Bellevue Salmon Spawner Surveys (1999-2020)

Kelsey Creek, West Tributary, Richards Creek, and Coal Creek

Prepared for
Christa Heller
Water Resources Planning
City of Bellevue, Utilities Engineering Division
450 - 110th Ave NE
Bellevue, WA 98009

Prepared by
Washington Dept. of Fish and Wildlife
Region 4 Office
16018 Mill Creek Blvd.
Mill Creek, Washington 98012

February 2021

CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

The City of Bellevue has monitored salmon spawning in select Bellevue streams since 1999. Two types of monitoring have been implemented: 1) professional spawning surveys by the Washington Department of Fish and Wildlife (WDFW) or other consultants; and 2) volunteer observations from Bellevue Stream Team's Salmon Watcher Program. Professional spawning surveyors walk established spawning reaches within Kelsey Creek and Coal Creek stream basins weekly, counting live fish, sampling carcasses and documenting salmon redds. Stream Team program data is collected by volunteer Salmon Watcher observers from established monitoring locations. Salmon Watchers are annually trained in salmon identification and commit to monitoring selected sites for at least 15 minutes twice a week.

The Kelsey Creek and Coal Creek basins, like many other mid-sized, independent tributaries in the Lake Washington Watershed, provide spawning and rearing habitat for Chinook, Sockeye, and Coho salmon. The number of salmon spawning in Bellevue streams is affected by the abundance of the overall salmon return (including hatchery and natural-origin) to the Lake Washington Watershed, and by the physical characteristics of each stream basin (such as barriers to adult migration). The relatively large salmon returns to the Kelsey Creek basin between 2004 and 2007 were heavily influenced by the large numbers of hatchery fish to return to the Lake Washington Watershed during those years.

However, salmon returns have been variable over the last decade throughout the greater Puget Sound Region. Bellevue streams may be particularly affected due to physical barriers to fish migration and chemical pollutants in the stream system. Dense mats of aquatic vegetation in Mercer Slough and beaver dams in the lower Kelsey Creek wetland complex may be inhibiting adult Chinook Salmon from migrating into spawning areas located in the upper reaches of the Kelsey Creek basin. Additionally, the greater Bellevue area is highly urbanized which may be negatively affecting Coho Salmon, an indicator species that is extremely vulnerable to stormwater runoff from impervious surfaces near waterways. Addressing salmon migration issues and working on habitat and water quality enhancements throughout these basins may increase salmon utilization of Bellevue streams in future years.

1. INTRODUCTION

Chinook, Sockeye, and Coho salmon inhabit the Lake Washington Watershed and use City of Bellevue streams for spawning and rearing, specifically those in the Kelsey Creek and Coal Creek basins. Chum and pink salmon do not inhabit the Lake Washington Watershed, and were not present historically. Migratory and resident Cutthroat Trout are also present in the Lake Washington Watershed and are common in Bellevue streams. Kokanee, a lake-bound relative of Sockeye Salmon, have historically used Bellevue streams for spawning but have primarily only been observed in tributaries of Lake Sammamish within in the last decade.

The Lake Washington Watershed (Watershed Resource Inventory Area [WRIA] 8) is among the most highly urbanized freshwater systems within the Puget Sound Evolutionarily Significant Unit (ESU) for Chinook Salmon (Puget Sound Indian Tribe and WDFW 2017). In 1917, stream delta and lake littoral habitat was lost after the water surface elevation of Lake Washington was lowered nine feet in order to create the Ship Canal. At the same time, the Cedar River was diverted from the Black River to flow directly into Lake Washington. The original outlet of Lake Washington, the Black River, was dammed and the river drained. Since then, anadromous salmonids have entered the Lake Washington Watershed through the Ballard Locks and the Lake Washington Ship Canal.

City of Bellevue stream systems, like many in the Puget Sound Region, are negatively affected by urban development and increasing population growth. Increases in impervious surfaces result in altered flow regimes (Moscrip and Montgomery 1997), impaired water quality (i.e. introduced stormwater contaminates, increased stream temperatures) (Scott et al. 1986, Scholz et al. 2011), and changes to natural stream processes that impact ecological structure and function (Richey 1982, Booth and Jackson 1997). Anadromous (returning from saltwater) and adfluvial (returning from a lake) salmonids access Coal Creek directly from Lake Washington. The Kelsey Creek basin is connected to Lake Washington by the Mercer Slough wetland complex. Chinook and Sockeye salmon typically enter streams early in September and spawn into late October and early November. Coho Salmon typically enter in October and spawn through December (Table 2-1). Adfluvial Coastal Cutthroat Trout generally enter in early December with spawning continuing through April or May.

The City of Bellevue has monitored salmon spawning activity in Bellevue streams since 1999 by conducting spawning surveys in coordination with professional biologists that monitor salmon returns throughout the Lake Washington Watershed. Survey data provides a strong foundation for assessing trends in salmon use within Bellevue's streams and allows for comparison to overall salmon returns throughout the Lake Washington basin.

Concurrent with professional surveys, Bellevue streams are monitored by the Bellevue Stream Team Salmon Watcher program. Bellevue Stream Team has annually trained observers to

monitor salmon activity in Bellevue streams since 1996. Salmon Watchers were originally a King County-wide Salmon Watcher Program (King County 2016). Although King County ended their participation in this program in 2015, Bellevue has continued monitoring and reporting salmon use in Bellevue streams. Salmon Watchers observe areas both inside and outside of the professional survey reaches and are able to collect data more frequently than the professional surveyors. Salmon Watchers are also able to conduct spot surveys more quickly after high flow storm events that make walking surveys difficult and often see fish before the professional surveyors or in stream sections located outside of the specified index reaches. These data are particularly useful in identifying the timing and presence of spawning salmon in Bellevue streams. Additionally, some Salmon Watcher sites are concentrated around restoration project sites to better aid in monitoring fish use of habitat and fish passage improvements. The professional and volunteer Salmon Watcher data go hand in hand to help us get a better picture of salmon use of Bellevue streams.

This document reports adult salmonid spawning activity observed in the Kelsey and Coal Creek basins during the years 1999-2020, with particular emphasis on 2020 surveys.

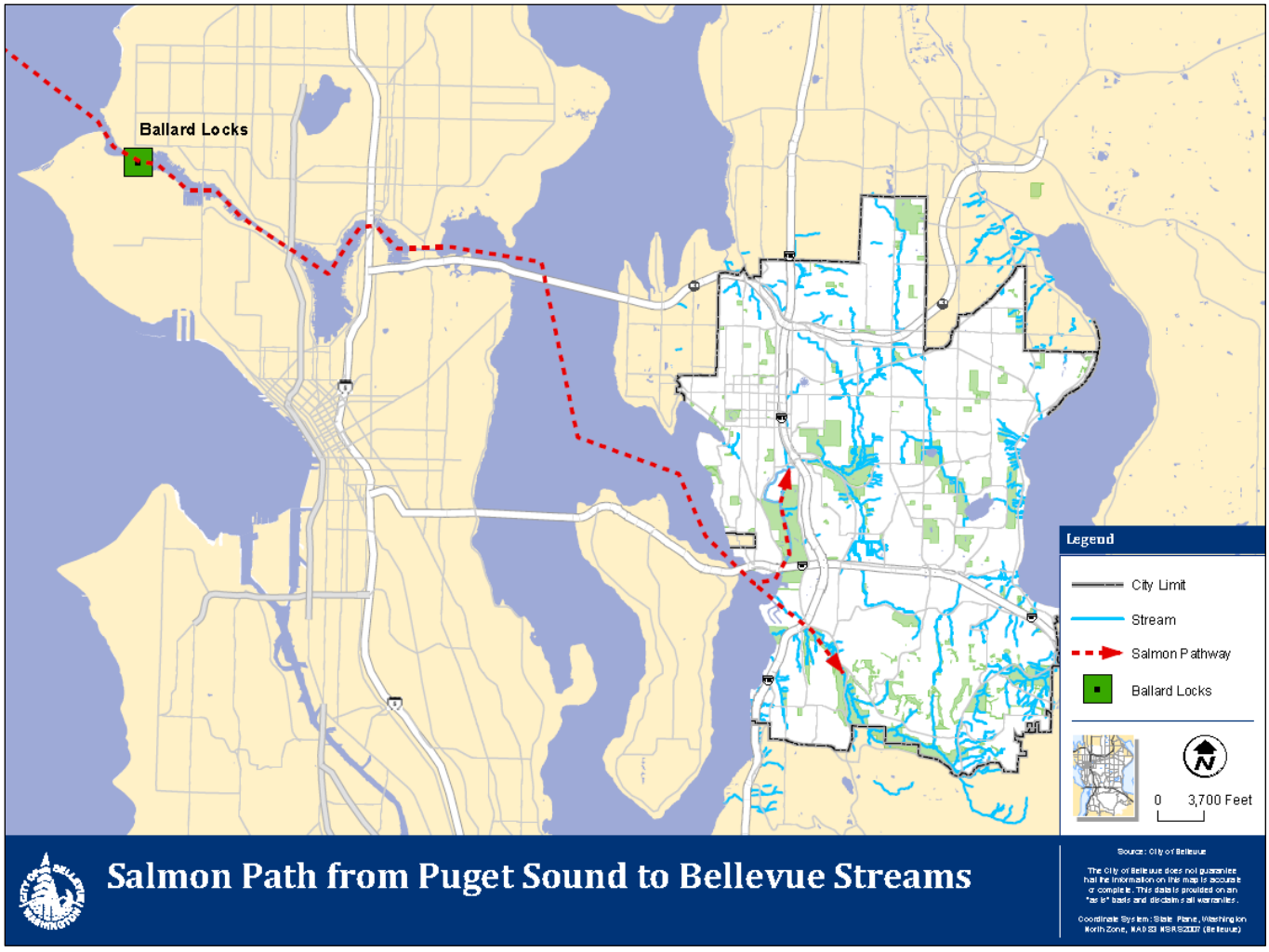

Figure 1-1. Salmon path from Puget Sound to Bellevue Streams.

2. SPAWNER SURVEYS AND RESULTS

2.1 PROFESSIONAL SURVEY METHODS

Salmon spawning surveys in Bellevue streams begin in late-August or early-September and are conducted weekly until late December. During the surveys, counts of live and dead fish are enumerated for all salmonid species, and individual redds constructed by Chinook Salmon, Coho Salmon and Cutthroat Trout are recorded using handheld GPS units. Sockeye Salmon redds are not recorded, as this species often spawns close together with numerous overlapping redds that are difficult to accurately count. All salmon carcasses are assessed for length, sex, origin (natural versus hatchery), age, and egg retention. Index reaches were established for Bellevue streams during the early 2000's with various new index reaches later added, including West Tributary Reach-5 and Coal Creek Reach 2 in 2011, Coal Creek Reach A in 2013, and Coal Creek Reach 2B in 2014. Currently, there are ten index reaches delineated in Kelsey Creek (Reach A, 1-7, Wetland, and Trestle), five in the West Tributary (Reach 1-5), five in Richards Creek (only the Confluence reach is consistently surveyed), and four in Coal Creek (Reach A, 1, 2, and 2b) (Figures 2-1 & 2-2).

2.2 SALMON WATCHERS PROGRAM METHODS

All Salmon Watchers attend a two-hour training program their first year and at least every other year thereafter. They are taught how to identify adult spawning salmon species, provided training materials and instructions on recording data, and assistance choosing appropriate viewing locations. Salmon Watchers make observations from mid-September through mid-December. The end date depends on weather conditions, and how late into the season fish are observed in the stream, generally ending two weeks after the last salmon observation. Recorded data includes site number, start/end times, number of live and dead salmon, presence or absence of adipose fins, how many citizens they talked to and additional notes as needed. Salmon Watchers are encouraged to check their sites twice a week for at least 15 minutes (Figure 2-3). Throughout the spawning period, information about where fish have been seen is shared between the professional surveyors and the Stream Team coordinator so both know what to expect and where.

