Single Family Residential Stormwater Management Guidelines

June 2012

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Introduction

The Phase II Western Washington National Pollutant Discharge Elimination (NPDES) stormwater general permit (permit) implements the federal Clean Water Act. The permit is administered by the Washington State Department of Ecology and requires stormwater management for new development and redevelopment projects (including Single Family Residential [SFR] projects) that create more than 2,000 square feet of new and replaced impervious surface or disturb 7,000 square feet or more of land.

For SFR projects, the type and extent of stormwater requirements vary depending primarily on the amount of new and replaced impervious surface area created. Small projects (e.g., projects that create less than 5,000 square feet of new and replaced impervious surface area) will be required to implement certain minimum stormwater requirements, but will not require engineered flow control or water quality treatment facilities. Large SFR projects could potentially require engineered flow control and/or water quality treatment facilities.

This document provides guidance on how to determine which stormwater requirements apply to your project, how to meet the requirements, and how to prepare submittals in accordance with the City of Bellevue's *Storm and Surface Water Engineering Standards* (latest edition) and Single-Family Combination Building Permits.

Definitions

The following terms as used in this document are defined below:

- BCC: Bellevue City Code.
- Clearing and Grading Code: Clearing and Grading Code, BCC 23.76.
- Ecology Manual: *Stormwater Management Manual for Western Washington*, Washington State Department of Ecology. February, 2005.
- LID Manual: *Low Impact Development – Technical Guidance Manual for Puget Sound*, Puget Sound Action Team and Washington State University Pierce County Extension, January 2005 or current edition.
- Permit Appendix 1: Appendix 1—Minimum Technical Requirements for New Development and Redevelopment in the Western Washington Phase II Municipal Stormwater Permit. Washington State Department of Ecology. Modified June 17, 2009.
- Stormwater Code: Storm and Surface Water Utility Code, Chapter 24.06 of the BCC, adopted by Ordinance 5905 on October 5, 2009.
- SWES: *Storm and Surface Water Engineering Standards*, City of Bellevue Utilities Department (latest edition).

Overview of Stormwater Requirements

The City of Bellevue has nine minimum stormwater requirements, as summarized in Table 1. Relatively small SFR projects (e.g., projects that create less then 5,000 square feet of new plus replaced impervious surface area) will generally only trigger MR #1-5. However, larger SFR projects could potentially trigger all nine. Projects that trigger MR #1-5 only do not require an Engineer to design stormwater facilities and prepare submittals, while projects that trigger MR #1-9 do require an Engineer for this purpose.

Table 1. Summary of Minimum Requirements for New Development and Redevelopment.

MR #	Minimum Requirement	Summary	Reference
1	Preparation of Stormwater Site Plans	Stormwater Site Plan shall be prepared in accordance with Volume 1, Chapter 3 of the Ecology Manual	SWES - Chapter 2; Vol. I, Chapter 3 of the Ecology Manual
2	Construction Stormwater Pollution Prevention Plan	Project shall comply with Construction Stormwater Pollution Prevention Plan Elements #1 through #12	Clearing & Grading Code and Development Standards, as regulated under the Clearing & Grading Permit.
3	Source Control of Pollution	All known, available and reasonable source control Best Management Practices (BMPs) shall be applied to all projects. Source control BMPs must be selected, designed, and maintained according to the Ecology Manual	Ecology Manual - Vol. IV
4	Preservation of Natural Drainage Systems and Outfalls	Natural drainage patterns shall be maintained. Discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.	Ecology Manual - Vol. I
5	On-site Stormwater Management	Projects shall employ on-site BMPs to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. BMPs applicable to transportation include dispersion and soil protection or amendment.	SWES - Chapter 6; Ecology Manual - Vol. III, Chapter 3 and Vol., Chapter 5; and LID Manual
6	Runoff Treatment	Treatment types include: basic treatment, enhanced treatment (for metals), phosphorus treatment, and oil control.	SWES - Chapter 5
7	Flow Control	Projects must provide flow control to reduce the impacts of stormwater runoff from impervious surfaces and land cover conversions.	SWES - Chapter 3&4
8	Wetlands Protection	Projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system must maintain the existing hydrologic conditions, hydrophytic vegetation, and substrate characteristics in the wetland.	Ecology Manual Land Use Code (Critical Areas)
9	Operation & Maintenance Manual	Operations and maintenance manual required for all proposed stormwater facilities. The Owner must maintain a copy of all manuals and a log of maintenance activities that indicates the dates of each maintenance visit and the specific activities that were performed on those dates.	SWES - Chapter 4; 2010 Storm and Surface Water Maintenance Standards

Determining and Meeting Stormwater Requirements

The process for determining and meeting stormwater requirements for your SFR project involves three basic steps:

Step 1- Gather necessary project information

Step 2- Determine which stormwater Minimum Requirements (MRs) apply

Step 3- Address applicable MRs in your site design and permit submittals

Each step is described in detail below. Following the description of these steps, an example of how to apply them is provided for a hypothetical SFR home remodel/addition project.

