3,040,000		C.O.B. STD. ALLOWANCE
2	Additional Mob / Demob	1	LS	$9,000,000	$9,000,000		Work Window July 16th to December 31st. Assume Fish / Work Windows applicable to grinder pump installation work along the shore. Assume 3 work windows to complete grinder pump installations.
3	**Clearing / Demolition**						
4	Grinder Pumps	103	EA	$20,250	$2,085,750		Install grinder pump at each lateral and side sewer connection, assume locate work to minimize clearing and demolition, 30 ft by 30 ft work area. Unit cost assumes - 10% minimal demo, 10% moderate demo, and 80% with maximum demo.
5	Lateral and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
6	Grinder Pump Discharge Pipe	11,886	LF	$170	$1,337,175		From grinder pump installations to new upland sewer. Mixed areas - driveways, pavement, grass, gravel, landscaping, etc. Assume cleared area is 15 ft wide maximum. Unit cost assumes - 50% minimal demo, 50% moderate demo, and no maximum demo.
7	Tree Removal / Mitigation (Allowance)	1	LS	$1,100,000	$1,100,000		Grinder pump installations and 6" Sewer Line, assume 20% of locations / areas requires tree removal.
8	Pavement Removal - 8" Sewer Line	4,500	SY	$54	$243,000		CoB Std S-14 - 3 ft wide trench, bench excavations greater than 4 ft deep, Assume 4 ft wide pavement removal. Assume asphalt pavement depth of 6-inches.
9	Barge Mob / Demob	4	LS	$350,000	$1,400,000		Mobilization / demobilization barges and pushers to work areas. For access and work on grinder pump installations.
10	Barge Rental	24	MTH	$235,000	$5,640,000		Fixed and moveable barges, pusher, pusher operator. For access and work on grinder pump installations.
11	TESC (Allowance) - 8" Sewer Line in pavement	10,096	LF	$10	$100,960		Work in pavement, minimal TESC
12	TESC (Allowance) - Discharge Main - Grinder Pump	11,886	LF	$15	$178,290		Work in mixed areas, grassed, gravel, paved areas
13	TESC (Allowance) - Grinder, Lateral and Sewer Line Connections	103	EA	$750	$77,250		Minimal TESC assumed
14	Permits - EXCLUDED				$0		EXCLUDED
15	**8" Sewer Line (Gravity) - Open Cut**	10,096	LF	$310	$3,129,760		SDR35 PVC pipe, 12.5 ft cut on average (5 to 20 ft range of cut depth), 100% import backfill, trench safety/trench boxes no shoring.
16	Trench Dewatering (Allowance)	10,096	LF	$100	$1,009,600		
17	4 FT Maintenance Hole	26	EA	$22,500	$585,000		Assume MHs spaced every 400 ft, 48-inch diam precast concrete MH, 15 VF / EA average
18	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
19	**Grinder Pump Discharge Sewer Line (Force Main) - Open Cut**	11,886	LF	$170	$2,020,620		Installed from grinder pump to 8" sewer pipe, PVC pipe, 3 ft cover, 100% import backfill, trench safety/trench boxes no shoring.
20	Trench Dewatering (Allowance)	11,886	LF	$100	$1,188,600		
21	Temporary Bypass	0	LS		$0		EXCLUDED - Not required
22	**Lateral Connections**						
23	Lateral w/Cleanout and Sewer Line Connections		EA		N/A		Not Applicable to this Alternate. Grinder pump installations replace this work.
24	Grinder Pump / Tank	103	EA	$86,000	$8,858,000		
25	Electrical (Allowance) for Grinder Pump Installations	103	EA	$30,000	$3,090,000		New electrical panel, disconnect for grinder pumps, power from existing service. New service drop - EXCLUDED.
26	**Restoration**						
27	Minimal - Grass Sod Only	100,000	SF	$15	$1,500,000		Assumes 10% restoration is minimal for grinder pumps and lateral connections, and 50% restoration is minimal for grinder pump discharge line.
28	Moderate - Landscaping, Minimal Hardscape	100,000	SF	$65	$6,500,000		Assumes 10% restoration is moderate for grinder pumps and lateral connections, and 50% restoration is moderate for grinder pump discharge line.
29	Maximum - Hardscapes, Structures	70,000	SF	$130	$9,100,000		Assumes 80% restoration is maximum. Grinder pumps, laterals, 6" sewer line
30	Temporary Pavement Patch - 8" Sewer Line	4,500	SY	$25	$112,500		Assume all 8" sewer is in asphalt pavement. 4 ft wide trench / pavement patch width, 2" temp. asphalt, 4" CSBC
31	Permanent Pavement Patch - 8" Sewer Line	6,700	SY	$50	$335,000		Assume all 8" sewer is in asphalt pavement. 6 ft wide pavement patch, 2" surface course, 4" base course.
32	Pavement Trench Patch - Concrete Panel		SY		N/A		Not Applicable to this Alternate.
33	Mill and Resurface - Asphalt	13,450	SY	$20	$269,000		2-inch mill and resurface, assume 1 lane width = 12 ft, includes pavement markings
34	System Test / Start Up	21,982	LF	$7.50	$164,865		
35	Abandon Existing Sewer Lake Line	10,175	LF	$11.00	$111,925		Flush / clean, cap ends, abandon in place, no grout fill
36	Traffic Control (Allowance)	1	LS	$440,000	$440,000		
37	Utility Conflict Resolution (Allowance)	1%	LS	$7,900,000	$79,000		1% of 8" and 6" sewer line costs
38	**Pump Stations**						
39	Pleasure Point Pump Station Rehab	1	LS	$80,000	$80,000		Abandon
40	Bagley Pump Station Rehab	1	LS	$893,500	$893,500		Replace 2 pumps
41							
42	**Flush Stations**						
43	Flush Station No. 8 Rehab incl. replace lake intake pipe	1	LS	$100,000	$100,000		Abandon flush station and lake intake line.
	SUBTOTAL =				**$63,770,000**		
	ALLOWANCE FOR INDETERMINANTS (AFI) (Consultant Controls) =				*$19,131,000*	*30.0%*	See estimate contingency.
	INFLATION =				*$0*	*0.0%*	EXCLUDED
	ESCALATION =				*$0*	*0.0%*	EXCLUDED
	SUBTOTAL (A) =				**$82,901,000**		
	WA SALES TAX =				$8,380,000.00	10.1%	Verify whether sales tax applies or not per Rule 171. City to confirm
	TOTAL BID AMOUNT (B) =				**$91,281,000**		
	CONSTRUCTION CONTINGENCY (City Project Manager Controls) =				*$36,520,000*	*40.0%*	*Risk based management reserve, High Risk Level*
	TOTAL CONSTRUCTION HARD COST (C) =				**$127,801,000**		

THE SECTION BELOW SHOULD BE USED FOR ESTIMATING SOFT COSTS DURING GATE 1 AND GATE 2 PREPARATION ONLY.

SOFT COSTS:

	Amount	%	Notes
ENGINEERING DESIGN (CONSULTANTS)	$40,896,000	32.0%	Percent of Construction Hard Costs (C)
PLANNING		4.0%	
ALTERNATIVE EVALUATION		7.0%	
DESIGN		14.0%	
PERMITTING		4.0%	
OUTREACH		3.0%	
ENGINEERING SERVICES DURING CONSTRUCTION (SDC) =	$3,834,000	3.0%	Percent of Construction Hard Costs (C)
CITY LABOR (PM AND PERMITTING SUPPORT) =	$6,390,000	5.0%	Percent of Construction Cost (C), 5% is typical
PERMITTING, LEGAL & PRINTED MATERIALS =	$639,000	0.5%	
CONSTRUCTION MANAGEMENT BY THE CITY =	$3,834,000	3.0%	Percent of Construction Cost (C), 3% is typical
POST CONSTRUCTION PERMIT MONITORING =	$0		For creek projects assume +/- $20K per year for 5 years (2019).
SUBTOTAL SOFT COSTS (W/O CONTINGENCY) =	**$55,593,000**		
SOFT COST CONTINGENCY =	*$22,237,000*	*40.0%*	
TOTAL SOFT COST W/ CONTINGENCY (D) =	**$77,830,000**		
EASEMENT /REAL ESTATE COSTS:			
TEMPORARY CONSTRUCTION EASEMENT (TCE) COST =			
PERMANENT EASEMENT =			
REAL PROPERTY STAFF =			
EASEMENT COST SUBTOTAL =	**$0**		
EASEMENT COST CONTINGENCY =	*$0*	*30.0%*	
TOTAL EASEMENT COST W/ CONTINGENCY (E) =	**$0**		
TOTAL PROJECT COSTS (TPC)=(C)+(D)+(E)	**$205,631,000**		

Cost Estimates Summary:		*% of TPC*
Total Construction Cost (TCC) w/o Contingency =	**$91,281,000**	*44%*
Total Soft Cost (TSC) w/o Contingency =	**$55,593,000**	*27%*
Total Easement Cost (TEC) w/o Contingency =	**$0**	*0%*
Total Contingency =	**$58,757,000**	*29%*
Total Project Cost (TPC) =	**$205,631,000**	*100%*

APPENDIX F POLICY AND CODE REVIEW

Appendix F - City Policy and Code Review

Category	Source	Document	Section Number	Section Title	Relevant Policy Statement or Sample Text	Relevance to Lake Line Policy	Policy Influence	Lake Line Topic 1	Lake Line Topic 2	Policy Considerations
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.065	Duty to serve.	The utility is responsible for providing sewer service to all customers within the utility service area, subject to the requirements of this code, other provisions of the Bellevue City Code and applicable state law.	Can type of service be changed from gravity to grinder pumps?	New Policy May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.115(A)	System ownership.	The utility owns all sewer facilities in public right-of-way and in easements dedicated to the public and accepted by the utility, except to the extent that private ownership is otherwise indicated as a matter of record.	If grinder pumps are to be owned and operated by the utility (similar to Bremerton and SPWSD) will easement be required at the grinder pump, or can it be by agreement with property owner (as is done by Bremerton and SPWSD)? Will grinder pump force mains need to be owned by the City or property owner. If the City constructs the grinder pump and force main, can it hand ownership back to property owner, or will it need to retain with easements? If have to compensate for easements will have a potential high cost increase?	Policy Change May be Required	Grinder Pumps	Easement Needs	Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.115(B)	System ownership.	Side sewers located on private property are exclusively owned by the underlying property owner(s), unless otherwise assigned or dedicated by easement to and accepted by the city, except to the extent that public ownership is otherwise indicated as a matter of record.	If require that property owners own and maintain grinder pump force mains, then they will in many cases need to acquire private easements from upland properties. If upland property owners are unwilling to grant easement, can the City use eminent domain to acquire and then transfer the condemned easement to the grinder pump property owner?	Policy Change May be Required	Easement Needs	Grinder Pumps	Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.120(C)	Permits - Approvals.	Utility Developer Extension Agreement.	Could developer extension agreement be used as a model (in reverse) for the City constructing grinder pump and force main and then transferring ownership to property owner upon completion?	New Policy May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.120(E)	Permits - Approvals.	Pump Station Agreement. Prior to construction of a privately owned sewer pump station other than for a single-family residence or serving a single-family lot, the property owner shall enter into a pump station agreement with the utility that sets forth the owner's maintenance and emergency responsibilities.	If end up having two or more properties draining to a single private grinder pump will this code requirement kick in? If so, should this be changed if have many combined small pump stations for lake line solutions?	Policy Change May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.120(H)	Permits - Approvals.	Other Permits. It is the property owner's responsibility to identify and obtain all permits/approvals required for any proposed work. (Ord. 5964 § 1, 2010.)	If the City initiates work on private facilities (or constructs new private facilities) does this code requirement need to be revised?	Policy Change May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.130(A)(1)	Engineering and design requirements.	The property owner is responsible for sewer system design.	If the City initiates work on private facilities (or constructs new private facilities) does this code requirement need to be revised?	Policy Change May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.130(C)(1)	Engineering and design requirements.	A maximum of four residential structures may be connected to a single side sewer.	If lake line replacement requires a change in side sewer collection to combine more than 4 residential structures onto a private system, then the City will either have to add a section of 8" line with a public easement downstream of the fourth structure.	Policy May be a Constraint on Lake Line Maintenance or Renewal/Replacement Activities	Easement Needs		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.140(A)	Installation responsibility.	The property owner shall be responsible for the installation of all sewer facilities required by this code. Installation shall be through a utility developer extension agreement or side sewer permit.	If the City initiates work on private facilities (or constructs new private facilities) does this code requirement need to be revised?	Policy Change May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.140(B)	Installation responsibility.	The property owner shall be responsible for all installation costs regardless of whether the work is done by the utility or by the owner; provided, that:	If the City initiates work on private facilities (or constructs new private facilities) does this code requirement need to be revised?	Policy Change May be Required	Grinder Pumps		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.160(B)(2)	Sewer easement requirements.	The proposed easement shall be compatible with utility clearance standards and setback standards and with other utilities, structures, buildings, or easements.	Lake line rehabilitation/replacement may require extraordinary protection of structures within setbacks, will this provide the City with means to recover cost from homeowners for protection/repair of structures within setbacks? Utilities setbacks were not put into engineering standards until they were established in 1988. Are structures built prior to this grandfathered in and therefore City pays all cost of protection?	Policy Change May be Required	Private Improvements	Easement Needs	Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.160(B)(3)	Sewer easement requirements.	The easement shall provide access to the facility for repair and maintenance. When deemed necessary by the utility, the easement shall contain provisions for long-term maintenance. Easements for side sewers serving more than one property must specify responsibility for costs of maintenance, repair and access;	Many sites will have mature and expensive landscaping as well as expensive hardscape built within easements and requiring removal or demolition when lake line rehabilitation/replacement takes place. Will the City be responsible for cost of removal/demolition? Should the cost of replacement be the property owner's responsibility?	Policy Change May be Required	Private Improvements	Easement Needs	Potential Gap