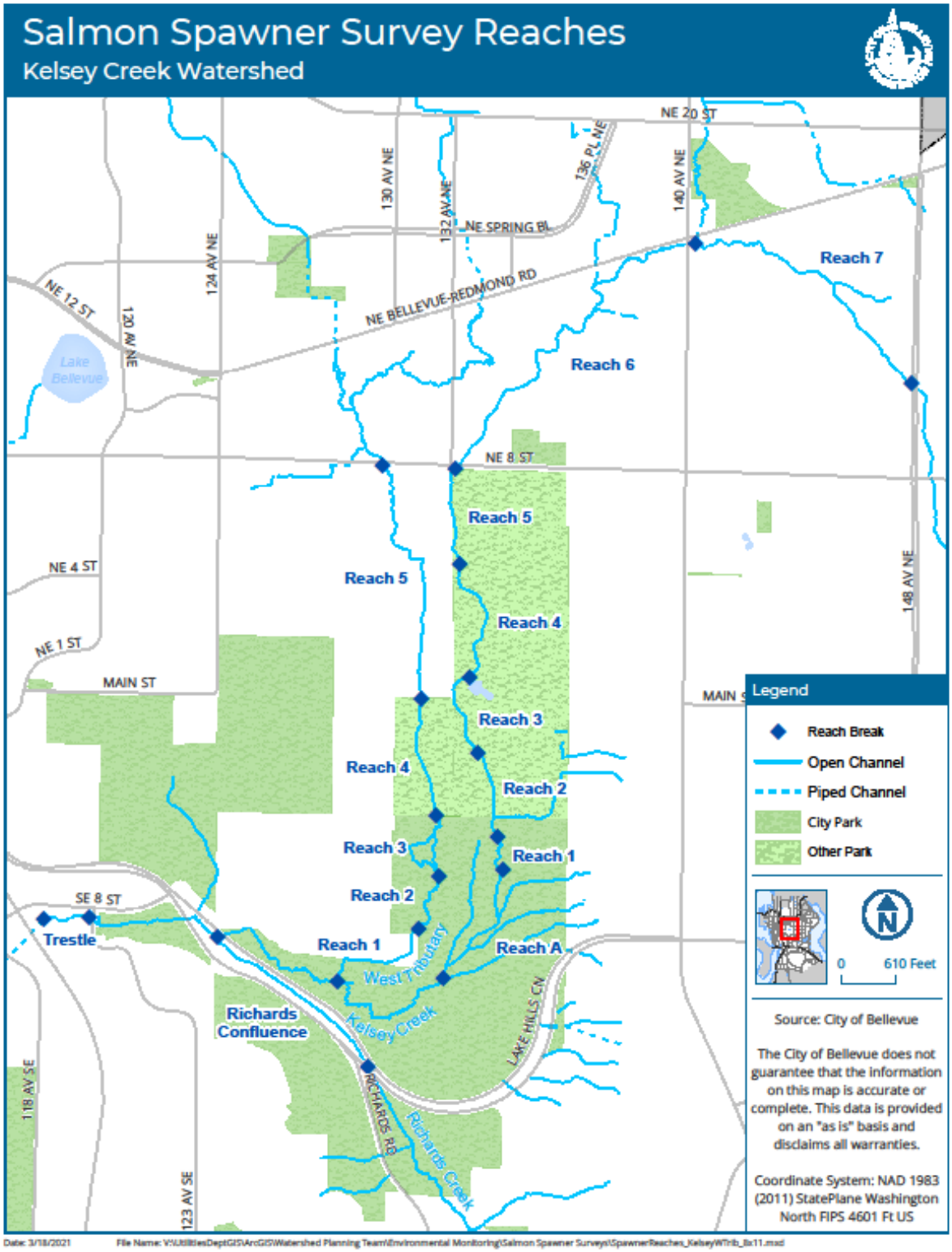

Figure 2-1. Map of 2020 survey reaches in the Kelsey Creek basin.

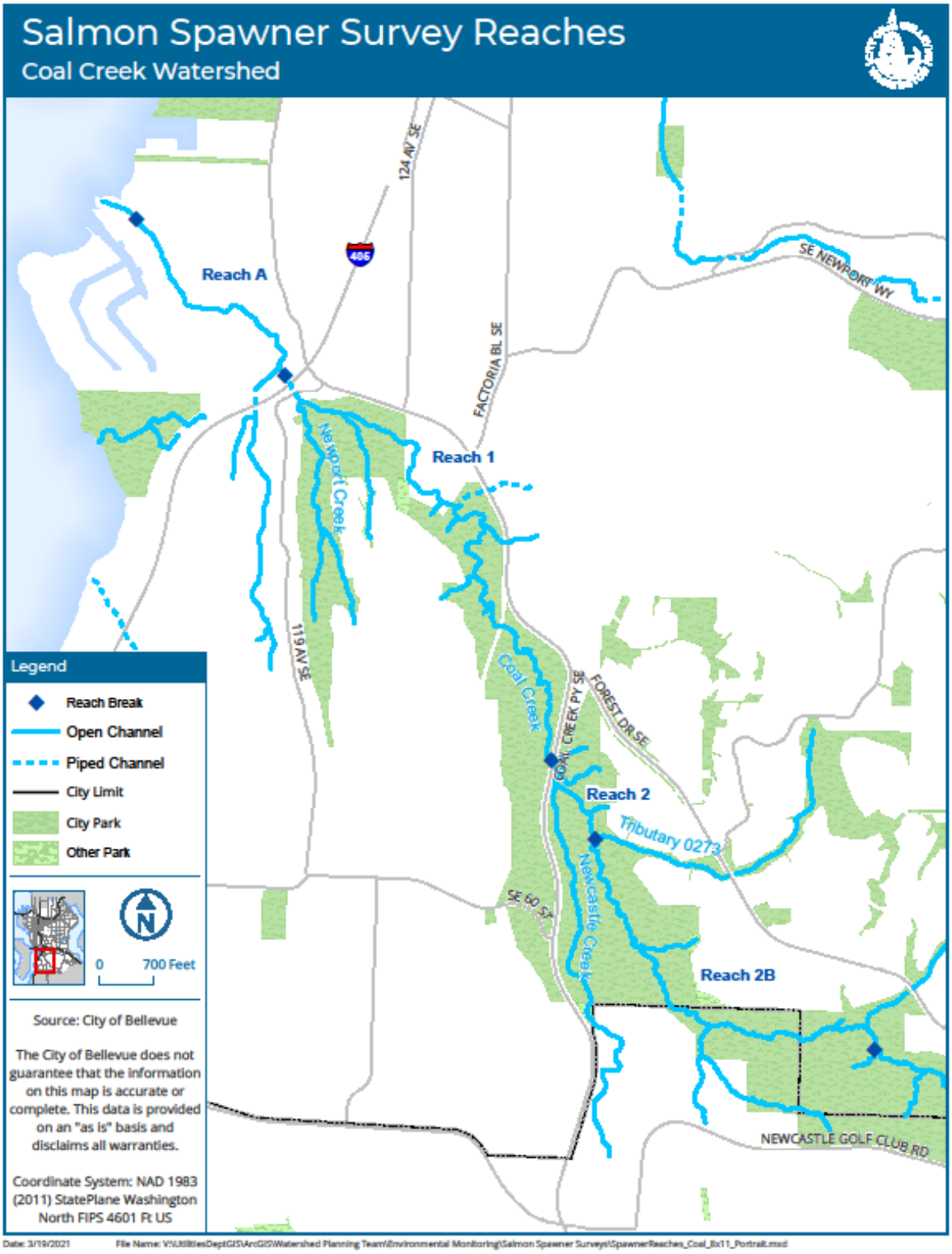

Figure 2-2. Map of 2020 survey reaches in the Coal Creek basin.

Figure 2-3. Salmon Watcher site locations, City of Bellevue, Washington 2020.

2.3 PROFESSIONAL SURVEY RESULTS

Kelsey Creek Basin (including the West Tributary and Richards Creek)

Chinook Salmon: Adult Chinook Salmon migration in the Kelsey Creek basin typically begins in early September; Chinook Salmon spawning activity begins in early October, peaks in mid-October, and is generally completed by mid-November (Table 2-3). However, Chinook Salmon utilization of the Kelsey Creek basin was not observed in 2018, 2019 or 2020 (Table 2-1), as there were no live fish sightings or carcasses recovered, and no redds recorded.

Past spawning surveys (since 1999) indicate that large numbers of Chinook Salmon have spawned in the Kelsey Creek basin in some years. The most recent spike in Chinook Salmon spawning activity occurred in 2006 and 2007 when 90 and 77 redds were observed in Kelsey Creek (Table 2-1). However, few Chinook Salmon have been observed in Kelsey Creek during the last 12-years (2008-2020). When Chinook Salmon are in the Kelsey Creek basin, most spawn in the Kelsey Creek mainstem; small numbers of Chinook Salmon are observed spawning in the West Tributary, and Chinook Salmon use of Richards Creek is sporadic.

Sockeye Salmon: No Sockeye Salmon were observed in the Kelsey Creek system in 2020. During the past 12-year period the numbers of Sockeye Salmon in Kelsey Creek have consistently been very low or zero (Table 2-1). Like Chinook Salmon, significant numbers of Sockeye Salmon have used the Kelsey Creek basin in past years. In the year 2000, 207 live Sockeye Salmon were counted in Kelsey Creek and 430 live Sockeye Salmon were counted in 2006 (Table 2-1), demonstrating that the Kelsey Creek basin can support large numbers of Sockeye Salmon spawners. Sockeye Salmon migration and spawn timing in the Kelsey Creek basin is similar to Chinook Salmon. Adults migrate into the stream during early/mid-September, with spawning peaking in mid-October and generally completing by mid-November.

Coho Salmon: Coho Salmon migration and spawn timing in the Kelsey Creek basin is later than Chinook and Sockeye salmon, with adults typically migrating into the stream during mid-October and spawning mid-November through early-December (Table 2-3). However, Coho Salmon presence in Kelsey Creek has also been low since 2015. In 2020, two Coho Salmon redds were recorded in the Kelsey mainstem (Reaches 1 and 4) in mid-November and one redd was observed in the West Tributary Reach 4 the following week. No live or dead Coho Salmon were seen this season.

Some Coho Salmon spawning activity has been observed in the Kelsey Creek basin most years that surveys were conducted (Table 2-1), but the number of Coho Salmon spawning in Kelsey is generally small. Large numbers of Coho Salmon were observed in 2013 and 2014 (Table 2-1) when surplus adult hatchery Coho Salmon from the Issaquah Hatchery were transported and released into Kelsey Creek (Table 2-4) in an effort to improve natural spawning and smolt production. The surplus hatchery outplants were discontinued after the 2014 spawning season,

and Coho Salmon observations subsequently dropped to the low levels seen in recent years. Coho Salmon spawning activity in the Kelsey Creek basin can be difficult to document because stream flows are often high during the late fall/early winter when Coho Salmon spawn, making fish and redds difficult to locate. Additionally, many of the Coho Salmon redds recorded in previous years were observed in the upper reaches of Kelsey Creek above the golf course and were primarily observed during mid-to-late December. In 2020, adfluvial (migrate seasonally from larger lakes into small streams for spawning) Cutthroat Trout were frequently seen building redds throughout the basin during this time frame. It is possible that some portion of previously recorded Coho Salmon redds were misidentified Cutthroat Trout redds.

Table 2-1. Summary of fish observations in the Kelsey Creek basin.

Kelsey Creek (including Richards Creek and West Tributary)								
Year	Chinook			Sockeye		Coho		
	Redds	Live Fish	Carcasses	Live Fish	Carcasses	Redds	Live Fish	Carcasses
1999	76	111	117	0	0	0	0	0
2000	1	17	13	207	103	0	18	13
2001	4	9	0	46	10	3	12	7
2002	5	16	12	23	6	0	0	0
2003	0	1	6	1	0	8	14	5
2004	17	20	88	12	6	0	1	0
2005	14	27	37	3	0	1	1	2
2006	90	168	220	430	162	2	2	2
2007	77	221	155	14	5	8	5	9
2008	8	25	38	0	1	12	8	0
2009	5	11	15	4	0	6	3	0
2010	0	1	1	6	0	0	0	0
2011	0	0	1	1	1	0	0	0
2012	0	0	0	0	0	9	30	2
2013	0	1	1	0	0	123*	294*	261*
2014	0	0	0	0	0	0*	138*	91*
2015	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0
2017	2	13	10	0	0	22	0	0
2018	0	0	0	0	0	4	0	0
2019	0	0	0	0	0	5	1	0
2020	0	0	0	0	0	3	0	0

(* indicates years when returned Coho Salmon adults were outplanted from the Issaquah Hatchery)

Coastal Cutthroat Trout: Coastal Cutthroat Trout are observed in the Kelsey Creek basin during salmon spawning surveys, but surveys do not extend through the duration of the Cutthroat Trout spawning period (Table 2-3). Adfluvial Cutthroat Trout migrate into the Kelsey Creek basin in early December and begin spawning shortly thereafter. The end of the Cutthroat Trout spawning period is not well documented in Kelsey Creek, but is likely prolonged, extending through the end of March. Additionally, small resident Cutthroat Trout are present in Kelsey Creek year-round. Three resident Cutthroat Trout, twelve adfluvial Cutthroat Trout, and nine Cutthroat Trout or unknown species redds were recorded throughout the Kelsey Creek basin between early December 2020 and late January 2021.