Step 1 – Gather Necessary Project Information

As a first step in determining what, if any, stormwater MRs apply to the proposed project, the following information must be gathered and tabulated from records, as-built drawings, survey, and plans:

- Project site area (square feet, SF)
- Existing impervious area (SF)
- Existing impervious coverage (%)
- New impervious area (SF)
- Replaced impervious area (SF)
- New plus replaced impervious area (SF)
- Proposed impervious area (includes all existing, new, and replaced pollution-generating and non-pollution-generating impervious surface areas in the developed condition) (SF)
- Converted pervious: Native vegetation converted to lawn or landscape (SF)
- Converted pervious: Native vegetation converted to pasture (SF)
- Total area of land disturbing activity (SF)

Land disturbing activity: "Any activity that results in movement of earth, or a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling, and excavation..."

Impervious surface: "A hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development… Common impervious surfaces include, but are not limited to rooftops, walkways, patios, driveways, … concrete or asphalt paving, gravel roads, packed earthen materials, and … other surfaces which similarly impede the natural infiltration of stormwater."

Replaced impervious surface: "For buildings and structures means the removal and replacement of any exterior impervious surface or foundation. For other impervious surfaces <such as walkways, driveways, and patios>, it means the removal down to bare soil or base course, and replacement..."

The text boxes on this page summarize the definition of key terms from the SWES. See the "Example Project" section below for an illustrated example of how to identify and tabulate this information for a typical SFR project.

With this information tabulated, the Applicant can proceed to Step 2 to determine which MRs apply to the project.

Step 2 – Determine Which Minimum Requirements Apply

Using the project information gathered in Step 1, the Applicant must navigate the flow charts in Figures 1 and 2 (reproduced from SWES Figures 2.2 and 2.3, respectively) to determine which MRs, if any, apply to the project. Figure 1 is first used to determine whether the project is classified as new development or redevelopment, based on the amount of existing impervious coverage. Sites that have less than 35 percent of existing impervious coverage are classified as new development sites and will use Figure 1 to determine the MR applicability. Sites that have 35 percent or more of existing impervious coverage are classified as redevelopment and will use Figure 2 to determine the MR applicability for the project.