Category	Source	Document	Section Number	Section Title	Relevant Policy Statement or Sample Text	Relevance to Lake Line Policy	Policy Influence	Lake Line Topic 1	Lake Line Topic 2	Policy Considerations
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.160(C)	Sewer easement requirements.	The property owner shall pay all costs of providing or obtaining and recording the easement.	If the City initiates work on private facilities (or constructs new private facilities) does this code requirement need to be revised?	Policy Change May be Required	Easement Needs		Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.210(B)	Maintenance of sewer system.	Contract Maintenance. The utility may agree to provide maintenance service to maintain private sewage pump stations that serve more than one residence, by contract and at the owner's expense, in order to meet the city's obligation to the Washington State Department of Ecology for maintenance responsibility.	The City could consider extending this to single-connection grinder pumps if conversion is required to remove lake lines from service. This could be considered a special case due to change of service for the lake line connection.	Policy Change May be Required	Grinder Pumps	Maintenance	Potential Gap
Bellevue Codes	City of Bellevue Municipal Code	Sewer Utility Code	24.04.270	Sewer rates.	A. General. The city council shall establish rates for sewer use and service; such rates are in addition to connection charges and fees for specific services. The utility may establish classifications of customers or service, using any method or methods authorized by law. B. Rate Basis. Sewer rates shall be based on revenue requirements necessary to cover all costs of the utility, as authorized by the city council by the adoption of the biennial budget and subsequent amendments and shall be guided by adopted financial policies and bond covenants. C. Rate Adjustments. Rates shall be evaluated periodically as part of the review and adoption of the biennial budget. Rate adjustments shall be recommended as needed to meet revenue requirements. Any recommended rate adjustment shall consider equity, adequacy, cost and other factors allowed by law. D. Billing and Collection. The utility shall develop and implement procedures and systems pertaining to the billing and collection of sewer service charges and fees in accordance with state law. E. Rate Relief. The city council may establish sewer rate relief measures for specific customer classes as authorized by state law. (Ord. 5964 § 1, 2010.)	Question related to utilities financial policies discussed in Section IV.H, Rate Uniformity. If the City decides to apply special rates or surcharges for lake line capital investments or maintenance costs, does this need to be explicitly noted in the utility codes? Perhaps not if utilized previously for the CBD surcharge and Lakemont facilities.	Policy Change May be Required	Utility Rates		Potential Gap
Easements	Sammamish Plateau Water and Sewer District	Sammamish Plateau Water and Sewer District - Chapter 6 Sewer System Policies	6.3.1.3.2	Policies Regarding Sewer Access	Easements shall include limitations on obstructions to District access for operation and maintenance of facilities unless there is express written approval by the District. In all cases, with or without written approval allowing a variance to the standard easement limitations, the property owner will be responsible for the cost of removal and replacement of any obstructions in the easement and restoration associated with removal of obstructions. Obstructions include, but are not limited to: a. Structures b. Fences c. Rockeries d. Trees e. Bushes or Shrubbery f. Other Obstructions	District policies on homeowner requirements for being responsible for structures/landscaping built in easement are more specific than those in the Bellevue template easement. Should Bellevue consider strengthening its terms?	New Policy May be Required	Private Improvements	Easement Needs	Potential Gap
Easements	City of Belleuve Utilities Templates	City of Belleuve Sewer Easement Template	N/A	N/A	Grantor shall retain the right to use the surface of said Easement so long as said use does not interfere with the installation, maintenance and repair of the water facilities and so long as no permanent buildings or structures are erected on said Easement.	Easement provision for maintenance access may not provide adequate requirements to keep easement free of obstructions. No discussion of cost of restoration of private landscaping or structures placed within the easement.	New Policy May be Required	Private Improvements	Easement Needs	Potential Gap
Easements	City of Belleuve Utilities Templates	Private Joint Use Sewer Maintenance Agreement Template	N/A	N/A	There shall be an easement (blank) feet wide for sewer line along the line as constructed for the use of said properties. The cost of maintenance, repairs or reconstruction of that portion of the sewer line used in common shall be borne in equal shares, except that the owners of any lower parcel shall not be responsible for the part of the sewer line above their connection; and when necessary to repair, clean or reconstruct the sewer line, the parties to this agreement shall have a right of entry for that purpose.	If lake line replacement requires a change in side sewer collection to combine more than one residential structure onto a private system that requires new joint-use sewer easements, will the property owners be required to pay easement acquisition and future joint maintenance costs? Or should the City pay costs due to imposing a changed condition on the properties that previously had a direct connection to the public sewer system?	New Policy May be Required	Easement Needs		Potential Gap

Category	Source	Document	Section Number	Section Title	Relevant Policy Statement or Sample Text	Relevance to Lake Line Policy	Policy Influence	Lake Line Topic 1	Lake Line Topic 2	Policy Considerations
Easements	City of Lake Forest Park	City of Lake Forest Park Easement Agreement for On-Site Grinder Pump System	7	Grantor's Use of Perpetual Easement Area	GRANTOR reserves the right to use the Perpetual Easement Area for any purpose not inconsistent with the rights herein granted; provided that, within the Perpetual Easement Area, GRANTOR shall not (i) erect any structure or fixture; (ii) plant trees; (iii) maintain any other obstruction that would interfere with GRANTEE'S use of the Easement Area. GRANTOR shall not excavate within the Perpetual Easement Area and shall not undertake any activity on the property that would disturb the compaction or unearth the Facilities or endanger the lateral support to the Facilities. GRANTOR shall not alter the surface level or- elevation of the ground within the Perpetual Easement Area. If GRANTOR violates this paragraph, GRANTEE shall have the right to remove, or require removal of, any obstruction, or to restore, or require restoration of, the Perpetual Easement Area to the condition that existed before violation of this paragraph either of which shall be accomplished within a reasonable period of time and at GRANTOR'S expense.	Lake Forest Park policies on homeowner requirements for being responsible for structures/landscaping built in easement are more specific than those in the Bellevue template easement. Should Bellevue consider strengthening its terms?	New Policy May be Required	Private Improvements	Easement Needs	Potential Gap
Financial Policies	City of Bellevue Utilities Financial Policies - 2021-2022 Budget	Capital Investment Program Policies	II.C.	Use of Debt	The Utilities should fund capital investment from rates and other revenue sources and should not plan to use debt except to provide rate stability in the event of significantly changed circumstances, such as disasters or external mandates. Resolution No. 5759 states that the City Council will establish utility rates/charges and appropriations in a manner intended to achieve a debt service coverage ratio (adjusted by including City taxes as an expense item) of approximately 2.00". Please note that the Moody's Investor Services rating should be Aa2 (not Aa as stated in Resolution No. 5759).	If additional source of funding for lake line capital investment is considered, the text discussion under this policy indicates that if low-interest sources of additional funding such as the Public Works Trust Fund loans could be considered over other forms of debt funding.	Policy Supports Lake Line Maintenance or Renewal/Replacement Activities	Utility Rates		Potential Gap
Grinder Pumps	Washington State Department of Ecology	Washington State Department of Ecology Criteria for Sewage Works Design	C1-10.4.1	Ownership, Operation and Maintenance	Utilities proposing to use alternative collection systems - specifically GP (grinder pump) , STEP and SDG systems - must clearly define in the Comprehensive Sewer Plan who will own the systems and who will be responsible for operation and maintenance. Utilities must also develop by ordinance or through local code a set of uniform standards for system design, installation, operation, maintenance and emergency response measures.	Grinder pump systems can be owned by the City or property owner, but require amendments to the wastewater system plan and standards be established by City ordinance.	New Policy May be Required	Grinder Pumps	External Regulations	Potential Gap
Grinder Pumps	Washington State Department of Ecology	Washington State Department of Ecology Criteria for Sewage Works Design	C1-10.4.3	Personnel Qualifications	Agencies operating alternative forms of wastewater collection must employ staff members who are qualified in maintenance of alternative forms of wastewater collection, unless the agency enters into a comprehensive service contract with the vendor supplying the system.	Conversion to grinder pump service will require new employee training or reliance on vendors for maintenance.	New Policy May be Required	Grinder Pumps	Maintenance	Potential Gap
Grinder Pumps	City of Bremerton	City of Bremerton Grinder Pump Agreement Template	N/A	N/A	See summary of relevant policy terms to the right.	Agreement establishes ownership/maintenance guidelines. Homeowner is responsible for power distribution to pump alarm/breaker panel, manual transfer switch (if want to connect their own generator), line from house to pump chamber, and line from chamber discharge valve to public side sewer connection at street. The City is responsible for pump components including chamber, valve, and power from pump alarm/breaker panel to pump motor. Maintenance is by a maintenance contractor under contract with the City.	New Policy May be Required	Grinder Pumps	Maintenance	Potential Gap
Grinder Pumps	Sammamish Plateau Water and Sewer District	Sammamish Plateau Water and Sewer District Grinder Pump Agreement Template	N/A	N/A	See summary of relevant policy terms to the right.	Agreement establishes ownership/maintenance guidelines. The homeowner provides and pays for cost of power. The grinder pump is owned and maintained by district. Owner pays maintenance charge with utility bill. There is no mention of ownership of the force main from the pump to the District system.	New Policy May be Required	Grinder Pumps	Maintenance	Potential Gap