Kokanee: Kokanee are adfluvial relatives to Sockeye Salmon and were once prevalent across the Lake Washington/Lake Sammamish basin (Bean 1981). Kokanee were documented in a 1946 survey in Mercer Slough, but the run size was considered "poor" (Garlick 1946). The remaining population of Kokanee is now considered to be limited to Lake Sammamish tributaries (Berge and Higgins 2003). None of the surveys documented in this report have observed Kokanee spawning activity in Kelsey Creek.

Coal Creek Basin

Chinook Salmon: Three Chinook Salmon redds, 11 live Chinook Salmon, and 9 Chinook Salmon carcasses were observed in Coal Creek in 2020 (Table 2-2). All Chinook Salmon redds were observed upstream of I-405 in Reaches 1, 2a and 2b. Small numbers of Chinook Salmon have been observed in Coal Creek in most years that surveys have been conducted, and the spawning activity that was observed in 2020 is consistent with previous observations. Chinook Salmon migration and spawn timing in Coal Creek is similar to that in the Kelsey Creek basin, with adult migration beginning in early September and spawning activity primarily occurring in October (Table 2-3).

Sockeye Salmon: No live Sockeye Salmon or carcasses were observed in Coal Creek in 2020 (Table 2-2) Previous years similarly had low or nonexistent Sockeye Salmon returns to the stream. Sockeye Salmon adults have been first observed in Coal Creek during early-to-mid September, with spawning activity generally peaking in mid-October and completed by mid-November (Table 2-3).

Coho Salmon: Seven Coho Salmon redds, one live Coho Salmon and two carcasses were observed in Coal Creek in 2020 (Table 2-2) which is the lowest return to Coal Creek since 2012. The number of Coho Salmon that use Coal Creek is typically small with the exception of 2013, 2014 and 2019 when large numbers of Issaquah Hatchery Coho Salmon were released into Coal Creek (Table 2-4) to increase natural spawning and smolt production. This year's numbers are similar to the numbers seen before this stocking occurred. In 2020, three Coho Salmon redds

were observed in Reach A and four were seen in Reach 2 and 2b. None of the redds in Coal Creek were in Reach 1. Spawning activity began in early November and culminated in early December when the two carcasses were found separately in Reach 1 and Reach 2.

Table 2-2. Summary of fish observations in Coal Creek.

Coal Creek								
Year	Chinook			Sockeye		Coho		
	Redds	Live Fish	Carcasses	Live Fish	Carcasses	Redds	Live Fish	Carcasses
2008	0	0	0	0	0	6	0	3
2009	0	0	0	0	0	0	5	1
2010	1	1	0	0	0	0	1	0
2011	0	0	0	1	0	1	2	1
2012	1	19	1	66	8	2	17	2
2013	3	8	2	1	1	152*	921*	340*
2014	2	1	0	2	0	174*	1032*	210*
2015	2	10	3	0	0	2	8	1
2016	7	13	4	17	8	13	43	15
2017	3	9	8	6	4	21	48	12
2018	0	0	2	0	0	68	39	11
2019	7	21	11	2	0	114*	521*	259*
2020	3	11	9	0	0	7	1	2

(* indicates years when returned Coho Salmon adults were outplanted from the Issaquah Hatchery)

Coastal Cutthroat Trout: Adfluvial Cutthroat Trout spawn in Coal Creek beginning in early to mid-December. Similar to Kelsey Creek, Cutthroat Trout spawning extends beyond regular surveying efforts, therefore the end time is not well documented. One live Cutthroat Trout was observed in early January of 2021. Five redds were found in Reaches A, and 2b in mid-December that were likely built by Cutthroat Trout but could have been Coho Salmon due to the overlapping spawning seasons.

Kokanee: In 2020, a spawning pair of Kokanee were observed in mid-November for the first time since professional surveys began in Coal Creek. Little is known about Kokanee spawning in tributaries to Lake Washington, but Kokanee spawning in Lake Sammamish tributaries typically occurs between October and January and peaks in late November (Berge and Higgins 2003). Growing regional interest in these fish have resulted in confirmed observations in other small Lake Washington tributaries including Swamp, McAleer, Lyon, and May Creeks (J. Bower, personal communication).

Table 2-3. Periodicity (timing) of salmonid stream habitat use in the Kelsey Creek and Coal Creek basins.

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Chinook	Adult In-Migration												
	Spawning												
	Egg Incubation/Fry Emerg.												
	Juvenile Rearing												
	Juvenile Out-Migration												
Coho	Adult In-Migration												
	Spawning												
	Egg Incubation/Fry Emerg.												
	Juvenile Rearing												
	Juvenile Out-Migration												
Sockeye	Adult In-Migration												
	Spawning												
	Egg Incubation/Fry Emerg.												
	Juvenile Rearing												
	Juvenile Out-Migration												
Cutthroat Trout	Adult In-Migration												
	Spawning												
	Egg Incubation/Fry Emerg.												
	Juvenile Rearing												
	Juvenile Out-Migration												

Table 2-4. Location and dates of adult Coho Salmon outplanted from Issaquah Hatchery to the Kelsey Creek and Coal Creek basins in 2013, 2014 and 2019.

Year	Stream	Dates planted	Planting location	Number of Coho planted
2013	Kelsey Creek	11/13-11/20	Reach A and 1	1,150
	Coal Creek	11/21	Reach 1	742
	West Tributary	11/13	Reach 2	100
2014	Kelsey Creek	10/23-10/24	Reach A and 1	643
	Coal Creek	10/30-11/7	Reach 1	1,573
2019	Coal Creek	11/4-11/14	Reach 1 and 2	1,049

2.4 SALMON WATCHERS PROGRAM

Volunteer Salmon Watchers were able to look for fish activity at 18 locations within Bellevue streams (10 in the Kelsey Creek basin and 8 in the Coal Creek basin). Between 2017 and 2019 Salmon Watchers surveyed for an average of 152 hours. Survey time was greatly reduced in 2020 as a response to the Covid-19 pandemic. In 2020, Salmon Watchers surveyed for 13 hours during 226 site visits (compared to an average of 568 site visits over the previous three years). A total of eight live fish and eleven dead fish were observed in Bellevue streams during the 2020 salmon spawning season.

Between 2011 and 2020, 111 Salmon Watchers made 5,218 site visits to Bellevue streams (Kelsey and Coal Creek basins), during which they interacted with over 1,100 citizens. The average number of site visits per year between 2011 and 2020 was 521. During this timeframe, a total of 845 live and 312 dead fish were counted by Salmon Watchers in the Kelsey and Coal Creek basins (Table 2-5, Figure 2-4, and Figure 2-5).

Table 2-5. Salmon Watcher observations of live fish in all Bellevue streams between 2011 and 2020 broken up by species. Gray highlighting indicates years when Kelsey and Coal Creeks were planted with surplus Coho Salmon adults from the Issaquah Hatchery.

Species	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Chinook	1	19	15	0	3	0	22	0	13	0	76
Sockeye	4	37	5	0	0	1	2	0	0	0	49
Coho	0	14	93	60	1	32	4	5	300	1	510
Trout	4	1	8	3	0	0	0	3	0	0	19
Kokanee	1	0	0	0	0	0	0	1	0	0	2
Unidentified	2	12	18	1	8	13	19	10	102	7	189
Total	12	83	139	64	12	46	47	19	415	8	845

Kelsey Creek Basin: Surveys conducted by Salmon Watchers during 2019 and 2020 in Kelsey Creek found no live or dead Salmon of any species.

Coal Creek Basin: Salmon Watchers reported one live Coho Salmon and seven unidentified fish in Coal Creek during the 2020 season. These numbers seem small compared to the inflated numbers in 2019 when thirteen Chinook Salmon, 300 live Coho Salmon and 129 Coho Salmon carcasses were observed across the observation locations as a result of the hatchery outplanting efforts but are similar to years when transplants did not occur.

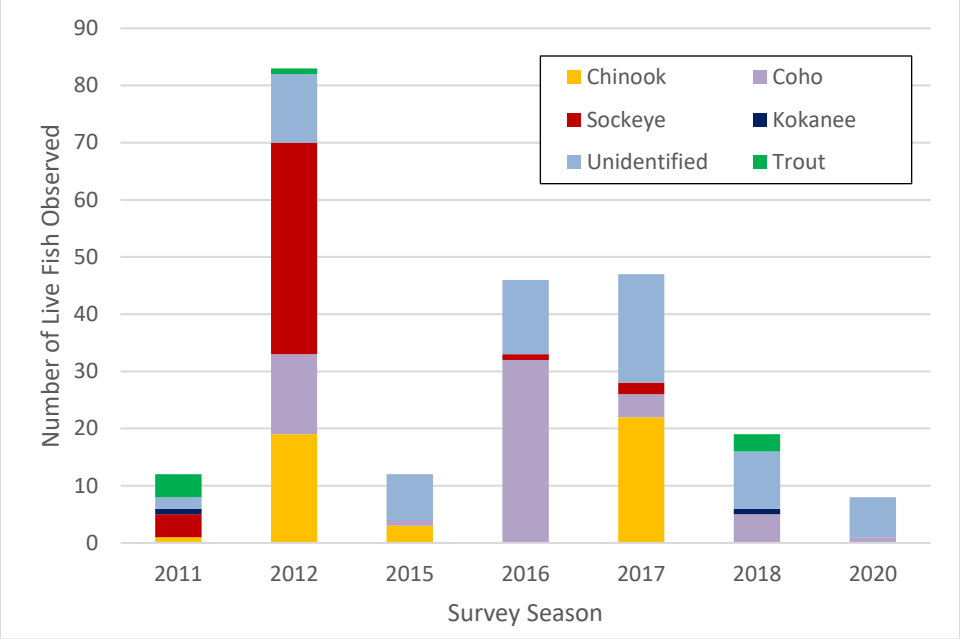

Figure 2-4. Number and species of live fish counted by Salmon Watchers in all Bellevue streams in the years between 2011 and 2020 that Coho Salmon hatchery adults were not outplanted to the Kelsey and Coal Creek basins.

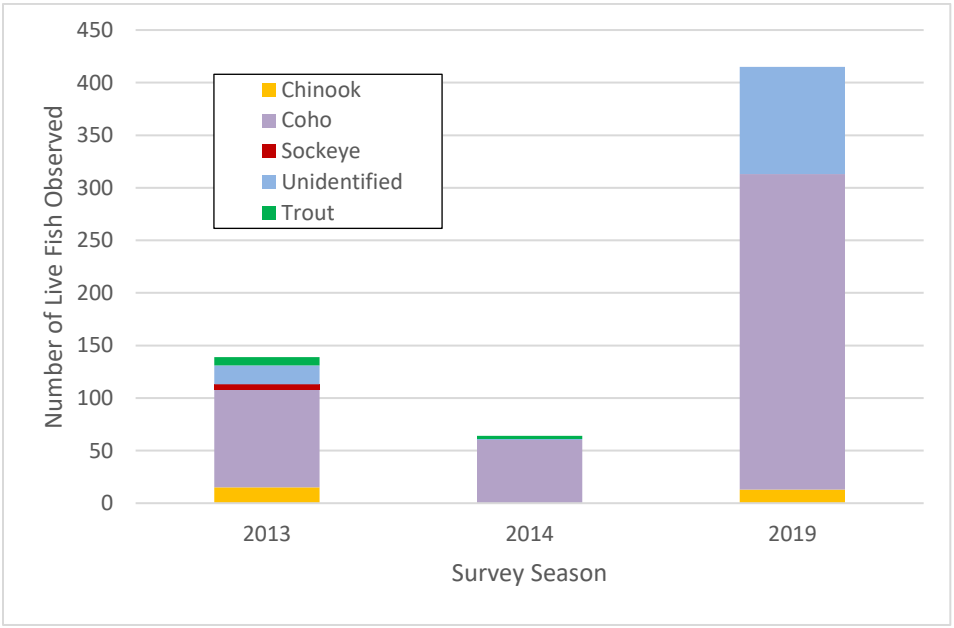

Figure 2-5. Number and species of live fish counted by Salmon Watchers in all Bellevue streams in 2013, 2014, and 2019 when Coho Salmon hatchery adults were outplanted to the Kelsey and Coal Creek basins.