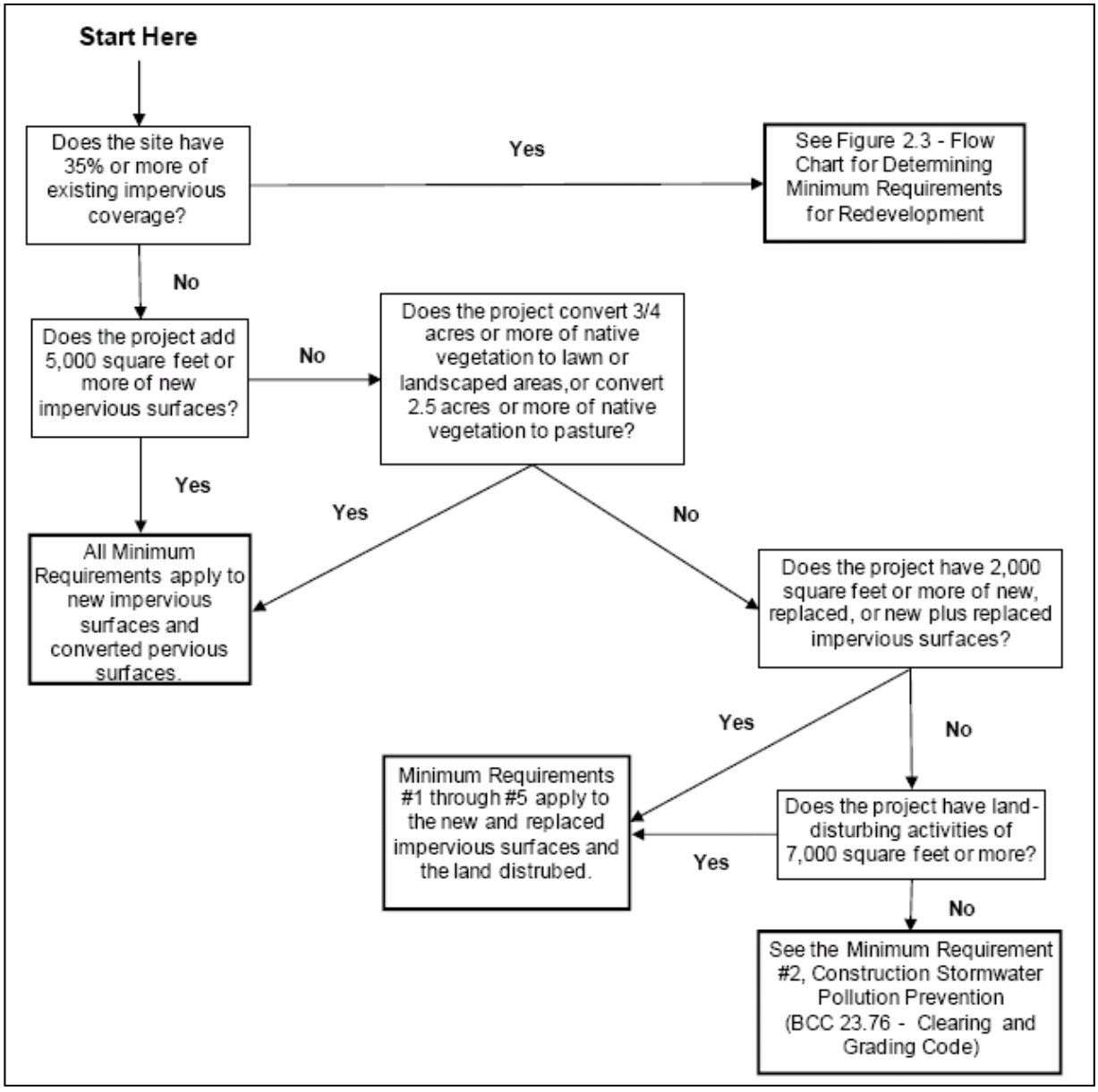

Figure 1. Flow Chart fort Determining Requirements for New Development (SWES Figure 2.2).

The Applicant must highlight the path through Figures 1 and 2 and include a highlighted copy with the permit submittals. See the "Submittals" and "Example Project" sections below.