Category	Source	Document	Section Number	Section Title	Relevant Policy Statement or Sample Text	Relevance to Lake Line Policy	Policy Influence	Lake Line Topic 1	Lake Line Topic 2	Policy Considerations
Grinder Pumps	Sammamish Plateau Water and Sewer District	Sammamish Plateau Water and Sewer District Chapter 6 Sewer System Policies	6.3.2	Grinder Pumps	In certain circumstances single-family residential sewer customers must use an individual District standard grinder pump system to connect to the sewer collection system. The District's policy to own, operate and maintain the grinder pumps used by new single-family customers follows the Washington State Department of Ecology guidelines. The District's Grinder Pump Program for single-family residential customers includes maintenance of the grinder pump systems. The Grinder Pump Program is intended to be self-sustaining and self-funded, with a Grinder Pump Charge included in the sewer bill in addition to the standard single-family District sewer rate.	Establishes agency responsibility for ownership and maintenance. Property owners fund cost of the grinder pump program.	New Policy May be Required	Grinder Pumps	Utility Rates	Potential Gap
Grinder Pumps	Sammamish Plateau Water and Sewer District	Sammamish Plateau Water and Sewer District Chapter 6 Sewer System Policies	6.12.1.1.3	Policies Regarding Single-Family Residential (Charges)	Multiple structures on a single-family lot may share one grinder pump system if located reasonably close to each other.	Limits grinder pump systems to individual lots. The City will need to decide if multiple lots can drain to a single grinder pump. If this is proposed, the City should consider if the one lot with the grinder pump receive any compensation to account for the added burden of accommodating upland neighbors.	New Policy May be Required	Grinder Pumps	Utility Rates	Potential Gap
Grinder Pumps	Sammamish Plateau Water and Sewer District	Sammamish Plateau Water and Sewer District Chapter 6 Sewer System Policies	6.12.1.1.5	Policies Regarding Single-Family Residential (Charges)	Grinder pump customers shall pay rates sufficient to cover the costs of the District's grinder pump program in addition to the base single-family rate.	The City will need to determine if customers converted from from gravity service to grinder pump service will be required to pay for the extra service. This deviates from rate uniformity, but is allowed by the City's financial policy for additional rates or surcharge for extraordinary maintenance or capital costs.	New Policy May be Required	Grinder Pumps	Utility Rates	Potential Gap
Interlocal Agreements	City of Bellevue Utilities Central Files	Yarrow Point Franchise Agreement 1986	15	Service and Service Charges	The City shall continue to provide water and sewer service to their customers in the Town of Yarrow Point equal in all respects to that provided to residents within the City of Bellevue, and the City shall fix service charges at the same rate for the same class of service whether located within the City or outside the City.	Sewer service and rates to Yarrow Point customers cannot differ from that provided to customers within the City. If a lake line surcharge or increased rate is applied in Yarrow Point, it will need to be considered equal to that applied to lake lines in Bellevue. Also, will need to consider if a change from gravity service to grinder pumps differs from service provided to customers in Bellevue.	Policy May be a Constraint on Lake Line Maintenance or Renewal/Replacement Activities	External Regulations	Utility Rates	Potential Gap
SEPA	City of Bellevue Meydenbauer Bay Park Sewer Line Replacement, Project Files	Meydenbauer Bay Park Sewer Line Replacement Shoreline Substantial Development Permit and Determination of Non-Significance (DNS) Land Use Staff Report File Number 16-136213-WG	IX.	IX. Decision Criteria	LUC 20.30R.155.B Shoreline Substantial Development Permit – Decision Criteria The Director may approve, or approve with modifications if: 1. The applicant has carried the burden of proof and produced evidence sufficient to support the conclusion that the application merits approval or approval with modifications; The applicant has demonstrated that the proposal is in conformance with required performance standards in the Land Use Code for work within the Shoreline Overlay District. 2. The applicant has demonstrated that the proposal complies with the applicable decision criteria of the Bellevue City Code; The proposal complies with all applicable decision criteria found in this section. 3. The applicant has demonstrated that the proposal is consistent with the policies and procedures of the Shoreline Management Act and the provisions of Chapter 173-14 WAC and the Master Program. As discussed in Section IV of this report, the proposal complies with the policies of the Shoreline Management Act, Chapter 173-14 WAC, and the Shoreline Master Program.	Permits to perform rehabilitation or replacement of the lake lines require that the projects demonstrate conformance with the State's Shoreline Management Act, the City's Shoreline Master Program, and Bellevue City Code. It will be important to make sure that the Utility maintains and adopts lake line policies that conform with these existing policies and codes.	Policy Change May be Required	Construction		Potential Gap

Category	Source	Document	Section Number	Section Title	Relevant Policy Statement or Sample Text	Relevance to Lake Line Policy	Policy Influence	Lake Line Topic 1	Lake Line Topic 2	Policy Considerations
Water & Wastewater System Plans	City of Bellevue Wastewater System Plan, Volume 1 July 7, 2015	Chapter 2 - Wastewater Utility Policies	2.1	Wastewater System Policies Background	The general policies have been reviewed and updated by Utilities Department management and the Environmental Services Commission as part of each subsequent wastewater system plan update. The policies in this document (excluding the financial policies) were reviewed by the Environmental Services Commission on October 4, 2012. Financial policies are reviewed, updated and adopted by Council as part of each bi-annual budget. The financial policies were last reviewed by the Environmental Services Commission as part of the 2013-14 budget update, on May 3, 2012 and adopted by City Council on December 3, 2012.	Policies in the system plan are not current. Need to assess latest sewer utility policies in the Bellevue City Code.	Policy Change May be Required			Potential Gap
Water & Wastewater System Plans	City of Bellevue Wastewater System Plan, Volume 1 July 7, 2016	Chapter 2 - Wastewater Utility Policies	2.2.1.2	Sewer System Ownership and Maintenance	The utility assumes ownership and responsibility for the structural integrity of all sewers, mainlines, and side sewers within public rights-of-way and easements dedicated to the utility, except to the extent that private ownership is otherwise indicated as a matter of record. Private property owners continue to own and be responsible for the construction, maintenance, protection and repair of that portion of the side sewer located on private property and any side sewer appurtenances, such as check valves (Sewer Utility Code 24.04.115). Private property owners also are responsible for any maintenance or repair associated with the misuse of utility-owned side sewers and mains.	Limits City ownership to be within lake line easements. If City determines that Grinder Pumps should be City-owned, will need to modify this policy, or acquire easements to operate and maintain grinder pumps on private property.	Policy Change May be Required	Grinder Pumps	Easement Needs	Potential Gap
Water & Wastewater System Plans	City of Bellevue Water System Plan, Volume 1 June 16, 2016	Chapter 2 - Water Utility Policies	2.2	Facility Abandonment	When the Utility abandons a facility, it shall be done in a safe and environmentally sound manner, consistent with all applicable federal, state, and local regulations at the time of abandonment. Occasionally, the Utility no longer needs some element of the water system infrastructure, such as a pipe, a pump station, or a reservoir. When a facility is abandoned in-place, detailed as-built records should be maintained in utility records. Facility abandonment should be done in the manner directed by the Engineering Standards. In the case of abandoned asbestos cement (AC) pipe, standard practice and currently accepted environmental policy dictates that the City should leave the pipe in-place. Asbestos fibers in AC pipe are not released or harmful unless the pipe is broken or disturbed (e.g. during excavation and removal). In that case, the pipe must be dealt with as a hazardous material, and special precautions must be taken to prevent fiber inhalation. For this reason, it is preferable to limit disturbance of this material and leave AC pipe in place in the right-of-way. However, when AC pipe is abandoned in an easement on private property, where it is unlikely the City would be aware of future pipe disturbance, it should be removed by the Utility unless dictated by specific circumstances.	This policy would require removal of asbestos cement (AC) lake lines when abandoned in easements on private property. If a lake line is located in public right-of-way it should be abandoned in place. The policy is silent regarding abandonment on City-owned property such as public parks. Where AC pipe removal from easements on certain private properties was deemed too disruptive, past Utility practice has been to not relinquish those easements so that the City retains control/responsibility for the buried hazardous material.	Policy May be a Constraint on Lake Line Maintenance or Renewal/Replacement Activities	Construction	Easement Needs	Potential Gap

APPENDIX G

SERVICE AREA PRIORITIZATION DATA AND CALCULATIONS

Weighted Risk

Likelihood of Failure	70%
Consequence of Failure	30%

		Lake Line RUL (R&R) (City provided scoring)	Material (R&R) (City provided scoring)	Couponing (2016) (City provided scoring)	Pump/Flush Station Condition	Outside Influences	Overflow History
Low	1	Within EUL	DI or Other (Non-AC/CI)	0%-10% Wall Loss	Good	< 3,500 LF	0
Medium	2	At/Beyond EUL (Non-AC/C	CI or Unknown	11%-25% Wall Loss	Adequate	3,500-5,000 LF	1
High	3	Beyond EUL AC/CI	AC Material	26%+ Wall Loss	Poor	> 5,000 LF	> 1

						Likelihood of Failure (Probability)						
Service Area	Reach	Sub-Basin	Reach Name	Weighted Total Risk	Raw Total Risk	Lake Line RUL (R&R)	Material (R&R)	Couponing (2016)	Pump/Flush Station Condition	Outside Influences	Overflow History	**Score**
						11%	11%	13%	35%	10%	20%	
Hunts Point & Yarrow Point	1	COZ_A_1	FLUSH #1 TO YARROW PT PS	4.52	4.40	2	2	2	3	2	2	**2.35**
	2	COZ_A_2	YARROW PT PS TO COZY COVE PS	4.58	4.56	1	2	1	3	2	3	**2.31**
	3	COZ_B_1	HUNTS PT PS TO COZY COVE PS	4.40	4.26	1	2	1	3	2	3	**2.31**
	4	COZ_B_2	FLUSH #2 TO HUNTS PT PS	4.04	3.66	1	2	1	3	2	3	**2.31**
Evergreen Point	5	FWR_A_1	EVG EAST PS TO FAIRWEATHER PS	4.64	4.14	3	2	3	3	1	3	**2.69**
	6	FWR_A_2	EVG WEST PS TO EVERGREEN EAST PS	4.29	3.95	3	3	3	3	1	1	**2.40**
	7	FWR_A_3	FLUSH #3 TO EVG WEST PS	4.00	4.14	1	2	2	2	2	2	**1.89**
Medina South	8	MED_A_1	FLUSH #3 TO LAKECREST PS	3.43	3.59	1	2	2	2	1	1	**1.59**
	9	MED_A_2	LAKECREST PS	3.77	3.55	3	3	3	2	1	1	**2.05**
	10	MED_A_3	MEDINA CITY HALL PS	3.48	3.46	1	2	1	2	2	2	**1.76**
	11	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	4.54	4.96	1	2	1	2	2	3	**1.96**
Meydenbauer Bay	12	PKR_A_1	FLUSH #5 TO PARKERS PS	4.71	4.85	3	3	3	2	1	2	**2.25**
	13	BEL_A_1	PARKERS PS TO LAGEN PS	5.05	5.15	3	3	3	2	1	3	**2.45**
	14	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	3.96	3.94	1	2	2	2	3	2	**1.99**
Killarney	15	SWL_A_1	FLUSH #7 TO KILLARNEY PS	4.31	4.39	1	2	2	2	2	3	**2.09**
	16	SWL_A_2	KILLARNEY PS TO KC SYSTEM	4.32	4.40	2	2	2	2	3	2	**2.10**
Newport South	17	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	4.47	4.51	1	2	1	3	3	2	**2.21**
	18	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	4.38	4.36	1	2	1	3	3	2	**2.21**

Weighted Risk

Likelihood of Failure	70%
Consequence of Failure	30%

			Environmental Impacts	Land Use	Parcels Served	Total Flow to D/S PS (Storm 1)	Approx. % in water	Operational Access
Low	**1**	**1**	Not spawning	Residential Onl	< 50	0-100 gpm	0-60%	Land, from easement/ROW
Medium	**2**	**2**	(None)	Public Access (I	50-100	101-200 gpm	60-89%	Land, private lot
High	**3**	**3**	Spawning Area	Essential Facilit	> 100	> 200 gpm	90-100%	No vehicle access