3. SUMMARY

3.1 CHINOOK SALMON USE

The Lake Washington Watershed is inhabited by two of the twenty-two distinct Chinook Salmon populations that make up the Puget Sound Chinook Evolutionary Significant Unit (ESU) (Ruckleshaus et al. 2006). The Sammamish Chinook Salmon population primarily spawns in Issaquah Creek, Big Bear Creek, and Cottage Lake Creek. The Cedar Chinook Salmon population returns mainly to the Cedar River. In addition to naturally produced Chinook Salmon in the Lake Washington Watershed, approximately two million sub-yearling Chinook Salmon smolts are released annually from the Issaquah Hatchery. Annual hatchery-origin Chinook Salmon adults returning to Lake Washington outnumber the natural-origin Chinook Salmon returns, reflecting the larger number of Chinook Salmon smolts released from the Issaquah Hatchery program compared to the number of naturally produced smolts in the Lake Washington Watershed (Figure 3-1). The Kelsey Creek and Coal Creek basins provide spawning and rearing habitat for Chinook Salmon likely representing each of these three populations. Overall, Chinook and Coho salmon abundance in the North Pacific has been negatively affected by climate change (Irvine and Fukuwaka 2011) and returns of natural-origin Chinook Salmon have declined in the last 50 years throughout the greater Puget Sound region (Losee et al. 2019). The declining seasonal returns to Bellevue streams are reflective of these trends.

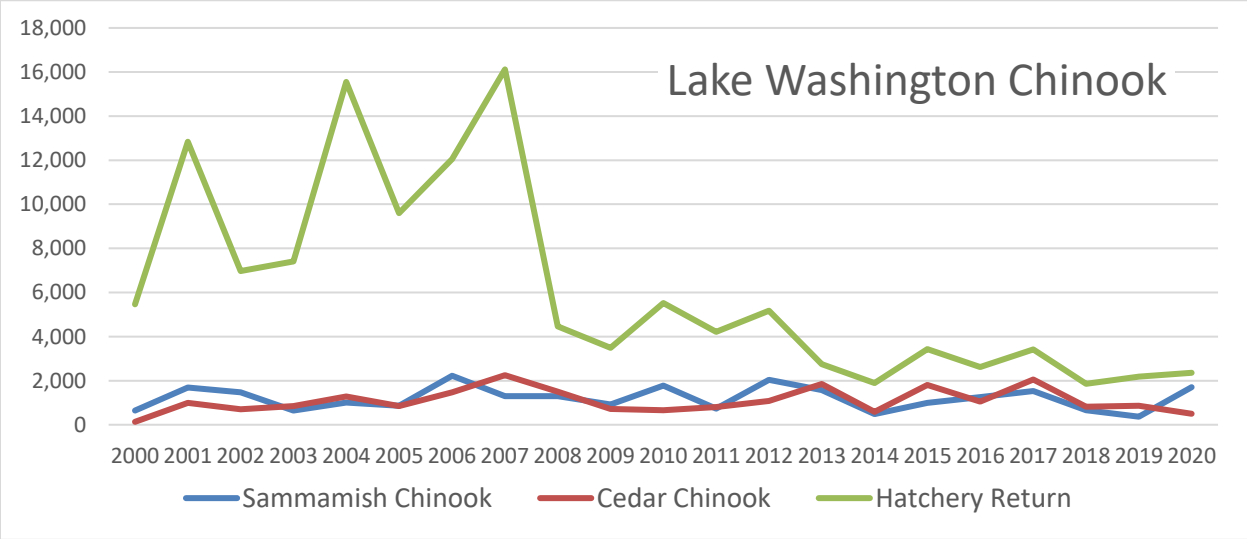

Figure 3-1. Adult Chinook Salmon returns to the Lake Washington Watershed.

The number of Chinook Salmon spawning in Kelsey Creek and Coal Creek is affected by the size of the overall Chinook Salmon return (hatchery and natural-origin combined) to Lake Washington and is influenced by the physical characteristics of each stream basin (such as physical barriers to adult migration). The relatively large Chinook Salmon escapements to the Kelsey Creek basin between 2004 and 2007 were heavily influenced by the large returns of hatchery fish to the Lake Washington Watershed during those years (Table 2-1, Figure 3-1).

There were no Coal Creek basin surveys conducted between 2004 and 2007, therefore it is not clear whether Chinook Salmon use was also high in the Coal Creek basin during that time period. Carcass surveys from 2006 and 2007 (years when carcass sample sizes were greatest) indicated that approximately 80% of the Chinook Salmon spawning throughout the Kelsey Creek basin were hatchery-origin fish, likely strays from the Issaquah Hatchery program. Since 2007, overall Chinook Salmon returns to Lake Washington have been smaller, largely due to lower survival of the hatchery smolts combined with reductions in the numbers of smolts released. The lack of Chinook Salmon spawning activity in the Kelsey Creek basin since 2007 is likely a result of the lower overall Lake Washington Watershed returns from 2008 to 2017, however habitat conditions, including water quality and altered flow in Kelsey Creek, may be inhibiting Chinook Salmon use. Dense mats of aquatic vegetation in Mercer Slough during the adult migration period may prevent Chinook Salmon from entering Kelsey Creek in some years (Figure 3-2). Because of the nature of urban flows in low gradient areas, beaver activity in the lower Kelsey Creek wetland may also be inhibiting adult Chinook Salmon from migrating into spawning areas located in the upper reaches of Kelsey Creek (Figure 3-2). Beaver activity is generally a beneficial condition for salmon, improving water quality and providing pools, except in low gradient, urban flow conditions. Aquatic vegetation in Mercer Slough and the beaver activity in lower Kelsey Creek are likely exacerbated in years with low stream flows during the Chinook Salmon migration period (e.g. September).

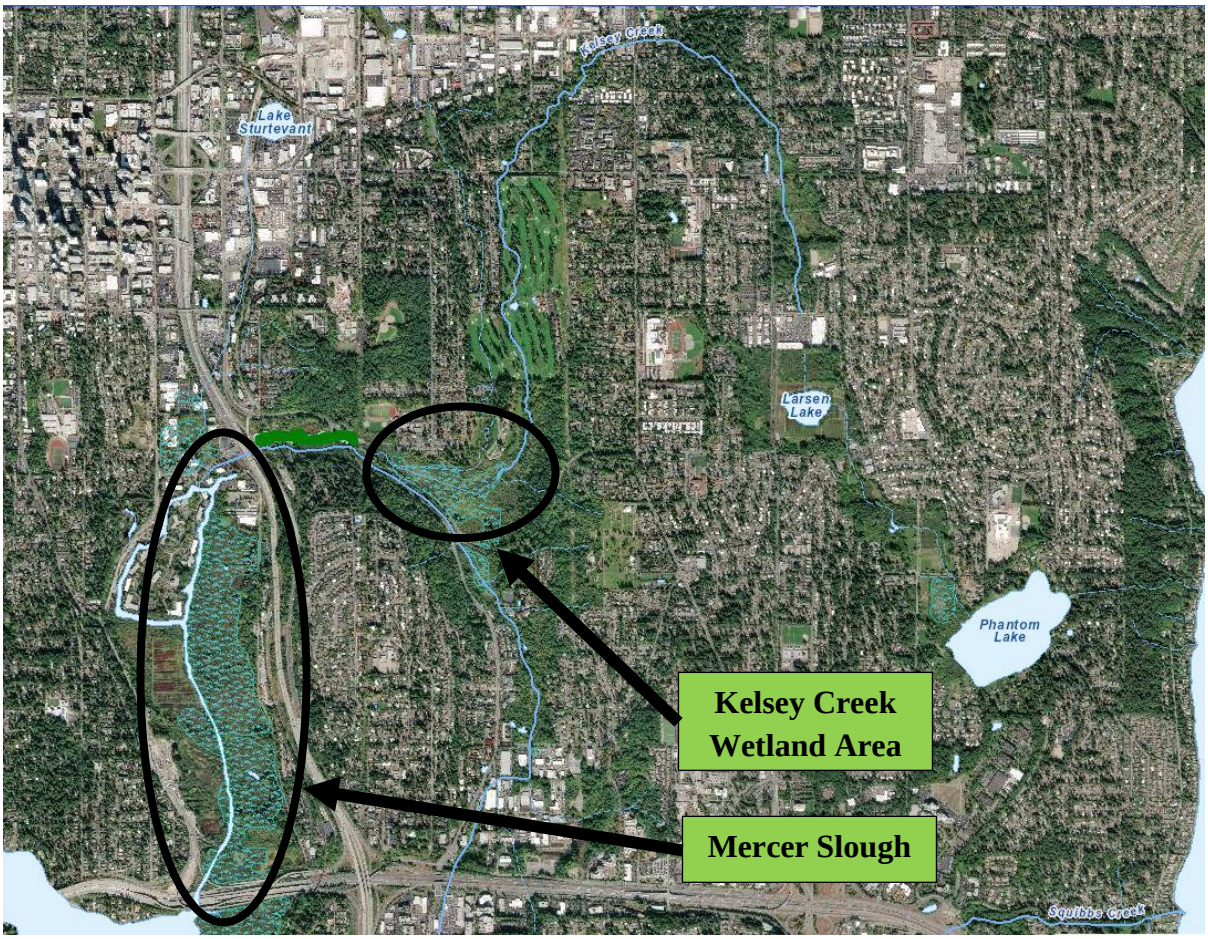

Figure 3-2. Aerial view of Mercer Slough and the lower Kelsey Creek wetlands, areas that may be inhibiting Chinook Salmon migration to upstream spawning areas in some years.

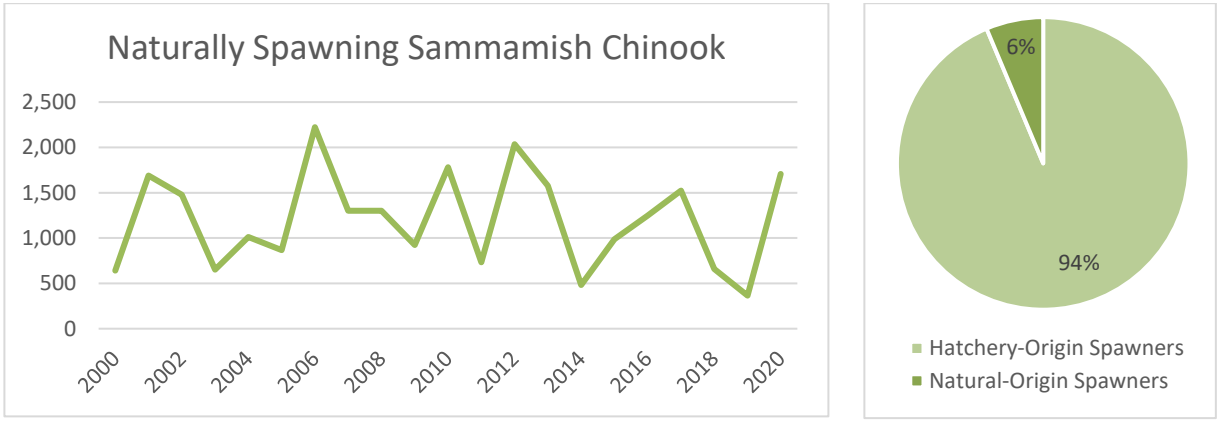

Figure 3-3. Abundance of naturally spawning Chinook Salmon and percent Natural-Origin and Hatchery-Origin spawners in the Sammamish River basin.