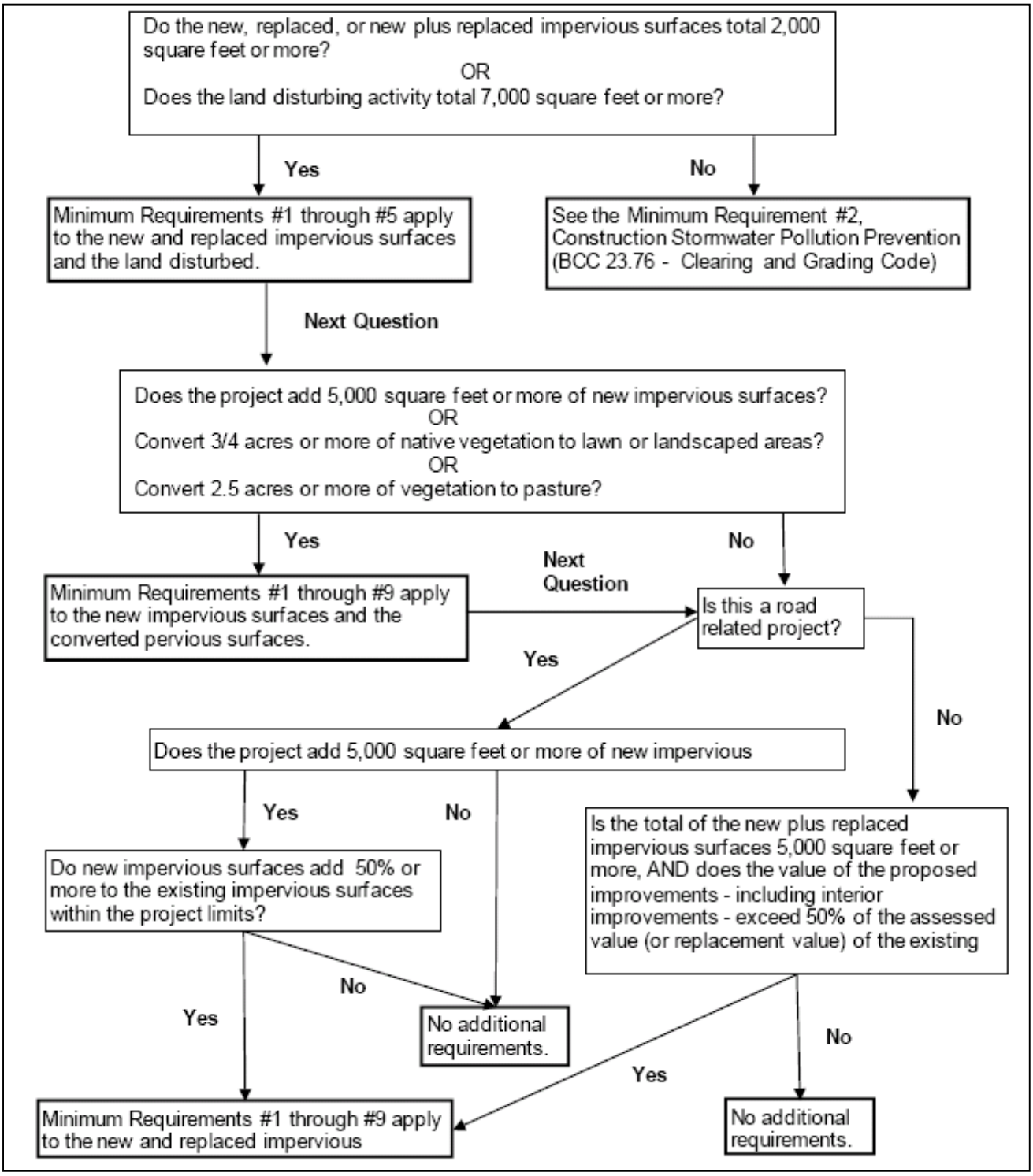

Figure 2. Flow Chart for Determining Requirements for Redevelopment (SWES Figure 2.3).

Step 3 – Address Applicable MRs in Site Design and Permit Submittals

In this step, the Applicant addresses the MRs that were determined above to be applicable. The MRs are addressed in the site designs and permit submittals. Although MRs #1-9 could potentially be applicable to an SFR project, only MRs #1 – 7 are discussed below. See the SWES for additional information on how to address MRs #8 and 9 if they are applicable.

Preparation of Stormwater Site Plans (MR #1)

If the project triggers MR #1, then the Applicant shall prepare a Stormwater Site Plan in accordance with SWES Chapter 2 and Volume I, Chapter 3 of the 2005 Ecology Manual.

Construction Stormwater Pollution Prevention Plan (MR #2)

If the project triggers MR #2, then a Construction Stormwater Pollution Prevention Plan (CSWPPP) must be developed in conjunction with a clearing and grading permit. The CSWPPP must describe the potential for pollution problems on the construction project and explain the measures to be taken during construction to control those problems. There are twelve required elements that must be considered in the CSWPPP. If any of the 12 elements are deemed unnecessary based on information contained in the text of the CSWPPP, those elements must be addressed in the CSWPP, but do not necessarily need to be implemented during construction.

The Single-Family Combination Building Permit Submittal Requirements packet includes a copy of the CSWPPP Short Form for Small Construction Projects, defined as projects that disturb less than 7,000 square feet of area and grade less than 100 cubic yards.

Source Control of Pollution (MR #3)

If the project triggers MR #3, then all known, available and reasonable source control Best Management Practices (BMPs) must be used. The intention of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost-effective means of reducing pollutants in stormwater, and, therefore, should be a first consideration in all projects.

Source controls may be used during construction or as part of the final site conditions (particularly for development of industrial and commercial sites). There are numerous types of source control BMPs, such as the use of mulches and covers on disturbed soil, covering outside storage areas, and/or berming areas to prevent stormwater run-on and pollutant runoff.

Source control BMPs must be selected, designed, and maintained in accordance with Volume IV of the 2005 Ecology Manual. For source control during construction, see Volume II, Chapter 4 of the Ecology Manual. Source control BMPs should be identified in the stormwater site plan and shown on site plans submitted for permit review.

Preservation of Natural Drainage Systems and outfalls (MR #4).

If the project triggers, MR#4, natural drainage patterns must be maintained, and discharges from the site must occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the site must not cause significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation. See Volume I, Chapter 2.5.4 of the Ecology Manual for more information.

On-Site Stormwater Management (MR #5)

If the project triggers MR #5, on-site stormwater management BMPs must be implemented to infiltrate, disperse, and retain stormwater on-site. These on-site BMPs include Low Impact Development (LID) principles that mimic the site's natural hydrologic characteristics. LID features are preferable to more traditional stormwater management techniques. Integration of LID BMPs into the site design can also help eliminate or reduce the size of stormwater facilities needed to achieve MRs #6 and # 7, if flow control and water quality treatment are required. On-site BMPs are categorized in the SWES as follows:

- Tier 1 On-site BMPs— Minimize Runoff
- Tier 2 On-site BMPs— Retain Runoff On-site
- Tier 3 On-site BMPs— Infiltrate or Disperse Runoff Prior to Discharge

Figure 3 (Figure 6.1 of the SWES) provides selection guidance for on-site stormwater management facilities for SFR projects. The BMPs must be evaluated and implemented in the order presented within each of the three tiers. See guidelines for design, construction, inspection, and long-term maintenance of two types of BMPs that may be used on SFR projects, including pervious pavement (www.ci.bellevue.wa.us/.../SFR_Guidelines_ PerviousPave_FINAL.pdf) and compost amended soils (http://www.bellevuewa.gov/pdf/Utilities/ SFR_Guidelines_Amended_Soil_FINAL.pdf).