+

						Consequence of Failure (Criticality)						
Service Area	Reach	Sub-Basin	Reach Name	**Weighted Total Risk**	**Raw Total Risk**	Environmental Impacts	Land Use	Number of Customers	Flow (gpm)	Location	Operational Access	**Score**
						20%	20%	25%	10%	10%	15%	
Hunts Point & Yarrow Point	1	COZ_A_1	FLUSH #1 TO YARROW PT PS	**4.52**	**4.40**	1	2	3	3	1	2	**2.05**
	2	COZ_A_2	YARROW PT PS TO COZY COVE PS	**4.58**	**4.56**	1	2	3	3	3	2	**2.25**
	3	COZ_B_1	HUNTS PT PS TO COZY COVE PS	**4.40**	**4.26**	3	1	1	3	3	2	**1.95**
	4	COZ_B_2	FLUSH #2 TO HUNTS PT PS	**4.04**	**3.66**	1	1	1	2	2	2	**1.35**
Evergreen Point	5	FWR_A_1	EVG EAST PS TO FAIRWEATHER PS	**4.64**	**4.14**	1	2	2	1	1	1	**1.45**
	6	FWR_A_2	EVG WEST PS TO EVERGREEN EAST PS	**4.29**	**3.95**	1	2	1	3	1	2	**1.55**
	7	FWR_A_3	FLUSH #3 TO EVG WEST PS	**4.00**	**4.14**	3	1	2	2	3	3	**2.25**
Medina South	8	MED_A_1	FLUSH #3 TO LAKECREST PS	**3.43**	**3.59**	3	1	1	2	3	3	**2.00**
	9	MED_A_2	LAKECREST PS	**3.77**	**3.55**	3	1	1	2	1	1	**1.50**
	10	MED_A_3	MEDINA CITY HALL PS	**3.48**	**3.46**	1	3	1	3	2	1	**1.70**
	11	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	**4.54**	**4.96**	3	3	3	3	3	3	**3.00**
Meydenbauer Bay	12	PKR_A_1	FLUSH #5 TO PARKERS PS	**4.71**	**4.85**	3	1	3	3	3	3	**2.60**
	13	BEL_A_1	PARKERS PS TO LAGEN PS	**5.05**	**5.15**	3	2	3	2	3	3	**2.70**
	14	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	**3.96**	**3.94**	3	1	2	1	1	3	**1.95**
Killarney	15	SWL_A_1	FLUSH #7 TO KILLARNEY PS	**4.31**	**4.39**	3	2	3	2	2	1	**2.30**
	16	SWL_A_2	KILLARNEY PS TO KC SYSTEM	**4.32**	**4.40**	3	2	3	2	2	1	**2.30**
Newport South	17	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	**4.47**	**4.51**	3	2	2	2	3	2	**2.30**
	18	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	**4.38**	**4.36**	3	1	2	1	3	3	**2.15**

Service Area	Reach	Sub-Basin	Reach Name	Raw Total Risk	Risk Ranking (High to Low)	Average Raw Area Risk (Baseline) Score	Average Raw Area Risk (Baseline) Rank	Average Area Weighted (70% LoF/30% CoF) Risk Score	Average Area Weighted (70% LoF/30% CoF) Risk Rank
Hunts Point & Yarrow Point	1	COZ_A_1	FLUSH #1 TO YARROW PT PS	4.40	6	4.22	4	4.39	3
	2	COZ_A_2	YARROW PT PS TO COZY COVE PS	4.56	4				
	3	COZ_B_1	HUNTS PT PS TO COZY COVE PS	4.26	10				
	4	COZ_B_2	FLUSH #2 TO HUNTS PT PS	3.66	15				
Evergreen Point	5	FWR_A_1	EVERGREEN EAST PS TO FAIRWEATHER PS	4.14	11	4.08	5	4.31	5
	6	FWR_A_2	EVERGREEN WEST PS TO EVERGREEN EAST PS	3.95	13				
	7	FWR_A_3	FLUSH #3 TO EVERGREEN WEST PS	4.14	11				
Medina South	8	MED_A_1	FLUSH #3 TO LAKECREST PS	3.59	16	3.89	6	3.81	6
	9	MED_A_2	LAKECREST PS	3.55	17				
	10	MED_A_3	MEDINA CITY HALL PS	3.46	18				
	11	MED_B_1	FLUSH #4 TO MEDINA CITY HALL PS	4.96	2				
Meydenbauer Bay	12	PKR_A_1	FLUSH #5 TO PARKER PS	4.85	3	4.65	1	4.57	1
	13	BEL_A_1	PARKERS PS TO LAGEN/GRANGE PS	5.15	1				
	14	MEY_A_1	FLUSH #6 TO MEYDENBAUER PS	3.94	14				
Killarney	15	SWL_A_1	FLUSH #7 TO KILLARNEY PS	4.39	8	4.40	3	4.31	4
	16	SWL_A_2	KILLARNEY PS TO KING COUNTY SYSTEM	4.40	6				
Newport South	17	NWP_A_1	PLEASURE PT PS TO BAGLEY PS	4.51	5	4.44	2	4.43	2
	18	NWP_A_2	FLUSH #8 TO PLEASURE PT PS	4.36	9				

Pump and Flush Station Improvements
Escalated Costs from 2015 MSA Report

Area	Station	Project	Year	Project Cost (2014)	Total Cost (2014)	Area Cost (2014)	Reference	Page	Project Cost (2023)	Project Cost (2023 Rounded)	Area Cost (2023)
Hunts Point & Yarrow Point	Flush #1	F1-1	2018-2022	$ 5,000			Table 32-6	1002	$ 6,810.87	$ 7,000.00	
		F1-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F1-3	2023-2026	$ 630,000					$ 858,170.09	$ 859,000.00	
					$ 710,000						
	Yarrow Point	YP-1	2015-2018	$ 379,000			Table 5-1	57	$ 516,264.23	$ 517,000.00	
					$ 379,000						
	Cozy Cove	CC-1	2015-2018	$ 18,000			Table 6-1	95	$ 24,519.15	$ 25,000.00	
		CC-2	2015-2018	$ 567,000					$ 772,353.08	$ 773,000.00	
					$ 585,000						
	Flush #2	F2-1	2018-2022	$ 5,000			Table 32-7	1003	$ 6,810.87	$ 7,000.00	
		F2-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F2-3	2023-2026	$ 1,230,000					$ 1,675,474.94	$ 1,676,000.00	
					$ 1,310,000						
	Hunts Point	HP-1	2015-2018	$ 373,000			Table 11-1	285	$ 508,091.18	$ 509,000.00	
					$ 373,000						
						$ 3,357,000					**$ 4,579,000.00**
Evergreen Point	Flush #3	F3-1	2015-2018	$ 75,000			Table 32-8	1004	$ 102,163.11	$ 103,000.00	
		F3-2	2023-2026	$ 300,000					$ 408,652.42	$ 409,000.00	
					$ 375,000						
	Evergreen West	EW-1	2015-2018	$ 352,000			Table 12-1	323	$ 479,485.51	$ 480,000.00	
					$ 352,000						
	Evergreen East	EE-1	2015-2018	$ 344,000			Table 7-1	141	$ 468,588.11	$ 469,000.00	
					$ 344,000						
	Fairweather		2018	$ 306,000		$ 1,071,000			$ 416,825.47	$ 417,000.00	
											$ 1,878,000.00
Medina South	Lakecrest	LC-1	ASAP	$ -			Table 13-1	360			
		LC-2	2018-2022	$ 360,000					$ 490,382.91	$ 491,000.00	
					$ 360,000						
	Medina City Hall	N/A	2015-2018	$ 292,000			Table 3-2	32	$ 397,755.03	$ 398,000.00	
					$ 292,000		31.2.5	994			
	Flush #4	F4-1	2018-2022	$ 5,000			Table 32-9	1005	$ 6,810.87	$ 7,000.00	
		F4-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F4-3	2023-2026	$ 285,000					$ 388,219.80	$ 389,000.00	
					$ 365,000						
						$ 1,392,000					
											$ 1,900,000.00
Meydenbauer Bay	Flush #5	F5-1	2020-2025	$ 5,000			Table 32-10	1006	$ 6,810.87	$ 7,000.00	
		F5-2	2023-2026	$ 122,500					$ 166,866.41	$ 167,000.00	
					$ 127,500						
	Parkers	N/A	2015-2018	$ 413,000			Table 3-2	32	$ 562,578.17	$ 563,000.00	
					$ 413,000		31.2.4	993			
	Grange	G-1	2018-2022	$ 234,000			Table 8-1	178	$ 318,748.89	$ 319,000.00	
					$ 234,000						
	Meydenbauer	M-1	ASAP	$ -			Table 15-1	434			
		M-2	2018-2022	$ 343,000					$ 467,225.94	$ 468,000.00	
					$ 343,000						
	Flush #6	F6-1	2018-2022	$ 5,000			Table 32-11	1007	$ 6,810.87	$ 7,000.00	
		F6-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F6-3	2023-2026	$ 232,500					$ 316,705.63	$ 317,000.00	
					$ 312,500						
						$ 1,430,000					**$ 1,951,000.00**
	Lagen (excluded - constructed in 2018)										
Killarney	Flush #7	F7-1	2018-2022	$ 5,000			Table 32-12	1008	$ 6,810.87	$ 7,000.00	
		F7-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F7-3	2023-2026	$ 225,000					$ 306,489.32	$ 307,000.00	
					$ 305,000						
	Killarney	K-1	2018-2022	$ 181,000			Table 14-1	397	$ 246,553.63	$ 247,000.00	
		K-2	2023-2027	$ 213,000					$ 290,143.22	$ 291,000.00	
					$ 394,000						
						$ 699,000					**$ 955,000.00**
Newport South	Flush #8	F8-1	2018-2022	$ 5,000			Table 32-13	1009	$ 6,810.87	$ 7,000.00	
		F8-2	2020-2025	$ 75,000					$ 102,163.11	$ 103,000.00	
		F8-3	2023-2026	$ 480,000					$ 653,843.88	$ 654,000.00	
					$ 560,000						
	Pleasure Point	PP-1	2015-2018	$ 150,000			Table 17-1	510	$ 204,326.21	$ 205,000.00	
		PP-2	2023-2027	$ 210,000					$ 286,056.70	$ 287,000.00	
					$ 360,000						
	Bagley	B-1	2015-2018	$ 154,000			Table 16-1	471	$ 209,774.91	$ 210,000.00	
		B-2	2023-2027	$ 210,000					$ 286,056.70	$ 287,000.00	
					$ 364,000						
						$ 1,284,000					**$ 1,753,000.00**
TOTAL				$ 9,164,000	$ 8,494,000	$ 7,949,000	$ -	$ 13,346	$ 12,482,969	$ 12,504,000	

Original MSA estimate includes:
Sales Tax 9.5%
Engr, Legal, Admin 35%
Contingency 30%

Cost Escalation over time - ENR Time Adjustment for the National Average

20 City Average

Pump and Flush Station Improvements - 2015 MSA Condition Assessment Report

2023	Index for Year A	13358.17
2014	Index for Year B	9806.5
	Escalation Factor	1.36

Other System Improvements

CCTV & Cleaning Project Costs - City of Renton, Kennydale project

2023	Index for Year A	13358.17
2018	Index for Year B	11061.75
	Escalation Factor	1.21

ENR Data

	2014	2018	2023
Jan	9664	10878	13175
Feb	9681	10889	13176
Mar	9702	10959	13176
Apr	9750	10972	13230
May	9796	11013	13288
Jun	9800	11069	13345
Jul	9835	11116	13425
Aug	9846	11124	13473
Sep	9870	11170	13486
Oct	9886	11183	13498
Nov	9912	11183	13511
Dec	9936	11185	13515
Average	9807	11062	13358

Source Cost Data - City of Renton, Kennydale, Cleaning Project (2018)

Table 5.1 Final Construction Cost

Project Element	Cost
Mobilization and Demobilization	$80,200
Minor Change	$25,000
Construction Surveying, Staking and As-Builts	$31,800
Excavation Safety System	$2,430
Temporary Manhole Installation	$71,800
Manhole Installation, Extra Days	$74,100
Pipe Cleaning	$343,800
Sewer Pipe Inspection by CCTV	$145,200
Spawning Gravel	$11,750
Bulkhead/Rockery Repair	$0
C.O #1(1)	$76,800.34
Subtotal	**$862,880.34**
Total with 10% Sales Tax	**$949,168.37**

Note:
(1) C.O.: change order.