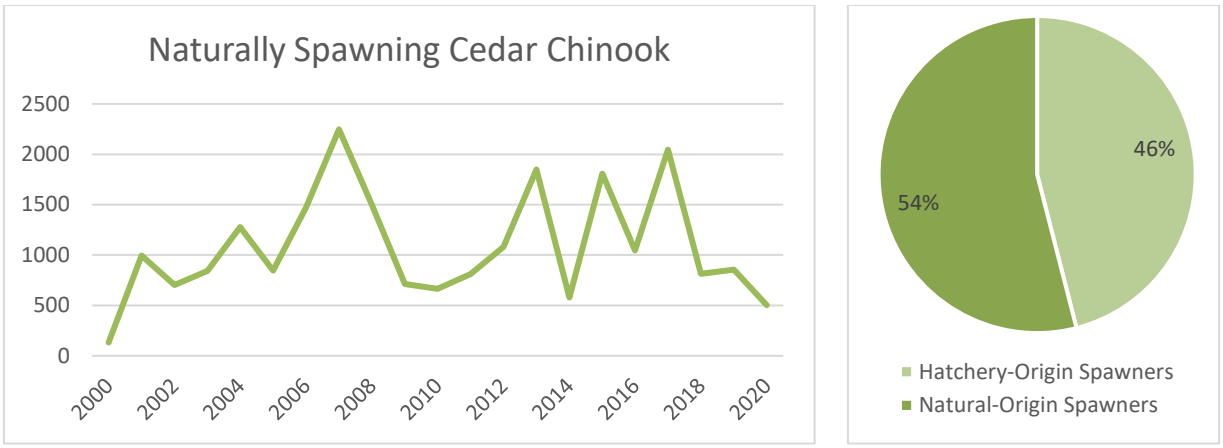

Figure 3-4. Abundance of naturally spawning Chinook Salmon and percent Natural-Origin and Hatchery-Origin spawners in the Cedar River basin.

Figures 3-3 and 3-4 show the numbers of naturally spawning Chinook Salmon adults that were observed in the Sammamish River and Cedar River between 2000 and 2020. Sammamish River Chinook Salmon spawn in Big Bear Creek, Cottage Lake Creek, and lower Issaquah Creek, and the Chinook Salmon that use these spawning areas resemble Kelsey Creek Chinook Salmon in that most of the naturally spawning adults (more than 80%) are hatchery-origin fish (Figure 3-3). The Cedar River Chinook Salmon population differs in that most naturally spawning adults (more than 75%) are natural-origin fish (Figure 3-4).

It should be noted that there was a large discrepancy between the 2020 estimated Chinook Salmon returns through the Ballard Locks and the total fish that spawned in Lake Washington tributaries. Estimated Chinook Salmon counts at the Locks exceeded the ten-year average (Figure 3-5). However, far fewer fish were observed successfully spawning throughout WRIA 8, as can be seen in the returns in Figures 3-3 and 3-4.

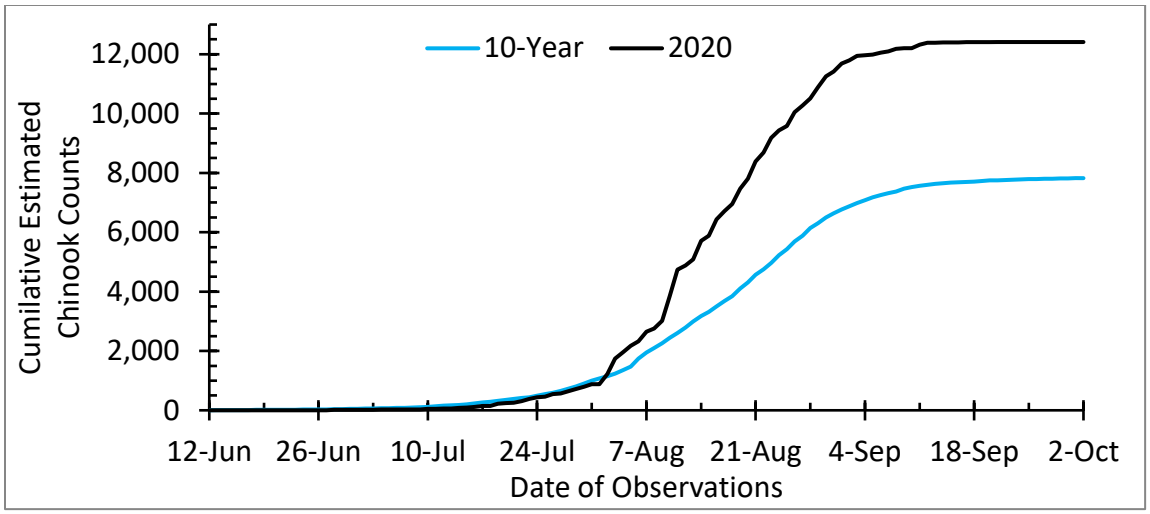

Figure 3-5. Cumulative estimated Chinook Salmon counts in 2020 compared to the average returns over the previous ten years of observations from the Ballard Locks.

One possible explanation for this could be the methods that the fish were counted as they traveled through the Hiram M. Chittenden Locks. Fish counts occur in the Ballard Locks Fish Ladder for ten minutes of every hour in daily ten-hour shifts during the salmon migration. Salmon are also counted in the large locks as boats enter Lake Washington from the Puget Sound. These numbers are then extrapolated to account for fish traveling at night or during lockages that are not observed during off hours to project the estimated totals. Ladder counts are highly accurate because every fish is easily counted as they pass the window. However, counting large schools in deep water or during low visibility conditions can lead to inaccuracies or estimations in the lockage counts. In recent years and especially in 2020, consistent harbor seal presence and predation has prevented salmon from using the ladder and diverted the schools to the locks where counts may be less accurate (Figure 3-6). Additionally, peak Chinook Salmon migration occurs later in the summer when the lake temperature is much warmer than the Puget Sound. It is possible that this high temperature differential may cause some fish to remain in the locks for more than one lockage. However, it is not known how many fish this affects, possibly leading to double counts and elevated official totals. The 2020 Chinook Salmon counts in the ladder were the smallest percentage of the total run seen in the last five years and may have contributed to higher projected run sizes than were observed in spawning streams throughout the watershed.

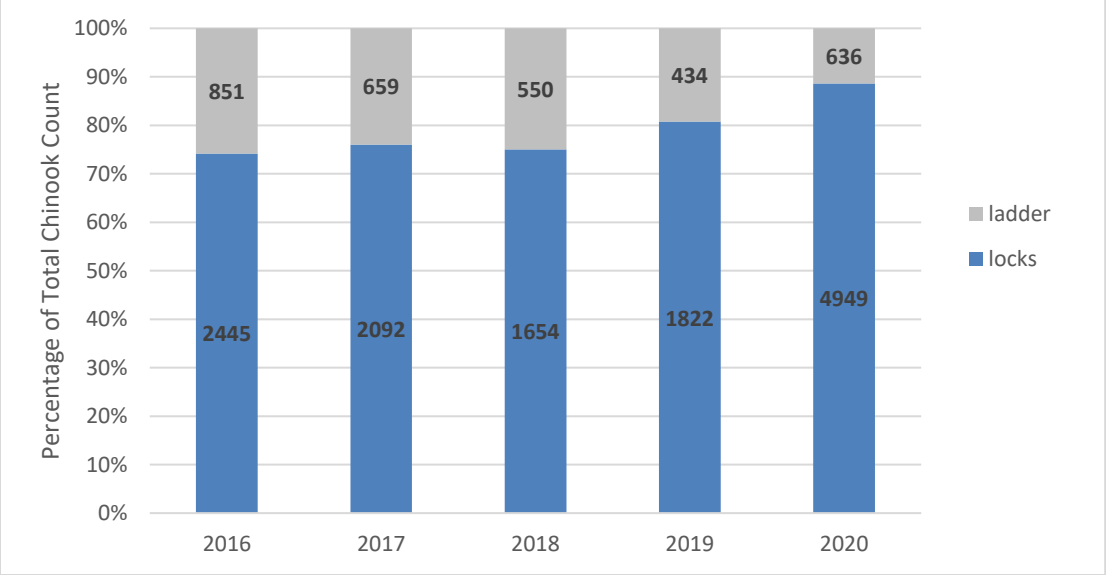

Figure 3-6. Total actual counts of Chinook Salmon observed in the ladder (gray) and lockages (blue) and the percentage of the total count that those locations represented over the past five years.

3.2 SOCKEYE SALMON USE

As with Chinook Salmon, the Kelsey Creek and Coal Creek basins each provide spawning and rearing habitat for Sockeye Salmon, but do not support self-supporting populations. Two populations of Sockeye Salmon inhabit the Lake Washington Watershed. One population is relatively small (1,000-5,000 spawners per year) and spawns in tributaries to the Sammamish River (Big Bear, Little Bear, Cottage Lake, and North Creeks). The second Sockeye Salmon population spawns in the Cedar River and is larger (10,000-100,000 spawners per year). In addition to the two naturally spawning populations, a hatchery program in the Cedar River also releases between 2 to 20 million Sockeye Salmon hatchery fry into the Cedar River each year. Most adult Sockeye Salmon returning to the Lake Washington Watershed are natural-origin fish from the Cedar River; adult hatchery-origin Sockeye Salmon from the Cedar Hatchery are a close second in terms of abundance, and natural-origin Sockeye Salmon returning to the Sammamish River tributaries are a distant third. In past years, Sockeye Salmon (numbering from 500 to 5,000 fish) spawned in shallow-water areas with cold water upwelling around Lake Washington (primarily around Mercer Island), however Sockeye Salmon have not been observed spawning along the Lake Washington lakeshore in recent years.

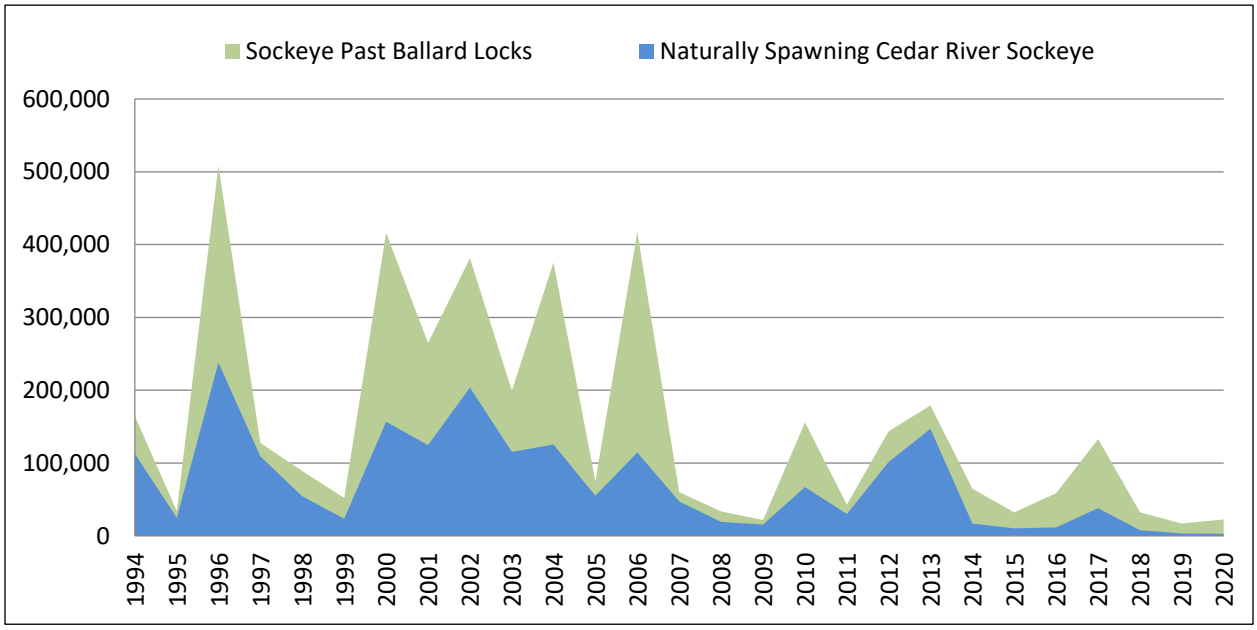

Figure 3-7. Number of Sockeye Salmon adults counted passing through the Ballard Locks (green), and the number of naturally spawning Sockeye Salmon adults observed in the Cedar River (blue).

Sockeye Salmon that use Kelsey and Coal Creeks for spawning are likely adult fish from the Cedar River population (of both natural and hatchery origin) that strayed into Bellevue streams. Years with higher levels of Sockeye Salmon spawning activity in Kelsey and Coal Creek are likely associated with years when there are large overall Sockeye Salmon returns to Lake Washington. Relatively large numbers of Sockeye Salmon were observed in Kelsey Creek in 2000 and 2006 (Table 2-1), years when there were high overall returns to Lake Washington (Figure 3-7). However, years with high overall Sockeye Salmon returns to Lake Washington do not always translate into large Sockeye Salmon spawning in Bellevue streams, indicating that local conditions (habitat and water quality conditions or barriers to migration) throughout the Kelsey Creek or Coal Creek basins may also affect the number of Sockeye Salmon that spawn there. For example, in both 2002 and 2004 large numbers of Sockeye Salmon returned to Lake Washington, yet relatively small numbers of Sockeye Salmon were observed in the Kelsey Creek basin.