For any remaining impervious area not fully managed by on-site practices, stormwater outfalls must be connected as described in D4.04.11 of the SWES (Private Single Family Drainage Systems).

Runoff Treatment (MR #6)

If the project triggers MR #6, an Engineer is required to design stormwater facilities. The Engineer will need to determine what type of treatment is required. Types of runoff treatment potentially applicable to SFR projects include basic, enhanced, and phosphorous treatment. The following information is needed to determine which type of treatment, if any, is required:

- New pollution-generating impervious surface area
- Replaced pollution-generating impervious surface area
- New pollution-generating pervious surface area
- Determination of whether or not the receiving water is designated as phosphorous sensitive

Pollution-generating impervious surfaces (PGIS):
"Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff, including those which are subject to: vehicular use; industrial activities…; or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. … A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced fire lanes, vehicular equipment storage yards, and airport runways. The following are not considered regularly-used surfaces: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, fenced fire lanes, and infrequently used maintenance access roads."

The thresholds for determining the levels of treatment required are summarized below. Additional detail can be found in Section 24.06.065 of the BCC and Chapter D2-05 of the SWES. Figure 4 illustrates the appropriate treatment selection process.

Basic treatment: Required if the project adds:

- ≥ 5,000 square feet pollution-generating impervious surface area, or
- ≥ 3/4 acres pollution-generating pervious surface area.

From D5-03.9 of the SWES, basic treatment generally applies to SFR projects as follows:

- Project sites that discharge to the ground, UNLESS:
  1) The soil suitability requirements for infiltration treatment are met; (see Ecology Manual, Vol. III, Chapter 3 for soil suitability criteria), or
  2) The project uses infiltration strictly for flow control – not treatment – and the discharge is within ¼-mile of a phosphorous sensitive lake (use a Phosphorous Treatment Facility, see below), or within ¼-mile of a fish-bearing stream or lake (use an Enhanced Treatment Facility). Phosphorus sensitive lakes include Larsen Lake, Phantom Lake, and Lake Sammamish.
- Project sites discharging directly to Lake Washington (lakes listed in Appendix I-C of the Ecology Manual except Lake Sammamish, which requires Phosphorous Treatment).

Enhanced treatment: Generally not applicable to SFR projects, but could be required for project sites that use infiltration for flow control and discharge within ¼-mile of a fish-bearing stream or lake.

Phosphorus control: Required for projects that drain to designated nutrient-sensitive water courses, including Larson Lake, Phantom Lake, and Lake Sammamish. The approved options for providing Phosphorous Treatment are listed in Figure 4 and presented in more detail in Volume V of the Ecology Manual. Additional means of meeting the phosphorous treatment requirement may be approved by the City if the proposal fulfills the design criteria in the DOE's General Use Level Designation (GULD) approval process.

Flow Control (MR #7)

If the project triggers MR #7, flow control BMPs are required for projects with:

- ≥10,000 square feet of effective impervious area,
- ≥3/4 acres conversion of native vegetation to lawn or landscape,
- ≥2.5 acres conversion of native vegetation to pasture, or
- ≥ 0.1 cubic feet per second increase in 100-year flood frequency (based on continuous hydrologic modeling; see Chapter D3 in the SWES).

Effective Impervious surface:
Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces on residential development sites are considered ineffective if the runoff is dispersed through at least one hundred feet of native vegetation in accordance with BMP T5.30 – "Full Dispersion," as described in Vol. 5, Chapter 5 of the Ecology Manual.

Flow control BMPs are required to reduce runoff volumes or control release of stormwater from the project site to prevent stream bank erosion. Flow control facilities must be designed by an Engineer and can include conventional facilities, such as detention tanks or vaults and/or LID facilities, such as dispersion, downspout infiltration, rain gardens, infiltration trenches, pervious pavement, and bioretention swales.

If flow control is required, it is important to note that on-site BMPs (discussed above in "On-site Stormwater Management [MR #5]") are still required.

The following exemptions to MR #7 may apply:

- Flow control is not required for project sites that discharge directly to, or indirectly through a Municipal Separate Storm Sewer System (MS4) to Lake Washington, Lake Sammamish, or Mercer Slough via a conveyance system that meets the requirements and restrictions in the engineering standards, see Section D3-05, page D3-17 of the SWES;
- Flow control is not required for properties located in the "No Detention Zone" within the Meydenbauer Drainage Basin, per Ordinance No. 3372.