Pipe cleaning and CCTV, with temporary access construction

	2018 Costs	Escalated to 2023	
Total Cost	$949,168.37	$ 1,146,215.50	
Linear Feet	4715		
$/LF	$ 201.31	**$ 243.10**	Value used for Service Area Plans
Cleaning only	$343,800.00		
$/LF	$ 72.92	$ 88.05	
CCTV	$145,200.00		
$/LF	$ 30.80	$ 37.19	
Total		$ 125.24	

Renton Phase 2B Coupon collection and RUL determination

3 coupons, review of CCTV
Assume review of CCTV negligible to coupon & RUL

	2018 Costs	Escalated to 2023	
V&A	$ 64,948.00	$ 78,431.19	
Confluence	$ 9,200.00	$ 11,109.92	
Ballard Marine	$ 31,885.00	$ 38,504.32	
Total	$106,033.00	$ 128,045.43	
$/coupon		$ 42,681.81	
		$ 45,000.00	(rounded) Value used for Service Area Plans

In-water Alt Cost of Pipes (excluding pump stations/lift stations) for Estimating Emergency Repairs

	Costs								Linear Feet			
Service Area	Mobilization (5%)	Clearing & Demo	New 8" Sewer Pipe	Sewer Lateral Connection w/ Cleanout	New Sewer Lateral Pipe	Sewer Line Connection (Allowance)	Restoration / Clean / Testing	Total	of 8" Sewer Pipe	of new Sewer Laterals	Total	Cost / Lf of Lake Line Sewer
Hunts Point & Yarrow Point	$ 2,765,013	$ 9,965,600	$ 23,457,000	$ 1,177,000	$ 15,400,000	$ 2,850,000	$ 2,450,663	$ 58,065,276	16,755	11,000	27,755	$ 3,465.55
Evergreen Point	$ 1,674,007	$ 5,559,460	$ 11,792,200	$ 845,300	$ 11,060,000	$ 1,050,000	$ 3,173,173	$ 35,154,139	8,423	7,900	16,323	$ 4,173.59
Medina	$ 2,059,015	$ 7,873,900	$ 17,248,000	$ 856,000	$ 11,200,000	$ 1,050,000	$ 2,952,400	$ 43,239,315	12,320	8,000	20,320	$ 3,509.68
Meydenbauer Bay	$ 2,290,643	$ 5,845,140	$ 12,714,800	$ 12,714,800	$ 9,380,000	$ 2,100,000	$ 3,058,115	$ 48,103,498	9,082	6,700	15,782	$ 5,296.58
Killarney	$ 2,047,172	$ 8,336,800	$ 18,151,000	$ 663,400	$ 8,680,000	$ 1,950,000	$ 3,162,238	$ 42,990,609	12,965	6,200	19,165	$ 3,315.90
Newport South	$ 2,074,381	$ 7,247,000	$ 14,245,000	$ 1,059,300	$ 13,860,000	$ 600,000	$ 4,476,313	$ 43,561,993	10,175	9,900	20,075	$ 4,281.28

Average Cost/LF = $ 4,007.10

Assumptions:

1) Temp Bypass not included in price per LF.
2) Permits excluded from price.
3) Bathymetric Survey exclued from price.
4) Pipe replaced in kind, so no abandonment of existing line.
5) Assumes not additional accesss / maintenance hole construction

APPENDIX H PUBLIC OUTREACH SUMMARY

Prepared for:

Prepared by:

Lake Washington Wastewater Lake Line Management Plan

Community Outreach Summary

Spring 2022 – Spring 2024
Development of the Lake Line Management Plan

Table of Contents

Project background

The City of Bellevue's Lake Lines are a portion of the sewer system located along the shorelines of Lake Washington and Lake Sammamish. The Lake Washington Wastewater Lake Line is the portion of the system that runs through the lake and adjacent to the shoreline of Lake Washington. It includes 14.6 miles of sewer line with 15 pump stations and eight flush stations along the shoreline.

This infrastructure serves more than 1,000 community members in Bellevue and neighboring communities. However, pipes in the lake line system are aging, and the aquatic environment creates challenging conditions for repair and replacement activities. The Lake Washington Sewer Lake Line Management Plan was developed to effectively assess lake line conditions and plan for the management and maintenance of the lake lines. The plan will help ensure the City can continue to provide safe and reliable sewer service to the community. Equally important, it will help us protect public health and the delicate Lake Washington ecosystem.

Report summary

Hearing from community members is a critical part of Bellevue Utilities' planning and decision-making process. From July 2022 to December 2023, the project team conducted virtual public meetings, provided community briefings, published several online open houses with accompanying community surveys, and hosted a series of in-person community events to collect input from project neighbors and partnering jurisdictions. The project team incorporated community feedback into the management plan alternative analysis and environmental documentation. This report summarizes the Bellevue Utilities' community outreach efforts and feedback received from the community.

By the numbers

- Engaged 21 community partners for project briefings
- Hosted a virtual public meeting with 12 attendees
- Hosted in-person pop-up events across eight locations
- Engaged communities in eight languages (Simplified Chinese, Traditional Chinese, English, Japanese, Korean, Russian, Spanish, Vietnamese)
- Sent two postcards to 6,342 residents each time
- Hosted two online open houses with 1,200 total visitors throughout the project
- Fielded two community surveys with 27 total respondents
- Published three "It's Your City" articles
- Posted four social media posts
- Published three website updates
- Distributed 15 posters to nine community locations

Community engagement goals

The project team engaged the community and local partners to:

- Build and maintain public support by sharing how the project will benefit the community.
- Raise awareness of the importance of Lake Washington lake line, as well as the needs, challenges and impacts for lake line rehabilitation and/or replacement.
- Communicate the repercussions to the community and Lake Washington if no action is taken to rehabilitate and/or replace the aging lake line.
- Lay groundwork and develop strong community relationships for future improvement projects that could include planning, design, and construction phases.
- Identify the needs of audiences directly affected by lake line rehabilitation or replacement.
- Share information early and often to ensure transparency and prevent surprises.
- Provide opportunities for public input during key steps of the project and incorporate audience feedback into project decisions.

Informed consent principles

The project team followed guidelines of informed consent to provide clear and transparent communication about the project and opportunities for public involvement. The project team used the following informed consent principles during outreach:

- Be clear about what problem the project is solving and why it is important.
- Establish the City's legitimacy as the right entity to solve the problem, and that it would be irresponsible to not address it.
- Be transparent about who is potentially affected, the problems and opportunities that the solutions solve or address and the benefits to the community of managing the lake line in contrast to not doing anything.
- Provide ample and early opportunities for engagement, while shifting the approach over time to adapt to each phase of the project.
- Be clear and transparent about the decision-making process and share how public feedback will be incorporated into that process.

Priority audiences

The project team prioritized engagement with audiences who will be directly impacted when the projects outlined in this planning effort are implemented. This included people who live, work, or recreate in the project service areas as well as Bellevue Utilities ratepayers. Additionally, the project team engaged community or advocacy groups who may have interest in the lake line system, as well as permitting authorities, and partner jurisdictions who may have decision-making authority on future work.

See **Appendix A** for a detailed list of audiences in the project area.

Community engagement report

The project team engaged community members virtually and in-person. The engagement approach included the following activities:

- **Briefings to local partners:** Between January and March 2023, the project team conducted outreach to local agencies and community groups to share information about the project background and timeline, offer an opportunity for an in-person or virtual project briefing, gather initial impressions, identify concerns, and answer questions. For those interested in the briefing opportunity, the project team prepared a Lake Line 101 presentation to share the project background, Programmatic EIS and Management Plan alternatives, evaluation factors for alternatives, and the evaluation approach before answering questions from participants. See **Appendix B** for a summary of outreach and briefings provided to local partners.
- **Virtual public meeting:** In spring 2023, the project team encouraged community members to participate in the Draft Environmental Impact Statement (DEIS) public comment period. The project team promoted the DEIS comment period by sharing posters at community locations and by hosting a virtual public meeting for community members to ask questions or share testimony. The project team hosted a virtual public meeting via Zoom Webinar on April 18, 2023. The project team shared a brief presentation with the group describing the project and the EIS process. The team then facilitated a public testimony period for attendees. See **Appendix C** for a summary of the virtual public meeting.
- **Online open houses:** To encourage community input, Bellevue Utilities hosted two online open houses on EngagingBellevue.com. The first online open house promoted the DEIS public comment period in spring 2023. The second online open house was to solicit feedback on alternatives analysis in summer/fall 2023. A total of 1,200 participants engaged with both online open houses to learn more about the project and share feedback. See **Appendix D** for more details about the online open houses.
- **Pop-up events:** In September 2023, the project team conducted community outreach in parks, along trails, and at community events near the project service areas. Creating opportunities for engagement at community-centered events and gathering places allowed for those who don't actively seek or lack resources pertaining to City-based projects to stay involved and to share their input. These pop-up events were designed to share information about the project and solicit input on the prioritization factors being used to analyze the project alternatives. See **Appendix E** for a summary of the pop-up events.
- **Community survey:** The team hosted two opportunities to provide feedback via online surveys throughout this project, one for the DEIS public comment period and one during the analysis of potential alternatives. During the alternative selection, the team hosted a community survey on the project website, promoted through community pop-up events and other notifications. Nineteen people responded to the survey. They provided

information about in which services areas they live, work, or play, how they would prioritize consequences of lake line failure, priorities for evaluation criteria for each alternative, how they prefer to be notified about project updates, and any other feedback they wanted to share with the project team. See **Appendix F** for a summary of survey data and **Appendix H** for a full list of comments.

Notifications

The project team encouraged community participation in outreach activities through the following channels:

- Multilingual postcard mailing to people living and working near the project area
- Social media announcements on the City's Facebook and X (Twitter) pages
- Email notices sent to email listserv subscribers
- Announcements on the project website
- Articles in the "It's Your City" quarterly newsletters
- Multilingual flyers distributed to jurisdictional partner and popular gathering spaces near the project area

See **Appendix G** for photo examples of project notifications.

Key themes

For the development of the management plan, we asked communities to provide input to help inform the final recommended alternatives. The project team incorporated themes from the in-person and virtual conversations and online survey data into their analysis. What we learned from the community feedback includes:

- When asked about the most important consequences to consider in the event of a lake line failure, the majority of people prioritized the difficulty of repair or replacement of a lake line, the number of customers impacted, and the risk to the environment. These themes were repeated in comments received throughout the project.
- When asked about the most important evaluation factors for alternative selection, community members ranked impacts to land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important. This echoes the themes mentioned above.
- Some people shared a desire to maintain Lake Washington's water quality and to protect native habitat. Additionally, people expressed desire to implement a long-term and sustainable solution so that service can continue be provided for years to come without further disruption to Lake Washington or personal property. Lastly, people expressed concerns over the cost of the maintenance of the lake lines, but consistently encouraged the project team to prioritize the impacts to the community members over the cost of the project.

- Bellevue Utilities learned that most people engaging with this project lived, worked, or played in the Meydenbauer Bay or Medina South service areas. The team also learned that most people preferred that Bellevue Utilities keeps them informed about this project via emails, postcards, and “It’s Your City” articles.

See **Appendix H** for a full list of public comments.

Incorporating public input

The themes reported in this document were used by the project team to verify the EIS scoping and to inform the preferred alternative(s) for the management plan. With the EIS and Management Plan now complete, Bellevue Utilities anticipates formal adoption of the management plan with the next update to the City’s Wastewater System Plan, currently anticipated in 2026. The project team is committed to ongoing engagement and will continue to inform the public before data collection, design or construction begins for any service area.