3.3 COHO SALMON USE

Naturally spawning Coho Salmon are not well monitored in the Lake Washington Watershed. Historically, Kelsey Creek and its tributaries were a major producer of Coho Salmon (Report 1948) but populations have declined significantly with increased land use. Infrequent spawning surveys of the basin between 1976 and 1981 found between 3 and 80 returning adult Coho Salmon (Scott et al. 1986, WDFW unpublished data set 1976-1981). Valley Creek, a tributary to

Kelsey Creek, particularly contributed to the productivity of Kelsey Creek basin as a whole. Spawning surveys in 1981 found more Coho Salmon spawners per river mile in Valley Creek compared to Kelsey Creek (Morrice and Johnson 1982). Another study in 1981 found 50 times as many juvenile Coho Salmon per square meter in Valley Creek as the mainstem of Kelsey Creek (Scott et al 1982). Less information is known about the historical Coho Salmon populations in Coal Creek. Coal washings from the coal mining in the basin significantly decreased existing fish populations in the late 1800s (Report 1948). Coho Salmon were transplanted from the Issaquah Hatchery in the mid-1940s to help restore a natural run (Report 1948) and from 1994-1997 between 9,000 and 13,800 juvenile Coho Salmon were planted by WDFW (Kerwin 2001). Broadly, wild populations of Coho Salmon have declined significantly throughout the Puget Sound (Losee et al 2019). Natural Lake Washington Coho Salmon escapement peaked at over 30,000 in 1970 (Fresh [c.1990]), however fish counts at the Ballard Locks indicate that in recent years 85-90% of adult Coho Salmon entering the Lake Washington system are hatchery-origin fish returning to Issaquah Hatchery (Figure 3-5). Coho Salmon that utilize habitat throughout the Kelsey and Coal Creek basins are likely a combination of mainly hatchery fish straying from the Issaquah Hatchery program with small numbers of naturally spawned fish from these basins.

Bellevue streams are annually supplemented by the release of small numbers of Coho Salmon fry raised from eggs donated by the Issaquah Hatchery in partnership with educational Salmon in the Classroom programs and private individuals. Most allocations are marginal; about 200 eggs for classroom programs and 5,000 eggs for two private incubation projects, one located in Reach 7 of Kelsey Creek and second located near the mouth of Coal Creek. It is expected that these educational Coho Salmon fry releases typically experience poor survival to adulthood. However, some of the fry released by private individuals are reared for short time periods prior to release in hopes of slightly higher survival rates. Hatchery-origin Coho Salmon released from these sites are not marked and therefore any returning adults are counted as natural-origin fish.

In 2013, 2014 and 2019, the City of Bellevue worked with the Muckleshoot Indian Fisheries staff to release adult Coho Salmon from the Issaquah Hatchery to the Kelsey and Coal Creek basins. This project clearly illustrated a reduced spawning success in the Kelsey Creek basin; 1150 Coho Salmon were released in 2013, resulting in 113 redds (approximately 0.03% spawning success); and in 2014, 643 Coho Salmon were released, but no fish were observed in the system after four days, and no redds were found (0% spawning success). In comparison, 742 Coho Salmon were released in Coal Creek in 2013, resulting in 152 redds (41% spawning success); and in 2014, 1573 Coho Salmon were released, resulting in 173 redds (22% spawning success). The disparate success in Coal Creek influenced the decision to release an additional 1,049 Coho Salmon (512 females) in 2019, resulting in 115 redds (22% spawning success). The higher-than-average adult Coho Salmon returns to Bellevue streams (especially Coal Creek) observed in 2016 and 2017 were likely a result of the hatchery Coho Salmon adult outplanting

that occurred in 2013 and 2014 (Table 2-4). This suggests Bellevue streams are capable of producing natural-origin Coho Salmon through good in-gravel survival and juvenile rearing, and that the practice of using adult transplants from Issaquah Hatchery may be an effective tool for augmenting Coho Salmon returns in these streams in future years.

Coho Salmon are considered an important sentinel species for stormwater and water quality in urban streams (Spromberg and Scholz 2011). Observations of Coho Salmon pre-spawn mortality and impaired swimming ability (loss of equilibrium, circular surface swimming, gaping, and immobility) have been linked to urban areas with more roads and impervious surfaces (Feist et al. 2018). These symptoms and death can affect as much as 90% of the returning fall run in urbanized areas (Spromberg and Scholz 2011). Recently researchers from the Center for Urban Waters in Tacoma, the University of Washington and Washington State University were able to identify that a chemical biproduct of automobile tires leached onto roadways is the source of the high observed Coho Salmon mortality (Tian et al. 2020).

Although Coho Salmon migrate in late October when higher stream flows allow them to more easily bypass physical barriers that may impede Chinook Salmon or Sockeye Salmon access to Bellevue Streams, they are threatened by toxic stormwater runoff from the surrounding impervious surfaces. Proper filtration of stormwater through soil systems can mitigate the effects of the pollutants (Spromberg et al. 2016) but these mitigation strategies are not widely used at this time. Investigating options to improve water quality and stream habitat in Bellevue streams may be vital to improving the success of Coho Salmon returns in the future.

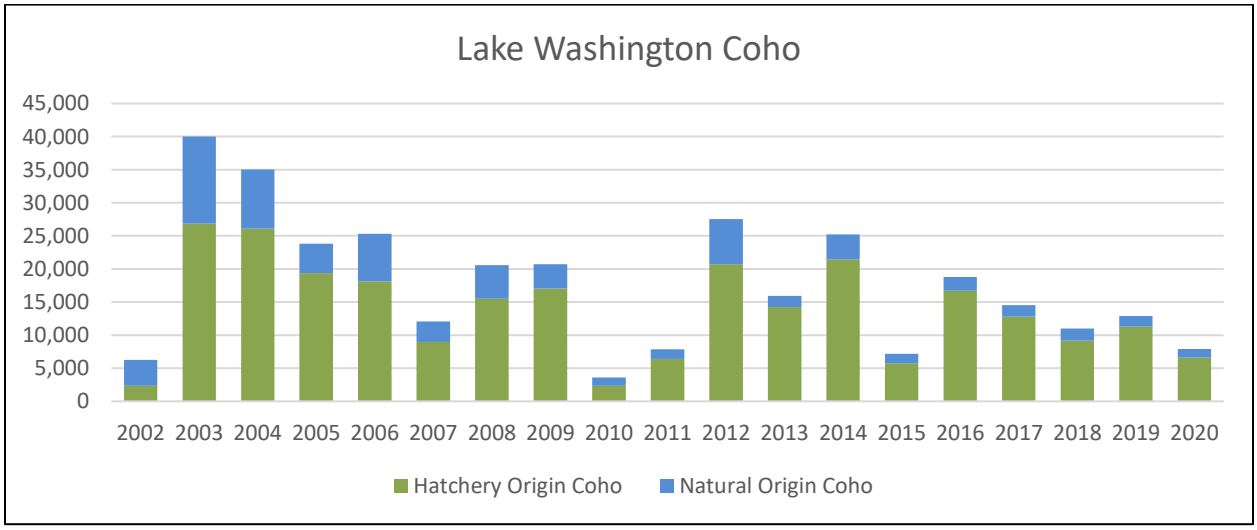

Figure 3-8. Lake Washington Coho Salmon returns (Natural-Origin and Hatchery-Origin) based on fish counts at Ballard Locks from 2002 through 2020.

3.4 COASTAL CUTTHROAT TROUT AND KOKANEE USE

Coastal Cutthroat are common in Bellevue streams, particularly the Kelsey Creek basin where they have been found to be the most prevalent salmon species that spawn in the creek (Scott et al. 1986). Spawning surveys are not well documented for Cutthroat Trout, and their exact use of Bellevue streams is not well known. However, they are considered to be so abundant in Lake Washington that they could pose a threat to out-migrating juvenile salmon and impact the survival of other species in the watershed (McPherson and Woodey 2009). Their presence and overlapping run time with Coho Salmon may also have inflated past assessments of Coho Salmon redds and may be worth further investigation.

The 1946 Washington Department of Game surveys reported the Kokanee run in Coal Creek as "excellent" and documented a "poor" run in Mercer Slough (Garlick 1946), but there is very little information about Kokanee spawning in Bellevue streams since that time. It is widely considered that the one prevalent Lake Washington/Lake Sammamish Kokanee population has been reduced from three historic runs, to one exceptionally small population that exclusively spawns in Lake Sammamish tributaries (Berge and Higgins 2003). A spawning pair discovered in Coal Creek Reach A in 2020 was exceptional and is important to note.

3.5 COMPARISONS WITH SALMON WATCHER OBSERVATIONS

Salmon Watcher data in Kelsey and the West Tributary is generally consistent with WDFW surveys but allows for a greater survey area. A Kokanee observation in 2018 was documented in Lewis Creek (stream site 327), a known spawning location of the remaining kokanee population in Lake Sammamish. This information is valuable to understanding salmon populations in the greater Lake Washington Watershed but can be misleading when reported with the other data where Kokanee observations are rare. Another important Salmon Watcher observation of live and dead fish outside the WDFW index reaches was made upstream of the professional surveys in West Tributary in 2018. While these fish were not positively identified to species, based on behavior and timing, they were likely Coho Salmon, and would not have been counted by WDFW surveyors. In 2020, the timing of Salmon Watcher observations in Coal Creek matched WDFW observations, but species identification was not always consistent. Chinook, Sockeye and Coho salmon may all be present concurrently in Coal Creek, making identification difficult. Salmon Watchers are also more likely to report an unknown species sighting, however, general descriptions of the observations and comparisons to the WDFW surveys can inform us of the most likely species the Salmon Watchers observed, making this information valuable.

3.6 RECOMMENDATIONS

Maintaining and restoring streams and riparian corridors is an increasingly difficult task in urban stream systems like the Kelsey Creek and Coal Creek basins. Sustaining stream ecological processes that continue to support the salmon lifecycle maintains public interest and inspires people to work toward preserving this important natural resource. The following recommendations, used in conjunction with on-going stream habitat restoration and monitoring, will help maintain and enhance public interest in salmon and salmon utilization of Bellevue streams.

- Monitor adult fish passage for Chinook and Sockeye salmon through Mercer Slough, the Kelsey Creek fish ladder, and the wetland beaver complex in lower Kelsey Creek each year during the adult migration season (mid-August through September).

- Encourage land owner best management practices for overall watershed health, with specific emphasis on streamside properties (i.e. riparian plantings, eliminating use of pesticides/herbicides, discourage riprap/velocity increasing bank armoring, cleaning up after pets, keep pets out of streams, limit access points to reduce disturbance/erosion, etc.).

- Continue to release Coho Salmon adults from the Issaquah Hatchery to the Coal Creek basin to encourage natural spawning.

- Look for ways to monitor fry and smolt production from the Kelsey Creek and Coal Creek basins. Continue monitoring adult salmon returns using both professional and volunteer programs.

- Continue implementing fish passage, water quality retrofit, and stream habitat restoration projects for salmon and other aquatic species.

- Provide education opportunities for the general public about salmon utilization of Bellevue streams, how they can contribute to the success of salmon, and the reduce the effects of urbanization on our streams and biota.

4. REFERENCES

Anchor QEA. 2012. 2011 salmon spawner surveys Kelsey Creek, West Tributary, Richards Creek, and Coal Creek: Bellevue spawner surveys. Prepared for City of Bellevue, Utilities Engineering Divisions, Watershed Planning Team.

Bean, T.H. 1891. Kennerly's salmon. Trans. Amer. Fish. Soc., Twentieth Annual Meeting, Washington, D.C.

Berge, H.B., and K. Higgins. 2003. The current status of Kokanee in the greater Lake Washington Watershed. Technical report by the King County Department of Natural Resources and Parks, Seattle Washington.

Berge, H.B., M.L. Hammer and S.R. Foley. 2006. Timing, abundance, and population characteristics of spawning Chinook Salmon in the Cedar/Sammamish Watershed. Technical report by the King County Department of Natural Resources and Parks and Washington Department of Fish and Wildlife.

Feist, B.E., E.R. Buhle, D.H. Baldwin, J.A. Spromberg, S.E. Damm, J.W. Davis, and N.L. Schiltz. 2018. Road to ruin: conservation threats to a sentinel species across an urban gradient. Ecological Applicants 27(8):2382-2396.