In addition to the above exemptions, the following modification to MR #7 applies in the Sturtevant Creek Basin:

- A modified flow control standard applies to the Sturtevant Creek Basin. Bellevue determined using procedures recommended by Ecology that this basin has had 40 percent total impervious area (TIA) coverage since the year 1985. Accordingly, the pre-developed condition to be matched in this basin is the existing land cover condition, rather than the pre-developed forested condition that applies in other basins. Consistent with D3-03 in the SWES, stormwater discharges from flow control facilities in the Sturtevant Creek Basin shall match developed discharge durations to existing durations for the range of existing discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak. However, water quality treatment (MR #6) may still be required within this basin, depending upon the project (see Figures 1 and 2).

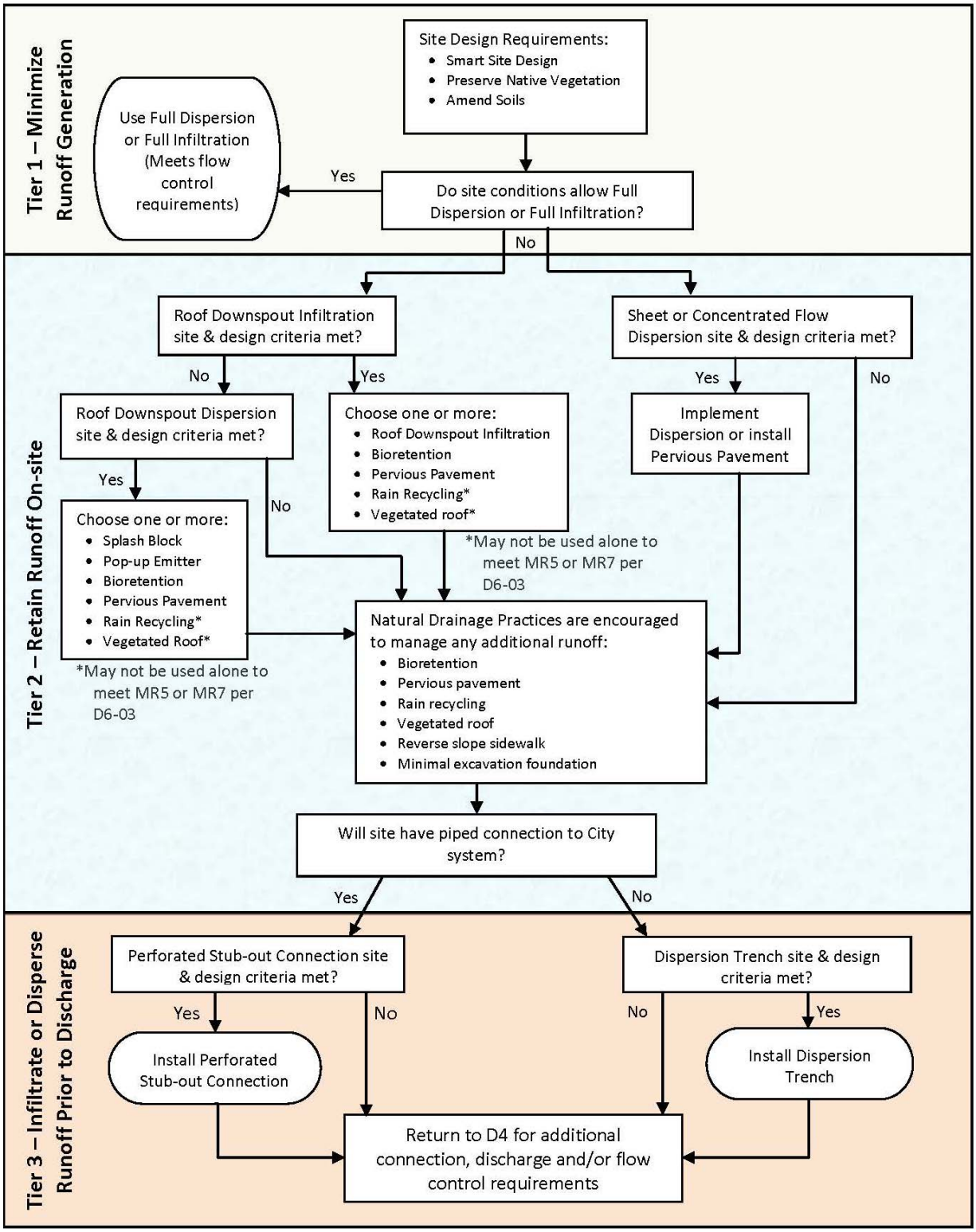

Figure 3. On-Site Stormwater Management BMP Selection (from Figure 6.1 in the SWES).