Accessibility

In compliance with Title VI, the City attached accessibility statements to all public materials:

- For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city’s ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

Appendix A – Audience spreadsheet

Name	Audience category
Beaux Arts Village Town Clerk	City department or other agency
Bellevue Chamber	Business
Bellevue Christian School – Three Points Elementary	School or childcare facility
Bellevue Parks and Recreation	City department or other agency
Boys & Girls Club of Bellevue	School or childcare facility
City of Bellevue Environmental Services Commission	City department or other agency
City of Bellevue Marinas	Boating facility
City of Clyde Hill	City department or other agency
City of Medina - City Manager's office	City department or other agency
City of Medina - Development Services	City department or other agency
City of Medina - Public Works	City department or other agency
City of Newcastle - City Manager's office	City department or other agency
City of Newcastle - City Manager's office	City department or other agency
City of Newcastle - Public Works	City department or other agency
City of Newcastle - Public Works	City department or other agency
City of Yarrow Point	City department or other agency

Name	Audience category
Enatai Elementary School	School or childcare facility
First Church-Christ Scientist	Cultural or religious organization
Killarney Circle Pool	Social service
King County	City department or other agency
Medina Elementary School	School or childcare facility
Medina Market	Business
Meydenbauer Bay Yacht Club	Boating facility
New Hope International Church	Cultural or religious organization
Newport Hills Community Club	Neighborhood group
Newport Yacht Club	Boating facility
NW Lifestyle Homes	Business
Old Bellevue Chevron Auto Repair	Business
Overlake Golf & Country Club	Business
Seattle Boat Company – Newport	Boating facility
Seismic Northwest	Business
St. Mary-on-the-Lake Peace & Spirituality Center	Cultural or religious organization
St. Thomas School	School or childcare facility
The Greater Newcastle Chamber of Commerce	Business
The Well Community Church	Cultural or religious organization
Town of Beaux Arts Village	City department or other agency

Name	Audience category
Town of Beaux Arts Village	City department or other agency
Town of Hunts Point	City department or other agency
US Army Corps of Engineers	City department or other agency
Villaggio on Yarrow Bay	Property owners and tenants
Virginia Mason Athletic Center	Business
Voeller and Associates	Business
Washington State Department of Ecology	City department or other agency
Washington State Department of Fish and Wildlife	City department or other agency
Washington State Department of Transportation	City department or other agency
Wells Medina Nursery	Business
Yarrow Bay Marina	Boating facility
Yarrow Point Town Hall	City department or other agency

Appendix B – Briefing outreach summary

Briefing outreach summary

To offer briefing presentations to community groups, the project team sent 38 outreach emails and conducted six follow up phone calls to 21 community-based organizations, agencies and local jurisdictions, neighborhood groups, chambers of commerce, and parent teacher associations. The team shared project information and details for how to provide input to the project team. Upon request, the project team shared the Lake Line 101 presentation via email or presented it during a briefing.

Generally, contacts shared appreciation for the outreach and participated in information sharing by distributing the email among their colleagues and peers. Few community members shared questions or requested briefings. Some noted the usefulness of the Lake Line 101 presentation and other online resources and committed to following up if questions arise.

Notable Outcomes

- Downtown Bellevue Residents Association requested further coordination to gather information to distribute through their Facebook page and will reconnect with the team as capacity allows.
- The Town of Yarrow Point supported the coordination of a briefing to the Hunts Point, Yarrow Point, and Beaux Arts Town Councils. The project team briefed these audiences during a meeting in spring 2023.
- The Medina Parent Teacher Association supported the project team in distributing a project update blurb in their monthly newsletter.

Outreach log

Name	Response
Bellevue Chamber	Primary contact forwarded the outreach email to colleagues who lead government affairs and communications to share the information among Bellevue Chamber membership.
Bellevue High PTSA	Primary contact shared thanks for the information and committed to reaching out after reviewing resources if any questions arise.
Downtown Bellevue Residents Association	Primary contact responded with interest in further discussion to support drafting a message for the DBRA Facebook page. Next steps pending DBRA capacity.
HOA for The Point on Yarrow Bay	During phone call outreach, primary contact requested an additional email with project information, which the project team sent following the call.
Hunts Point	Primary contact did not respond. However, contacts with the Town of Yarrow Point supported the coordination of briefings with municipalities. See notes in Yarrow Point communications.

Name	Response
Lochleven Community Association	Connected via follow up phone call and sent follow up email with more information. Primary contact shared information among Lochleven commissioners and expressed interest in supporting information sharing on NextDoor.
Medina Parent Teacher Association	Coordinated with primary contact to share project information blurb in the Medina PTA newsletter. Did not share any questions or request a briefing.
Meydenbauer Bay Yacht Club	Primary contact shared thanks, noted that the information provided was sufficient, and expressed interest in future partnership.
Newport Yacht Club and HOA	Primary contact forwarded information along to additional Newport Shores community contacts. None shared questions or briefing requests.
Overlake Golf & Country Club	Connected with primary contact during phone call outreach and gathered email information to share follow up information.
WABA (Town of Beaux Arts)	Primary contact did not respond. However, contacts with the Town of Yarrow Point supported the coordination of briefings with municipalities. See notes in Yarrow Point communications.
Wetherill Nature Preserve	Primary contact shared thanks, sharing positive feedback for the Lake Line 101 presentation, and committed to sharing the information among organization commissioners and following up if any questions arise.
Yarrow Point	Primary contact shared information with the Town Engineer, who offered to coordinate presentations to Hunts Point, Yarrow Point, and Beaux Arts Town Councils. The project team organized a presentation and offered one-off follow ups.

Additionally, the project team conducted outreach to the City of Medina, the Enatai Elementary School PTSA, the Enatai Neighborhood Association, the Fairweather Basin Boat Club, the Meydenhauer Bay Neighbors Association, the Newport Hills Community Club, the Greater Newcastle Chamber of Commerce, and the Vuecrest Community Association, but did not receive responses.

Appendix C – Virtual public meeting summary

Poster distribution summary

To promote the Draft Environmental Impact Statement (DEIS) virtual public meeting and to direct community members to where they can participate in the DEIS public comment period, the project team distributed 15 posters on April 4, 2023, to nine different community gathering spaces, including:

- Beaux Arts Village
- Bellevue Botanical Gardens
- Bellevue City Hall
- Bellevue Library
- Crossroads Community Center
- Hunts Point Town Hall
- Northwest Arts Center
- South Bellevue Community Center
- Yarrow Point Town Hall

The team followed up to provide virtual project materials at two locations: the Crossroads Community Center and the Yarrow Point Town Hall.

Virtual public meeting summary

The project team hosted a virtual public meeting via Zoom Webinar on April 18, 2023. The project team shared a brief presentation with the group describing the project and the EIS process. The team then facilitated a public testimony period for attendees.

Attendance:

Project team

Bellevue: Angela Chung, Reilly Pittman, Elizabeth Stead, Linda De Boldt

Carollo: Lara Kammereck, Cheyenne Thompson

ESA: Lisa Adolfson

PRR: Scott Burns, Conny Garcia Gaitan, Emma Dorazio, Morgan Calder

Community members

Eight people attended the virtual public meeting out of the 18 people who registered.

Q/A:

- Is a combination of these different alternatives also an option? For example, use on shore option in some places and other options in some other areas.
    - Answer: Yes, one alternative might not be feasible in each service area, so the final recommendation might be a combination of alternatives.

Testimony Comments:

- I am not sure what kind of testimony you are looking for.
    - Response from project team: Any comments are good; you can submit written comments by May 8 if you don't have anything to share now.
- In terms of the alternatives provided, I think moving the lines off the lake, instead of inside it, would be safer for the ecosystem in case it breaks. There would be less damage to the lake if they were out of the water. I think there might be an opportunity to combine some of the alternatives, which would be my recommendation. My question is: How do the private side sewers connect to the main line and who is responsible for them when they are clogged? We had a bad experience with our line clogging and backing up, and we were told we were responsible, but the clog was exactly where it joined with the main line. I was told within 5 feet of that junction is the City's responsibility.
    - Response from project team: I would say questions about the system should be directed to Bellevue Utilities, Angela Chung. The EIS is looking for comments on the environmental impact of the alternatives, or comments on the alternatives and the plan itself.
    - Response from project team: We will follow up with you, or you can contact Angela directly!

Links shared with participants during the webinar:

- To download a copy of the DEIS or submit electronic testimony through the survey, please visit: https://www.engagingbellevue.com/lake-washington-line
- Visit the project website: https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/capital-projects/lake-washington-line
- View the Lake Line 101 presentation: https://prezi.com/p/edit/l_n1k8xgivgr/
- Email testimony to: LakeLineEIS@bellevuewa.gov

Next Steps:

- Bellevue Utilities Project Manager, Angela Chung, followed up via email with the participant who provided testimony during the meeting to answer his outstanding questions.
- PRR posted the public meeting recording to the project website.
- Any public testimony received during the DEIS comment period will be documented as part of the EIS process.

Appendix D – Online open house summaries

Online open house #1

To share information about EIS scoping and accept scoping comments for the management plan, Bellevue Utilities hosted an online open house on the EngagingBellevue.com platform. The online open house was live from July 11, 2023, to August 31, 2023. The online open house shared information about the Lake Washington Lake line system, why a management plan and EIS are needed, and potential solutions for the aging lake lines. Information and graphics for four potential alternatives – a “no action” alternative (emergency repairs and continued maintenance only), an in-water alternative, on shore alternative, and upland alternative – were presented. The online open house was published in English and a summarizing text block of information was provide on the website in Chinese (simplified and traditional), Japanese, Korean, Spanish, Russian, and Vietnamese. Visitors were able to submit scoping comments through an online open house form available in all eight languages. The online open house had a total of 286 visitors during the scoping period and two EIS scoping comments were submitted in English.

Online open house #2

To share information about the alternatives analysis and to solicit feedback for the management plan, Bellevue Utilities hosted an online open house on the EngagingBellevue.com platform. The online open house was live from September 1, 2023, to November 1, 2023. The online open house shared information about the Lake Washington Lake line system, information and graphics for potential alternatives, and the alternative evaluation factors. The main focus of this online open house was to encourage people to take the community survey to provide input on the evaluation factors so the project team could incoporate commuity priorities into the analysis of potential alternatives. The online open house was published in English and a the community survey was available in Chinese (simplified and traditional), Japanese, Korean, Spanish, Russian, and Vietnamese. The online open house had a total of 914 visitors and 19 survey responses were submitted in English.

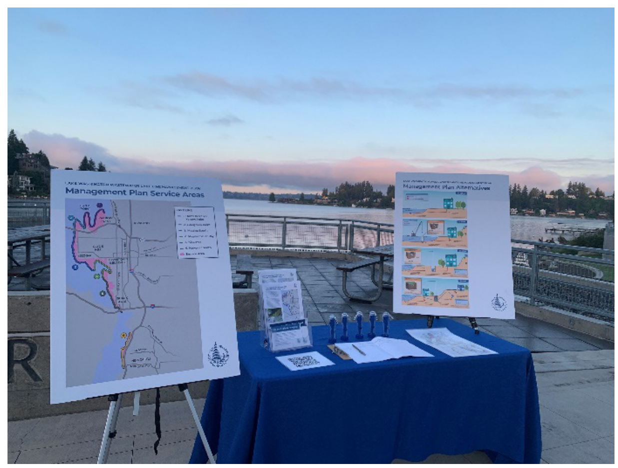
Appendix E – Community pop-up event summary

Overview

Hearing from community members is a critical part of Bellevue Utilities' planning and decision-making process. In September 2023, the Lake Washington Wastewater Lake Line project team conducted community outreach in parks, along trails, and at community events near the service area. Creating opportunities for engagement at community-centered events and gathering places allows for those who don't actively seek or lack resources pertaining to City-based projects to stay in the know and share their input. These pop-up events were designed to share information about the project and solicit input on the prioritization factors being used to analyze the project alternatives. Residents within the service area were notified of these community events and the community input survey through promotions detailed below.