Fresh, K.L. [c. 1990s.] Lake Washington fisheries: A historical perspective. State Department of Fisheries. Historical Lake Washington Chinook Salmon Records 7:3

Garlick, L.R. 1946. Report on check of silver trout run in Lake Washington tributaries. Unpublished report. Washington Dept. of Game, Olympia

Irvine, J. R., and Fukuwaka, M. 2011. Pacific salmon abundance trends and climate change. ICES Journal of Marine Science, 68(6):1122–1130.

Losee, J., N.W. Kendall, and A.M. Dufault. 2019. Changing salmon: An analysis of body mass, abundance, survival, and productivity trends across 45 years in Puget Sound. Fish and Fisheries, 00:1-18.

Hahn, P.J.K., M.C. Mizell, C. Kraemer and P. Castle. 2003. Assessment of Chinook Salmon redd life and spawner escapement in the Skagit, Stillaguamish, and Snohomish River systems, 2001. Report to U.S. CTC and U.S. NMFS. Washington Department of Fisheries, Olympia, WA.

Hilborn, R., B.G. Bue and S. Sharr. 1999. Estimating spawning escapements from periodic counts: a comparison of methods. Canadian Journal of Fisheries and Aquatic Science 56:888-896.

King County. 2016. 2015 volunteer salmon watcher program annual report: Lake Washington watershed and other Puget Sound streams. Prepared by Jennifer Vanderhoof, Water and Land Resources Division. Seattle, Washington.

King County Water and Lands Resource Division (WLRD). 2016. Lake Washington/ Cedar/Sammamish Watershed Chinook Salmon Conservation Plan.

Morrice R. and A. Johnson. 1982. Salmon spawning ground report- 1981. Washington Department of Fisheries. Olympia, Washington.

Moscrip A.L. and D.R. Montgomery. 1997. Urbanization, flood frequency, and salmon abundance in Puget Sound lowland Streams. Journal of the American Water Resources Association 33(6)1289-1297.

McPherson S. and J.C. Woodey. 2009. Cedar River and Lake Washington Sockeye salmon biological reference points estimates. Washington Department of Fisheries and Wildlife.

Puget Sound Indian Tribes and the Washington Dept. of Fish and Wildlife (WDFW). 2017. Comprehensive Management Plan for Puget Sound Chinook: Harvest Management Component.

Richey, J.S. 1982. Effects of urbanization on a lowland stream in western Washington. PhD. Dissertation, University of Washington, Seattle, Washington.

Report on the condition of spawning tributaries of the Lake Washington watershed. 1948. Historical Lake Washington Chinook Salmon Records 4:17

Ruckleshaus, M.H., K.P. Currens, W.H. Graeber, R.R. Fuerstenberg, K. Rawson, N.J. Sands, and J.B. Scott. 2006. Independent populations of Chinook Salmon in Puget Sound. U.S. Dept. of Commerce, NOAA Technical Memo. NMFS-NWFWC-78.

Scholz, N.L., M.S. Myers, S.G. McCarthy, J.S. Labenia, J.K. McIntyre, G.M. Ylitalo, L.D. Rhodes, C.A. Laetz, C.M. Stehr, B.L. French, B. McMillan, D. Wilson, L. Reed, K.D. Lynch, S. Damm, J.W. Davis, and T.K. Collier. 2011. Recurrent die-offs of adult coho salmon returning to spawn in Puget Sound Lowland Urban Streams. PLoSOne 6(12) e28013.

Scott, J.B., C.R. Steward and Q.J. Stober. 1986. Effects of urban development on fish population dynamics in Kelsey Creek, Washington. Transactions of the American Fisheries Society 115:555-567.

Smith, C. and P. and Castle. 1994. Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*) escapement estimates and methods – 1991. Northwest Fishery Resource Bulletin. Project Report Series No. 1.

Spence, B.C., G.A. Lomnicky, R.M. Hughs, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. Management Technology. 356 p.

Spromberg J.A. and N.L. Scholz. 2011. Estimating the future decline of wild Coho salmon populations resulting from early spawner die-offs in urbanizing watersheds of the Pacific Northwest, USA. Integrated Environmental Assessment and Management 9999.

Spromberg J.A., D.H. Baldwin, S.E. Damm, J.K. McIntyre, M. Huff, C.A. Sloan, B.F. Anulacion, J.W. Davis, and N.L. Scholz. 2016. Coho salmon spawner mortality in Western US urban watersheds: bioinfiltration prevents lethal storm water impacts. Journal of Applied Ecology 53:398-407.

Tian Z., H. Zhao, K.T. Peter, M. Gonzalez, J. Wetzel, C. Wu, X. Hu, J. Prat, E. Mudrock, R. Hettinger, A.E. Cortina, R.G. Biswas, F.V.C. Kock, R. Soong, A. Jenne, B. Du, F. Hou, H. He, R. Lundeen, A. Gilbreath, R. Sutton, N.L. Scholz, J.W. Davis, M.C. Dodd, A. Simpson, J.K. McIntyre, E.P. Kolodziej. 2020. A ubiquitous tire rubber–derived chemical induces acute mortality in Coho salmon. Science 371(6525):185-189

Watershed Company, 2009. 2008 salmon spawner surveys: Kelsey Creek, West Tributary, Richards Creek and Coal Creek. Report prepared for the City of Bellevue Contracting Services.

Whiley, T. 2009. Review of storm-event water quality data – City of Bellevue. Washington State Department of Ecology Publication no. 09-10-038.

5. APPENDIX

Table 5-1. Volunteer observers who reported data during the 2011-2020 seasons.

Peggy Albin	Audrey Gao	Ed Niblock
Marisol Asselta	Preston Glidden	Steve Palmen
April Atwood	Laurie Gogic	Betty Peltzer
Kathleen Auld	Doug Greaves	Cindy Reed
Ruth Bacha	Ron Green	David Reitz
Hilary Barnes	Faye Haas	Kevin Ruuhela
Diane Bell	Erica Halford	Phil Sandifer
Bryan Bendix	Cameron Haslam	Martha Schindler
Marilyn Blue	Evelyn Heath	Henry Shirinyan
Tom Blue	Jana Hindman	Neil Skilton
Cindy Boyer	Neal Hines	Tim Skilton
Richard Brashen	Jeff Hsia	Mary Smith
Joe Carrol	Bev Jennings	Scott Smouse
Heather Chaney	Jeremy Jones	John Spilker
Eric Chaney	Kevin Jones	Brent Spurgeon
James Chaney	Leah Juhle	Catherine Spurgeon
Michael Chaney	Tatsu Komada	John Stephenson
Kellene Collins	John Komorowski	Johnny Stephenson
Kate Conant	Janusz Komorowski	Becky Stephenson
Paul Cooper	Tommy Kraft	Gregg Takamura
Nancy Daar	Debra Kumar	Surys Tewari
Karen Dawson	Ronan Larrivee	Roshni Tewari
Harriet Dempsey	Jim Laughlin	Lew Thorson
Lisa Denbeste	Rich Leighton	Gazel Tan
Lisa Denbestie	Ken Mackey	Krys Tierney
Tianmin Ding	Kurt Manning	Kay Tokuda
Siyao Ding	Alina Marshall	Gary Tribble
Carol Druse	Maria Marshall	Carla Trsek
Greg Druse	Lynn McKay	Calvin Wang
Harry Dursch	Krys McMahon	Leslie Waters
Art Eash	Jim McRoberts	Nancy Weisel
Ilya Elkin	Jeff Mendenhall	Barb Williams
Gary Emerson	Dave Mickelson	Steve Williams
Kelly Fine	Chris Mitchell	Gregg Wilson
Ernie Frankenberg	Mary Alice Moran	Karen Winter
Hon Cheung Fung	Danny Murray	Kyoko Yoshikawa
Jeannette Gaines	Anna Murray	Jon Aaron Yurchak

Table 5-2. Counts of live, dead, and redds for Chinook Salmon in Bellevue streams for years 1999-2020.

Bellevue Streams Chinook		AUG	SEPTEMBER				OCTOBER					NOVEMBER				DECEMBER				JANUARY		TOTALS
		Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48	Week 49	Week 50	Week 51	Week 52	Week 1	Week 2	
Live	1999					11		69	31													111
	2000				0	1	4	4	3	2	1	2	0	0	0	0	0					17
	2001						4	1	1	1	2	0	0	0	0	0	0	0	0			9
	2002			0	1	4	0	5	3	2	0	1	0	0	0	0	0					16
	2003					0	0	0	1	0	0	0	0	0	0	0	0	0	0			1
	2004			0	2	0	0	2	2	9	2	3	0	0	0	0						20
	2005		0	3	2	2	11	2	3	2	2	0	0	0	0	0	0					27
	2006				12	29	10	35	51	31	0		0	0	0		0					168
	2007		5	3	15	17	55	72	23	22	9	0	0	0	0	0	0	0				221
	2008					6	9	2	6	2	0	0	0	0	0	0	0	0	0			25
	2009	0	0	1	3	0	3	2	2	0	0	0	0	0	0	0	0	0	0	0		11
	2010			0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2
	2011		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
	2012			0	0	0	0	0	5	3	4	5	0	0	2	0	0	0	0			19
	2013			1	0	1	6	0	0	0	0	0	1	0	0	0	0	0	0	0		9
	2014			0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		1
	2015		0	0	0	0	1	0	5	4	0	0	0	0	0	0		0	0	0		10
	2016		0	0	0	1	0	1	2	6	2	1	0									13
	2017		0	0	0	0	4	8	6	4	0	0	0		0	0	0	0	0	0		22
	2018		0	0	0	0	0	0	0	0	0	0	0									0
	2019		0	1	0	6	8	4	0	2	0	0	0	0	0	0	0	0	0			21
	2020		0	0	0	0	8	1	2	0	0	0	0	0	0	0	0	0	0		0	11
Carcass	1999					5		39	73													117
	2000				0	0	1	3	2	3	3	1	0	0	0	0	0					13
	2001						0	0	0	0	0	0	0	0	0	0	0	0	0			0
	2002			0	1	1	0	0	4	6	0		0	0	0	0	0					12
	2003					0	0	0	0	3	1	2	0	0	0	0	0	0	0			6
	2004			0	2	2	4	0	5	22	8	37	8	0	0	0						88
	2005		0	1	2	0	13	8	9	2	1	1	0	0	0	0	0	0				37
	2006				23	18	17	22	84	37	17		1	0		1	0						220
	2007		1	0	5	7	15	18	64	24	16	4	1	0	0	0	0	0				155
	2008					6	4	20	2	2	1	2	0	1	0	0	0	0	0			38
	2009	0	0	0	1	1	4	5	3	0	1	0	0	0	0	0	0	0	0	0		15
	2010			0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	2011		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			1
	2012			0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0			1
	2013			0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0		3
	2014			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
	2015		0	0	0	0	0	0	1	1	0	0	0	0	1	0		0	0	0		3
	2016		0	0	0	0	1	0	0	0	3	0	0									4
	2017		0	0	0	0	1	5	6	6	0	0	0		0	0	0	0	0	0		18
	2018		0	0	1	0	0	1	0	0	0	0	0									2
	2019		0	0	0	7	0	0	0	0	2	0	0	0	0	0	0	0	0			9
	2020		0	0	0	0	2	5	0	1	1	0	0	0	0	0	0	0	0		0	9
Redd	1999					1		45	30													76
	2000											1										1
	2001						1	0	1	0	1	0	1	0	0	0	0	0	0			4
	2002			0	0	0	0	1	1	3	0	0	0	0	0	0	0					5
	2003					0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
	2004			0	0	0	0	1	3	10	1	2	0	0	0	0						17
	2005		0	0	0	0	3	4	5	2	0	0	0	0	0	0	0	0				14
	2006				4	10	14	12	36	12	2		0	0	0		0					90
	2007		0	0	0	4	9	34	15	12	3	0	0	0	0	0	0	0				77
	2008					0	4	2	0	2	0	0	0	0	0	0	0	0	0			8
	2009	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0		3
	2010			0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
	2011		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
	2012			0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0			1
	2013			0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0		3
	2014			0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0		2
	2015		0	0	0	0	0	0	1	1	0	0	0	0	0	0		0	0	0		2
	2016		0	0	0	0	2	0	2	2	1	0	0									7
	2017		0	0	0	0	1	1	1	2	0	0	0		0	0	0	0	0	0		5
	2018		0	0	0	0	0	0	0	0	0	0	0									0
	2019		0	0	0	2	4	0	0	0	1	0	0	0	0	0	0	0	0			7
	2020		0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0		0	3

Color indicates a survey was performed.

Table 5-3. City of Bellevue anadromous salmonid spawning ground survey implementation information (1999-2020).