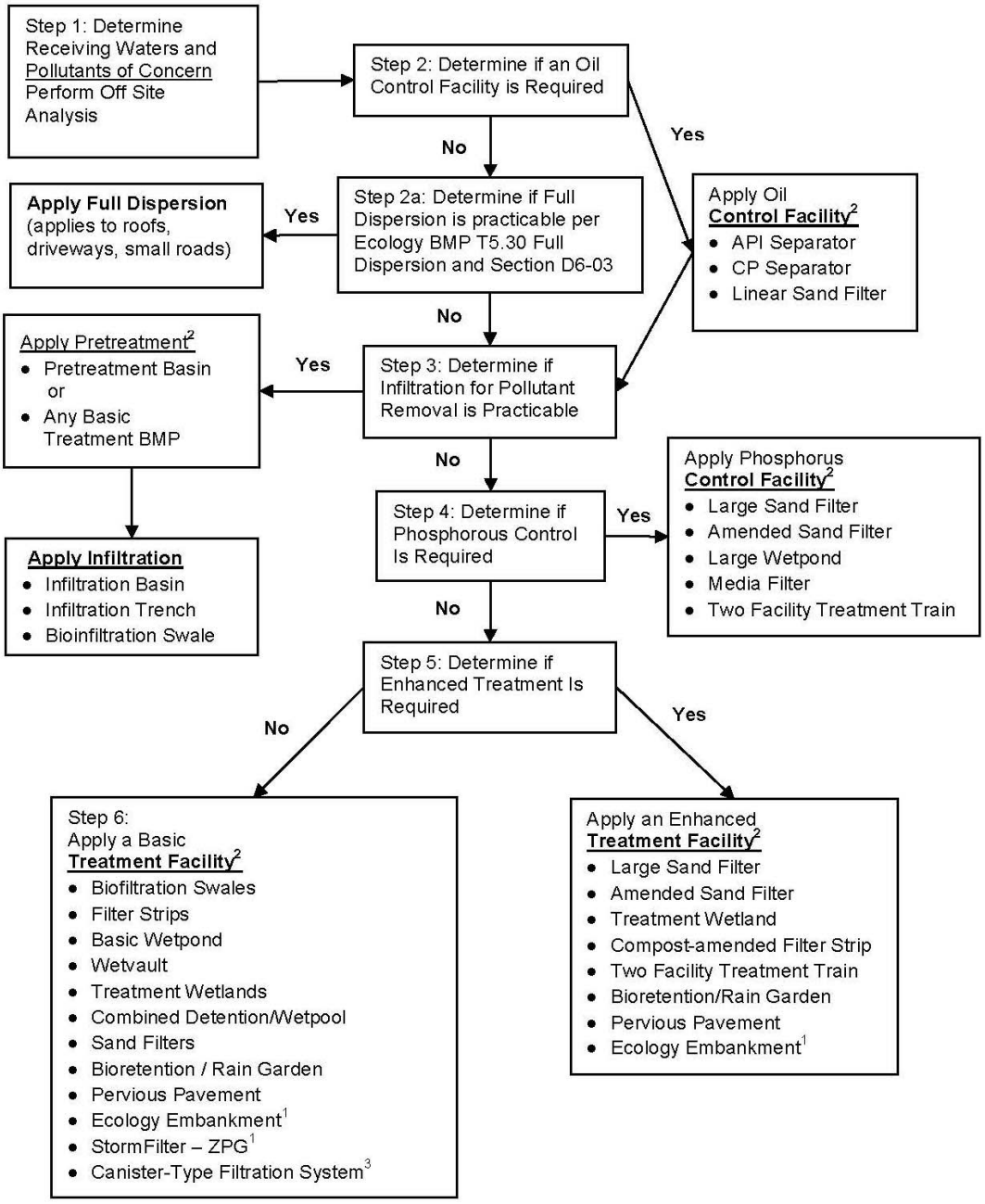

Figure 5.1 Treatment Facility Selection Flow Chart

Notes:
[1] See DOE Manual Volume V Chapter 3 Section 3.5 for more information.
[2] Facilities that have DOE General Use Level Designation (GULD) rating, or that are deemed by DOE to be functionally equivalent to approved facilities, are also allowed.
[3] Medium must be of type approved by DOE.

Figure 4. Treatment Facility Selection Flow Chart (from Figure 5.1 in the SWES).

Submittal Requirements

Submittal requirements described in Chapter 2 of the SWES are summarized in Table 2. The requirements for projects that trigger only MRs #1-5 are less stringent than the requirements for projects that also trigger MR #6 and/or #7. The differences for storm drainage reports, geotechnical reports, infiltration testing, and BMP sizing calculations are summarized below.

Storm Drainage Report

The storm drainage report requirements for projects that trigger MRs #1-5 only are substantially less than those for projects that also trigger MR #6 and/or #7. The major differences are the requirements for including a geotechnical report, conducting infiltration testing, and BMP sizing, as described below. Table 2 summarizes the requirements and Section D2-06.2 of the SWES provides details for both types of projects.