Goals

- Share information about the project and answer questions
- Collect feedback from the community that will be incorporated into the management plan alternatives recommendation



Promotions

- Postcard mailer sent to residents
- Social media posts
- Listserv emails
- Website updates

Event details

Date	Pop-up location	Impressions	Common questions and comment themes
September 6	Medina Park and Points Loop Trail	24	- Expressed curiosity about what the project is. - Questions about where the service areas are located
September 13	Meydenbauer Bay Park and Wildwood Park	14	- Expressed curiosity about what the project is. - How will this affect me as a rate payer?

Date	Pop-up location	Impressions	Common questions and comment themes
			- What happens to private property owners within the service areas?
September 14	Bellevue Farmers Market	63	- Expressed curiosity about what the project is. - How does this impact the environment? How will environmental impacts change based on each alternative? - Expressed concern about property easements. Prioritize that as an evaluation factor.
September 21	Meydenbauer Bay Park and Wildwood Park	6	- Expressed curiosity about what the project is. - Shared that environmental impact is more important than cost.
September 26	Road End Beach	4	- Expressed curiosity about what the project is. - Shared that waterfront property owners are more invested in this project than other ratepayers.

Survey responses and analysis

Community members who were engaged during a pop-up event were provided the option to leave more robust feedback through an online survey. The community survey received 19 responses.

Themes from the survey responses include:

- Prioritization of the difficulty of repair or replacement of a lake line, the number of customers impacted, and the risk to the environment as most important consequences of failure.
- Prioritized evaluation criteria were impacts to land use and property easements, environmental impacts, and the feasibility of long-term maintenance as most important.
- Desire to maintain Lake Washington's water quality and to protect native habitat, desire to implement a long-term and sustainable solution, and prioritization of the impacts to the community members over the cost of the project.
- Most people engaging with this project lived, worked, or played in the Meydenbauer Bay or Medina South service areas.
- Most people preferred that Bellevue Utilities keeps them informed about this project via emails, postcards, and "It's Your City" articles.

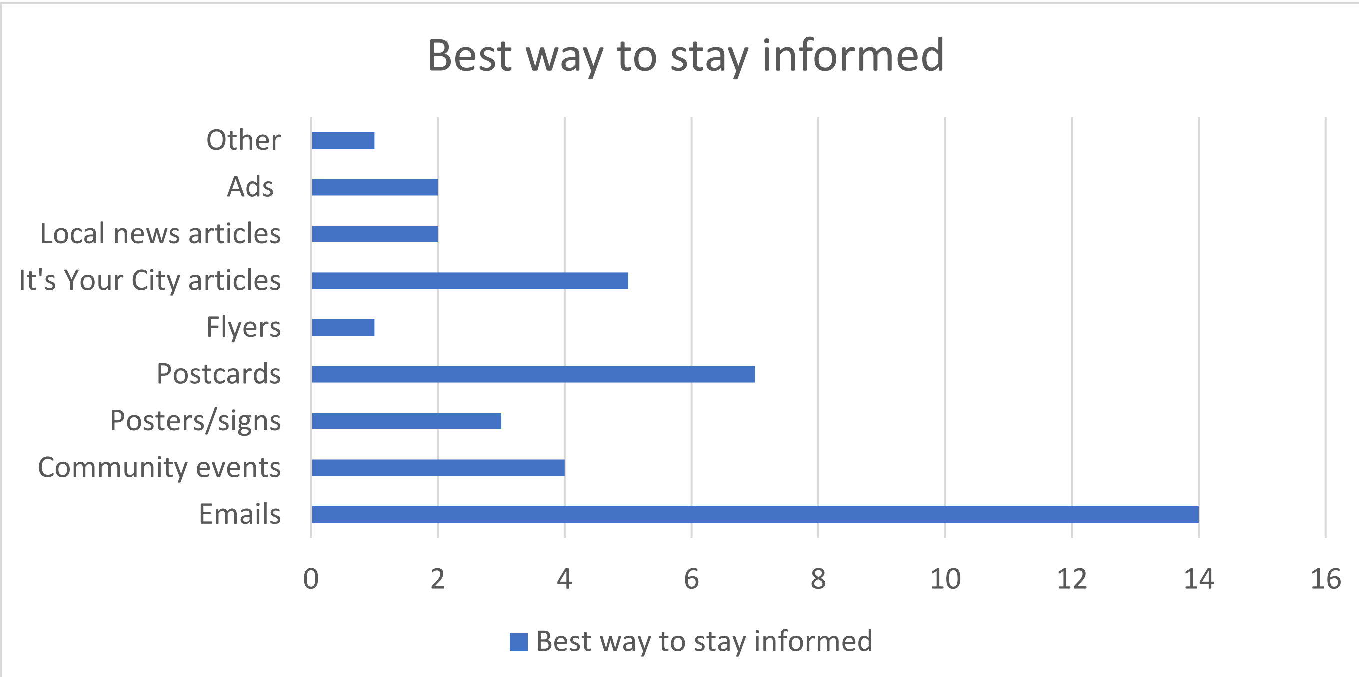
Incorporation of feedback

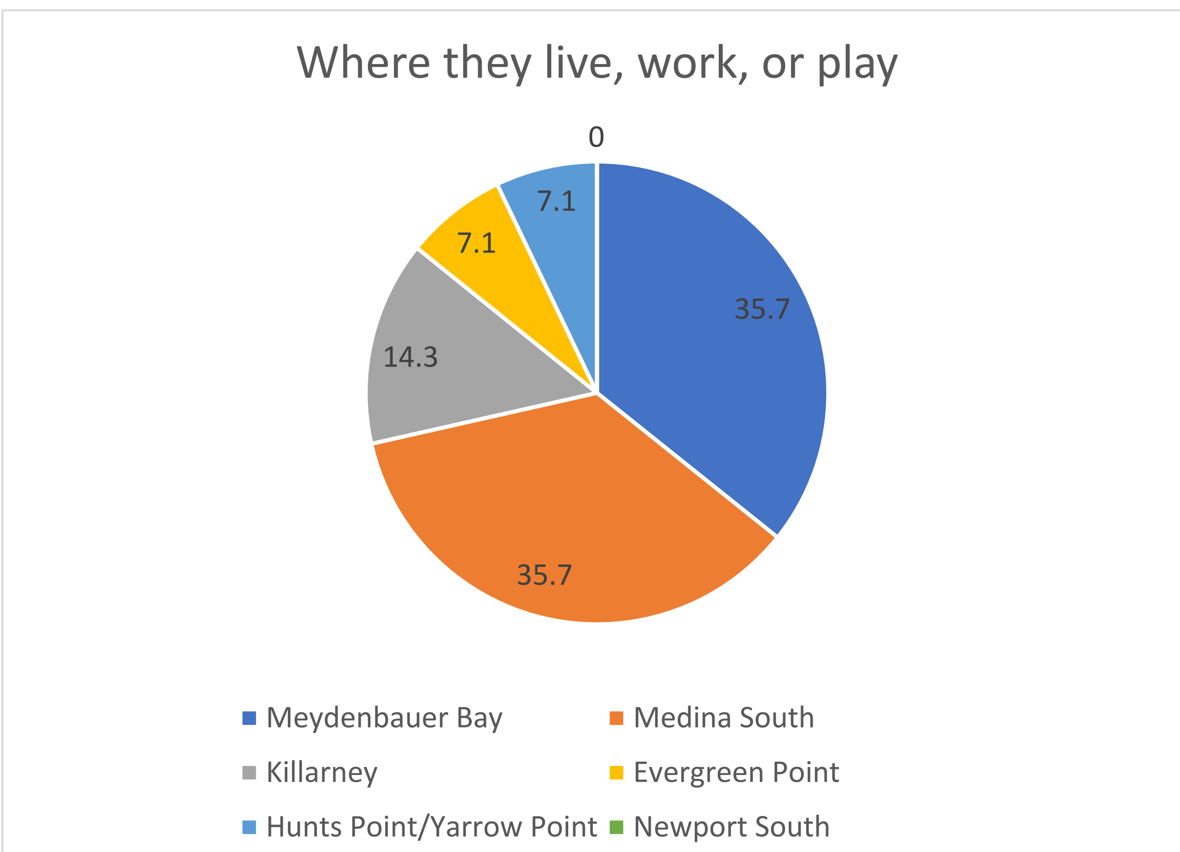
The project team incorporated community feedback into the management plan options analysis and environmental documentation in the following ways:

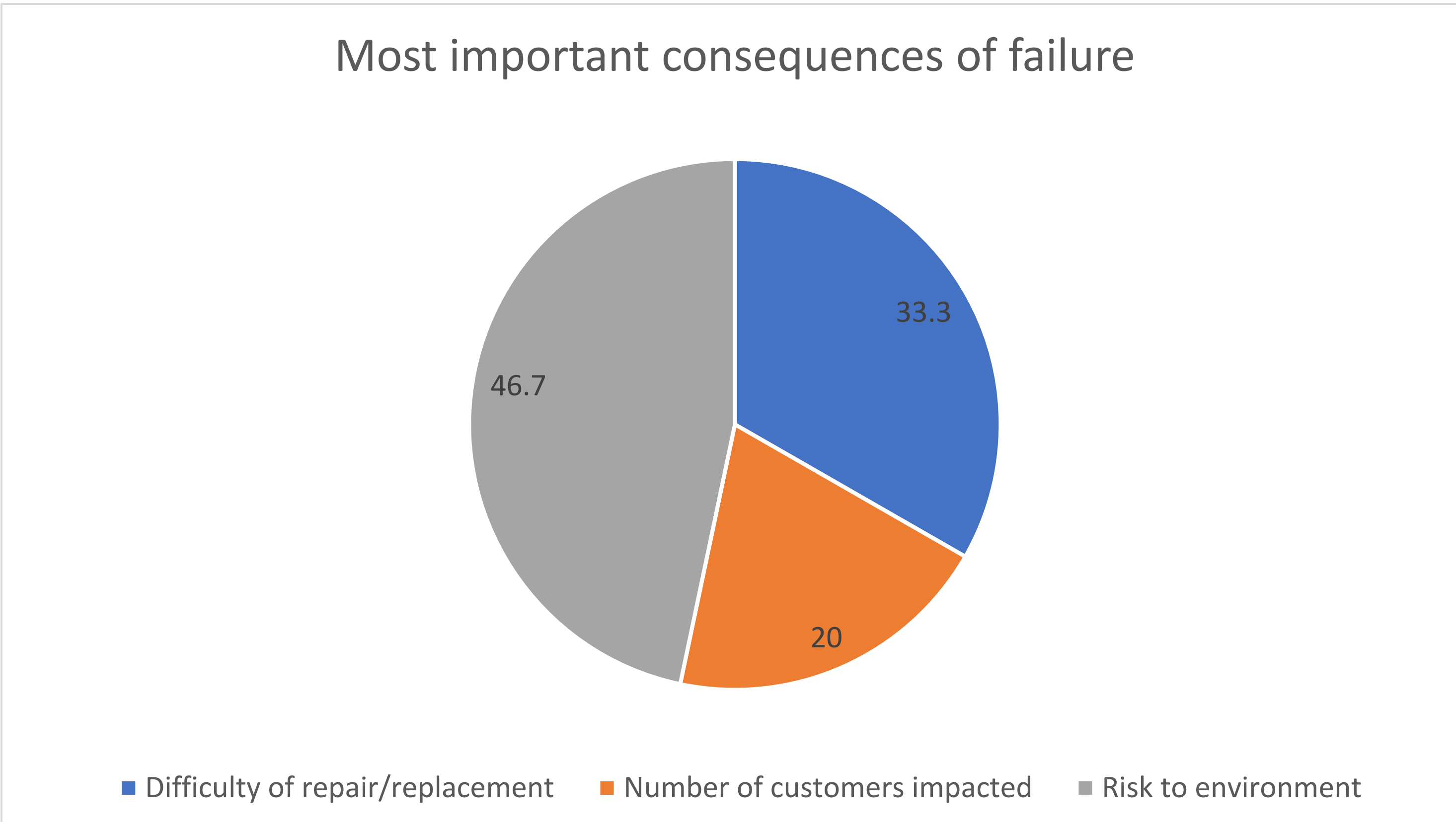
Topic	How we used it
Specifics about each service area	Management plan development and saved for future planning use
Priorities for consequences of failure	Compared to our analysis and assessed different scenarios if community priorities were different than our baseline
Priorities for evaluation criteria	Compared to our analysis and factored into high-level alternative evaluation, and saved for future planning use
How to reach folks	Will be used to prioritize outreach methods during project implementation and saved for future planning use

Appendix F – Survey data

Public comments from community surveys can be viewed in Appendix H.