Year	Kelsey Creek	West Tributary	Richards Creek	Coal Creek	Data Format	Surveyor	Reporting Agency
1999	X				Excel	?	
2000	X		X		Excel	?	
2001	X	X	X	X	SGS / Excel	Taylor Assoc.?	
2002	X	X	X		Excel	Watershed Co.	Watershed Co.
2003	X	X	X		Excel	Watershed Co.	Watershed Co.
2004	X	X	X		Excel	Watershed Co.	Watershed Co.
2005	X	X	X		Excel	Watershed Co.	Watershed Co.
2006	X	X	X		Excel	Watershed Co.	Watershed Co.
2007	X	X	X		Excel	Watershed Co.	Watershed Co.
2008	X	X	X	X	Excel	Watershed Co.	Watershed Co.
2009	X	X	X	X	Excel	Watershed Co.	Watershed Co.
2010	X	X	X	X	SGS / Excel	WDFW	
2011	X	X	X	X	SGS / Excel	WDFW	Anchor QEA
2012	X	X	X	X	SGS / Excel	WDFW	
2013	X	X	X	X	SGS / Excel	WDFW	
2014	X	X	X	X	SGS / Excel	WDFW	
2015	X	X	X	X	SGS / Excel	WDFW	
2016	X	X	X	X	SGS / Excel	WDFW	
2017	X	X	X	X	SGS / Excel	WDFW	WDFW
2018	X	X	X	X	SGS / Excel	WDFW	
2019	X	X	X	X	SGS / Excel	WDFW	WDFW
2020	X	X	X	X	SGS / Excel	WDFW	WDFW

Source: WDFW Spawning Ground Survey (SGS) database, Anchor 2012, The Watershed Company 2008.

Table 5-4. Survey Reach Descriptions.

Stream	Reach	Reach Description	RM Start	RM Stop
Kelsey Creek	Trestle	I-405 to 121st Ave SE	1.9	2.0
Kelsey Creek	Wetland	Lake Hills Connector to Kelsey Creek Farm	2.2	2.4
Kelsey Creek	Reach A	Kelsey Creek Farm to footpath on right.	3.0	3.2
Kelsey Creek	Reach 1	Foot path on right to Kelsey Creek Park footbridge.	3.2	3.4
Kelsey Creek	Reach 2	Footbridge to third bridge on golf course.	3.4	3.6
Kelsey Creek	Reach 3	Third golf course bridge to first cement weir/pump house on river left.	3.6	3.8
Kelsey Creek	Reach 4	First cement weir to brown bridge with stone posts.	3.8	4.0
Kelsey Creek	Reach 5	Brown bridge with stone posts to NE 8th St culvert.	4.0	4.4
Kelsey Creek	Reach 6	NE 8th St (at 132nd) to Valley Creek/140th Ave NE.	4.4	5.1
Kelsey Creek	Reach 7	Valley Creek/140th Ave NE to 148th Ave NE.	5.1	5.8
Richards Creek	Confluence	Confluence with Kelsey Creek to intersection of Lake Hills Connector Rd and Richards Rd.	0.0	0.3
West Tributary	Reach 1	Confluence with Kelsey Creek to first footbridge in Kelsey Creek Park.	0.0	0.3
West Tributary	Reach 2	First footbridge to second footbridge.	0.3	0.5
West Tributary	Reach 3	Second footbridge to golf course boundary.	0.5	0.7
West Tributary	Reach 4	Golf course southern boundary to northern boundary.	0.7	0.9
West Tributary	Reach 5	Private property to NE 8th St.	0.9	1.3
Coal Creek	Reach A	Skagit Key to I-405 culvert.	0.0	0.6
Coal Creek	Reach 1	I-405 (119th Ave SE) to Coal Creek Parkway.	0.7	2.2
Coal Creek	Reach 2	Coal Creek Parkway to first footbridge on left (second tributary on the left when walking upstream).	2.2	2.4
Coal Creek	Reach 2b	First footbridge to third footbridge.	2.4	3.5
Newport Creek	NP-1	Newport tributary from mouth at Coal Creek upstream.	0.0	varied

5-1 STREAM DESCRIPTIONS AND TYPICAL HABITAT PHOTOS

5-1.a Kelsey Creek

The headwaters of Kelsey Creek are located in the Lake Hills Greenbelt near Phantom Lake, and the stream flows downstream into Larsen Lake (Figure 2-1) in Bellevue, Washington. From Larsen Lake, Kelsey Creek flows northwest, through the dense mixed-forest and extensive wetlands and beaver ponds.

The uppermost survey reach, Reach 7, begins at the crossing of 148th Ave NE and continues down to 140th Ave NE. Habitat in Reach 7 is characterized by cobble, gravel pools and riffles with some boulders and woody debris. Fairly diverse riparian vegetation is bordered closely by residential and some commercial properties (Figure 5-2(b)). Riparian buffer consists of blackberry, some mature conifers, and landscaping vegetation such as rhododendrons. Reach 7 supports some good sections of spawning gravel.

140th Ave NE marks the upper end of Reach 6, where Kelsey turns to the southwest and flows through residential and commercial spaces with little to no riparian buffer downstream to NE 8th Street. Almost all of Reach 6 is highly modified and channelized with boulder bank armoring that results in high velocities and bed scour. Stream habitat ranges from boulder riffles and pools to exposed clay banks and cobble. Riparian vegetation that is present is largely invasive species and landscaping plants such as bamboo, Japanese knotweed, and Himalayan blackberry (Figure 5-2(a).

NE 8th Street marks the upstream end of Reach 5. Reach 5 downstream to Reach 2 flows south through the Glendale Golf Course. Stream habitat within the course includes sand and gravel glides, gravel and boulder riffles, and engineered concrete weirs (Figure 5-1). Several sediment bars create short pools in these reaches. Most of the riparian area is composed of grassy stream banks, interspersed with mixed conifer and hardwood stands, with some riparian shrubbery and thickets of Himalayan blackberry.

Reaches 1 and A flow along the east side of the Kelsey Creek Farm. This is a lower gradient section with habitat ranging from sand and gravel riffles, to deeply scoured plunge pools with some woody debris and undercut banks. Most of the riparian area is composed of grassy stream banks with hardwood stands and dense woody shrubs (Figure 5-1). Kelsey Creek flows downstream of the Kelsey Creek Farm property into an expansive wetland. Numerous beaver dams seasonally limit upstream movement by adult salmon in the wetland until fall rains increase flows and enable accessibility to upstream habitats (Figure 5-2(c)). Downstream of the wetland, Kelsey Creek flows under Interstate 405, where it becomes Mercer Slough, eventually draining into Lake Washington.

Figure 5-1: Typical habitat in Kelsey Creek: Reach A on January 11, 2021 (a); Reach 1 on January 11, 2021 in the Kelsey Creek Farm (b); Reach 2 on January 11, 2021 just below the start of the golf course (c); Reach 3 on January 25, 2021 between the golf course and blackberries (d); Reach 4 on December 7, 2020 (e); and Reach 6 on December 24, 2020 (f).

Figure 5-2: Typical habitat in Kelsey Creek continued: Reach 6 on December 2, 2020 (a); Reach 7 on October 28, 2019 (b); and the Wetland Reach near the confluence with Richards Creek on January 25, 2021(c).

5-1.c West Tributary

The headwaters of West Tributary (a tributary to Kelsey Creek) begin near Bridle Trails State Park (north Bellevue) (Figure 2-1). The creek flows south through a mixture of forest, residential, commercial, and industrial spaces until it enters, and flows through, the Glendale Golf Course, subsequently converging with Kelsey Creek near Kelsey Creek Farm (Figure 5-3). Reach 5 begins in a residential neighborhood at NE 8th St. and flows between RM 1.3 and 0.9 (Figure 5-3(d)). The channel in Reach 5 is frequently lined with riprap and other bank armoring, and habitat consists of low gradient gravel, scoured clay beds, and cobble pools and riffles. Riparian vegetation consists mainly of mature landscape trees and non-native landscaping plants including bamboo and other shrubs. Reach 4 flows from the north at RM 0.9, at the Glendale Golf Course northern boundary, south through the golf course to RM 0.7 (Figure 5-3(c)). This reach is relatively shallow and consists of meandering gravel runs with few pools. The riparian zone is primarily open with little overhead vegetation, except an approximately 100-yard section with mature conifer trees. There is little to no instream cover in the form of woody debris or undercut banks.

Reach 3 of West Tributary flows through the upstream part of the Kelsey Creek Farm, between RM 0.7 and 0.5 (Figure 5-3(b)). The stream widens through a forested section of the park that is characterized by thick streamside willow and other riparian vegetation. The reach has interspersed smaller pools and a larger amount of woody debris. A large pool is present at the base of the reach that is prone to flooding during high flows. The streambed substrate is comprised predominantly of gravel and sand. Reach 2 continues through the downstream part of the Kelsey Creek Farm, between RM 0.5 and 0.3 (Figure 5-3(a)). Reach 1 flows through the south boundary of the Kelsey Creek Farm to the confluence with Kelsey Creek. Habitat in reaches 1 and 2 are similar, with beaver activity often impounding the streamflow, willow and other shrubs and small trees. Substrates range from silt and sand to large gravel.

Figure 5-3. Typical habitat in West Tributary: Reach 2 on January 25, 2021 (a); Reach 3 January 25, 2021 (b); Reach 4 through the golf course on January 25, 2021 (c); and Reach 5 on January 25, 2021 (d).

5-1.c Richards Creek

The headwaters of Richards Creek begin near Eastgate Park and Factoria (Figure 2-1). The creek flows north under Interstate 90. On the north side of Interstate 90, Richards Creek flows through commercial and industrial space as it intersects with the upper end of Reach 4. The upper end of Reach 3 starts at SE 26th St, where it enters a forested area that continues downstream to the upper end of Reach 1. The upper end of the Confluence Reach is located at RM 0.3. The Confluence Reach is constrained on either side by the lanes of Lake Hills Connector and flows through low gradient sandy habitat with some gravel and cobble riffles, with a thin stand of hardwood buffer (Figures 5-4).

Figure 5-4. Typical habitat in the Richards Creek confluence with Kelsey Creek on January 25, 2021.

5-1.d Coal Creek

Coal Creek drains from the west slopes of Cougar Mountain Regional Wildland Park and flows generally northwest into Lake Washington (Figure 2-2). Reach 2b extends from RM 2.7 to a right bank tributary confluence at RM 2.0 at the top of Reach 2. Both reaches 2 and 2b flow through a confined valley contained in Coal Creek Natural Area. Habitat consists of moderate gradient gravel and cobble pools and riffles with mixed forest canopy and riparian shrubs (Figures 5-5(c)). Recent high-density development activity in Newcastle Commons above the valley containing Reach 2/2b is increasing impervious surfaces and will likely negatively affect stream flashiness and water quality due to road runoff pollution.

The upper end of Reach 1 starts at the containment pool in the Upper Coal Creek Trail West Trailhead off Coal Creek Parkway at RM 1.7. Reach 1 continues through the Coal Creek Natural Area along mixed forest canopy and riparian shrubs, with some residential space (Figures 5-5(b). Habitat consists of cobble and gravel pools and riffles, including several sediment bars that create short pools. Reach 1 also supports a large beaver complex with frequent dams throughout Figures 5-5(d)). The lower end of Reach 1 is located on the east (upstream) side of Interstate 405 near the Coal Creek Trailhead at RM 0.8. Throughout Reaches 1, 2 and 2b the intact forest canopy provides shade and instream cover is present from many logs, salmonberry, and undercut banks.

The upper end of Reach A is located on the west (downstream) side of Interstate 405. Reach A flows through the Newport Shores residential neighborhood and into Lake Washington with little to no riparian buffer; banks primarily consist of lawns and bank armor. The upper section of the reach below Interstate 405 is a higher gradient and consists of pools, boulders and engineered

weirs. The majority of the reach is contained in neighborhood below, where the stream is lower gradient and made up of sand to cobble riffles and glides (Figures 5-5(a)). All the road crossings (and associated culverts/bridges) over the stream in this neighborhood have been replaced with fish-friendly passage options as of December 2019. We did not gain permission from some landowners in Reach A and as a result, did not survey Coal Creek between the Glacier Key and Skagit Key road crossings.

Figure 5-5. Typical habitat in Coal Creek: Reach A on January 25, 2021 (a); Reach 1 on January 8, 2021 (b); Reach 2 on December 23, 2020 (c); and large beaver dam in Reach 1 on December 7, 2020 (d).