Most important consequences of failure
33.3
20
46.7
Difficulty of repair/replacement
Number of customers impacted
Risk to environment

Appendix G – Notifications

The City of Bellevue needs your input!

Bellevue Utilities is developing a management plan for the repair, replacement and maintenance of the Lake Washington sewer lake lines, which include 14.6 miles of pipes along the lake's shore. To understand the potential impacts of this plan on the environment, Bellevue Utilities will produce an environmental impact statement (EIS). The project team is currently determining the most important factors to study in the EIS and wants your input.

You're invited!

Join the EIS team for a virtual public meeting to learn more about the plan and the programmatic EIS process, to comment and ask questions about the EIS!

- Tuesday, July 26, 6 – 7 p.m.
- Visit our online open house through August 5 at: engagingbellevue.com/lake-washington-line

Other ways to get involved

Your input is important. If you can't join us at the meeting, or if you would like additional background, you can view the latest information at bellevuewa.gov/lake-washington-line

450 110th Ave. NE
Bellevue, WA 98004

For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city's ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

Information 425-452-6800

UTL 22 Vendor Lake Line B

Example of project postcard

LAKE WASHINGTON WASTEWATER LAKE LINE MANAGEMENT PLAN AND EIS

You're invited!

Join the EIS team for a virtual public meeting to learn more about the plan and the EIS process, comment and ask questions about the EIS!

- Tuesday, July 26, 6-7 p.m.
- Visit our online open house through August 5 at: engagingbellevue.com/lake-washington-line

Bellevue Utilities is developing a management plan for the repair, replacement and maintenance of the Lake Washington sewer lake lines, which include 14.6 miles of pipes along the lake's shore. The plan will help ensure the city can continue to provide safe and reliable wastewater service to the community and help us protect public health and the delicate Lake Washington ecosystem.

To understand the potential impacts of this plan on the environment, Bellevue Utilities will produce an environmental impact statement (EIS). The EIS team is currently determining the most important factors to study and wants your input.

Other ways to get involved

If you can't join us at the meeting, you can still stay updated on latest information at bellevuewa.gov/lake-washington-line

Questions?

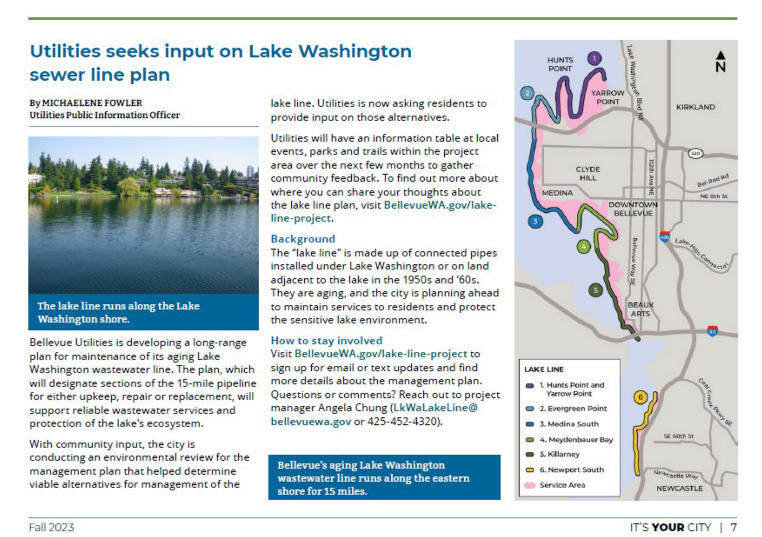
For more information about the EIS, email LakeLineEIS@bellevuewa.gov

For alternate formats, interpreters or reasonable accommodations, please contact Claude Iosso (ciosso@bellevuewa.gov or 425-452-4448) at least 48 hours in advance. For complaints regarding accommodations, please contact the city's ADA/Title VI administrator (adatitlevi@bellevuewa.gov or 425-452-6168). If you are deaf or hard of hearing, dial 711. All meetings are wheelchair-accessible.

Information 425-452-6800

UTL 22 Vendor Lake Line A

Example of project poster



Utilities seeks input on Lake Washington sewer line plan

By MICHAELENE FOWLER
Utilities Public Information Officer

The lake line runs along the Lake Washington shore.

Bellevue Utilities is developing a long-range plan for maintenance of its aging Lake Washington wastewater line. The plan, which will designate sections of the 15-mile pipeline for either upkeep, repair or replacement, will support reliable wastewater services and protection of the lake's ecosystem.

With community input, the city is conducting an environmental review for the management plan that helped determine viable alternatives for management of the lake line. Utilities is now asking residents to provide input on those alternatives.

Utilities will have an information table at local events, parks and trails within the project area over the next few months to gather community feedback. To find out more about where you can share your thoughts about the lake line plan, visit BellevueWA.gov/lake-line-project.

Background

The "lake line" is made up of connected pipes installed under Lake Washington or on land adjacent to the lake in the 1950s and '60s. They are aging, and the city is planning ahead to maintain services to residents and protect the sensitive lake environment.

How to stay involved

Visit BellevueWA.gov/lake-line-project to sign up for email or text updates and find more details about the management plan. Questions or comments? Reach out to project manager Angela Chung (LkWaLakeLine@bellevuewa.gov or 425-452-4320).

Bellevue's aging Lake Washington wastewater line runs along the eastern shore for 15 miles.

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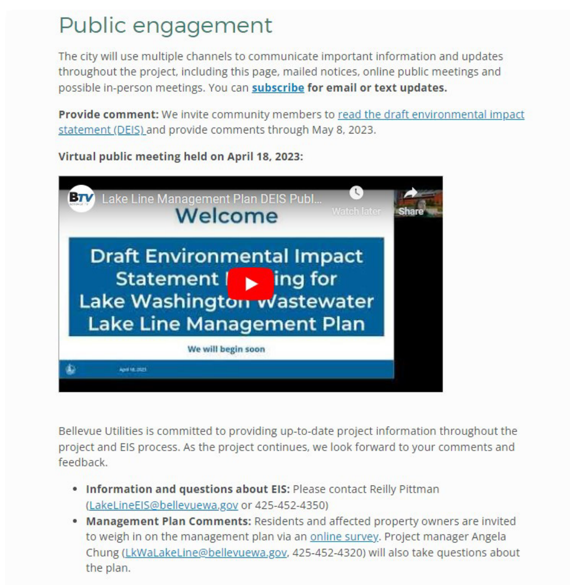
Example of It's Your City article



Public engagement

The city will use multiple channels to communicate important information and updates throughout the project, including this page, mailed notices, online public meetings and possible in-person meetings. You can subscribe **for email or text updates.**

Provide comment: We invite community members to read the draft environmental impact statement (DEIS) and provide comments through May 8, 2023.

Virtual public meeting held on April 18, 2023:

Bellevue Utilities is committed to providing up-to-date project information throughout the project and EIS process. As the project continues, we look forward to your comments and feedback.

- **Information and questions about EIS:** Please contact Reilly Pittman (LakeLineEIS@bellevuewa.gov or 425-452-4350)
- **Management Plan Comments:** Residents and affected property owners are invited to weigh in on the management plan via an online survey. Project manager Angela Chung (LkWaLakeLine@bellevuewa.gov, 425-452-4320) will also take questions about the plan.

Example of project website update

Appendix H – Full list of public comments

DEIS public comments

After reviewing the draft EIS please share your comments.
Entire Bellevue-managed sewer line should be inspected and areas that show concern should be addressed first. FYI - Its odd to ask the public what they would study without defining what an EIS is supposed to encompass.
How it impacts residents

Alternatives selection survey

Is there anything specific about the area our team should know as we plan for the management of the lake line in your service area?
No
Not really
we strenuously object to anything that dramatically encumbers our property such as easements that make that area unbuildable. Something must be done eventually with the line, but some of the proposed approaches can disproportionately harm properties served by a line update. We have 150' of lakefront on a small shelf of land before the bluff. Trenching and defining an easement across our property could seriously impact our ability to use or build on our property. We would want to know how the city plans to address this in the proposals. we do not want to see a process in which community input is simply a performative process because the city has already predetermined the option it wants. we also don't want internal priorities like the ease and convenience for staff working on this or departmental objectives that don't care about cost or impact on property owners don't trump the interests of citizens that will be affected by any changes.
It would be terribly difficult to move the sewer lines from the water to land in Meydenbauer Bay.
this could be an excellent opportunity to replace the waste water system and to potentially put all the utility lines underground.
I think that residents that do NOT have waterfront property - with it's accompanying gigantic property values - will naturally be interested in how the cost of these improvements will be shared. Clearly it's in the interest of all to maintain water quality in the lake and to get in front of necessary system improvements - but solutions will naturally have differing costs associated with them. I am encouraging the City to keep the cost and cost-sharing elements of the project transparently in front of all residents who will be expected to participate in the cost of the project.
Many families and children swim in the Meydenbauer Bay area and it is important to keep the water safe for them to use.

Why did you rank the alternatives evaluation criteria the way you did?
I feel that we need to prioritize the environment before any work can begin.
I think thats important
Thinking more on long term, how the action will effect it. Want to be sustainable long term (good quality and little impact). And then feasibility (permits and access etc). If quality is good then people would be less disrupted in the long term
Cost is important but permitting and the local people are more important
My number one concern was how much changes might jeopardize usage of our property. The current lakebed solution has worked successfully for 60 years...it's unclear why this wouldn't be the preferred approach. If there are challenges with permits for this, keep working at permits and the choice of construction tech to mitigate any concerns in doing this. We do care about the environment, but my concern would be that the city may use concern about it to drive through options that disproportionately and needlessly impact us. I'm distrusting because previously, a city-maintained sewer line running across our neighbor's lot down the bluff to the lake sewer line broke. There was landslide and raw sewage that dumped onto our property. The city fixed the break, but did nothing to remedy the debris or sewage and showed complete lack of concern when we raised this with them.
We need action and the ordering above is in my opinion the most expeditious.
Right of way will drive the cost and impact to the community. You have left our two options, lining the current pipe, and a floating line.
It needs to be taken care of so prioritization of doing it regardless of impact to residents/partners etc seems important to me. Cost of course is critical, but in light of the potential for fail and the impact to the lake quality and fish habitat etc, not as important in the end.
This area is home to many. People need to be considered, but animals and environment even more so.
It is a hard place to work.
placing the new system in a logical location should be the number on criteria
Unless you are a waterfront property owner - the environmental, ease of maintenance, and costs are primary. The permitting, right of way, and temporary inconvenience to property owners are administrative and comparatively short lived. I'm hoping the City ensures that the costs of special attention to high end property is paid by those property owners, and not just spread out to all City residents.
I appreciate that this will be challenging for the departments involved but I feel we need to prioritise the impact on the environment and the ease of future repair (if/when necessary) and think ahead - which is something that the City of Bellevue does exceptionally well.