Geotechnical Report and Infiltration Testing

For projects that trigger MRs #1-5 only, a geotechnical reports as described in the Development Services plan description sheet “Geotechnical Report and Stability Analysis Requirements” is required when infiltration facilities (including bioretention or pervious pavement) are proposed and the project site is within 100 feet of a stream, wetland, steep slope or landslide hazard area. A simplified infiltration test may be used (SWES Section D4-06.7(D)) instead of the Ecology Manual methods presented in Volume III, Chapter 3.3.6.

For projects that also trigger MR #6 and/or #7, a geotechnical report as described in the Development Services plan description sheet “Geotechnical Report and Stability Analysis Requirements” is required.

BMP Sizing

Projects that trigger MRs #1-5 only may use the BMP Sizing Table provided in the SWES. Other projects must provide continuous hydrologic modeling results demonstrating that MR #6 and/or MR #7 are met. However, engineers for these projects may use the sizing tables to guide their design.

Table 2. Submittal requirements for projects that trigger MRs #1-5 only and projects that also trigger MR #6 and/or MR #7.

Submittal Component	Projects that Trigger MRs #1-5 Only	Projects that Trigger MR #6 and/or #7
Geotechnical Report	Required only when infiltration facilities are proposed and within 100 feet of stream, wetland, steep slope or landslide area.	√
Storm Drainage Report	√	√
Project Overview	√	√
Vicinity Map		√
Site Maps	√	√
Infiltration Test Information	Simplified Infiltration Test may be used; (Section D4-06.7(D) of the SWES)	√
Proposed Development	√	√
Proposed On-site Stormwater Facilities	√	√
Soils Information	√	√
Drainage Maps	√	√
Sizing Calculations	Simplified sizing of on-site BMPs (Section 6-03 of the SWES)	√
Permanent Stormwater Controls	√	√
As-Built Drawings	√	√
O&M Manual	See Section D2-09 of the SWES and the 2010 Storm and Surface Water Maintenance Standards	√

Example Project

This section walks through the stormwater requirements for an example SFR redevelopment project. The project is a hypothetical remodel/expansion of an existing home on a single family residential lot. The project site is not located within 100 feet of a stream, wetland, steep slope or landslide hazard area and does not discharge directly to Lake Washington or Lake Sammamish.

Existing Conditions

The existing home is on a 6,000 SF lot and includes a single-story, 1,540 SF house with a gabled roof and 1.5-ft-wide eaves on two sides of the roof. The total existing roof area for the home, including the eaves, is 1,620 SF. This roof area is based on the projected horizontal area of the roof, not the actual surface area of the roof (including the angled surface areas).

Other impervious surfaces include a 200 SF driveway, 250 SF patio, 96 SF shed, and 100 SF walkway. The total existing impervious area is 2,266 SF.

There are two large maple trees, each with canopies of approximately 100 SF (total of 200 SF existing tree canopy), in the back yard. The remaining 3,534 SF of the site is landscaped with lawn. Table 3 provides a summary of the existing site conditions.

Table 3. Summary of existing site conditions.

Surface Type	Area	Units	Notes
Total Lot	***6000***	***SF***	
Roof (with eaves)	1620	SF	Includes 2’ eaves on two sides of roof
Driveway	200	SF	10’ x 20’
Patio	250	SF	Semi-circular shape
Shed	96	SF	8’ x 12’
Walkway	100	SF	5’ x 20’
Impervious Subtotal	***2266***	***SF***	
Trees	200	SF	2 large maple trees
Lawn	3534	SF	
Pervious Subtotal	***3734***	***SF***	

Proposed Conditions

The project entails demolishing the existing house and constructing a new 2-story, 5,600 SF house (2,800 SF on each floor). With the roof eaves, the proposed roof area will be 3,010 SF. A new 120 SF patio will be constructed between the existing shed and one of the maple trees. An additional 100 SF feet of walkway will be added in the back yard. The shed and driveway will remain unchanged. The total impervious surface area will be 3,626 SF.

The two existing maple trees (200 SF) will remain, and all disturbed pervious areas (2,174 SF) will be compost amended and landscaped. Table 4 provides a summary of proposed site conditions.

Table 4. Summary of proposed site conditions.

Surface Type	Area	Units	Notes
Total Lot	***6000***	***SF***	
Roof (with eaves)	3010	SF	Includes 2-ft eaves on two sides
Driveway	200	SF	10’ x 20’ (unchanged)
Patio	120	SF	10’ x 12’
Shed	96	SF	8’ x 12’ (unchanged)
Walkway	200	SF	Includes 100 SF extension
Impervious Subtotal	***3626***	***SF***	
Trees	200	SF	2 large maple trees
Landscape	2174	SF	Compost amended landscaping
Pervious Subtotal	***2374***	***SF***	

To evaluate and address the stormwater requirements for this project, we follow the three steps described above:

Step 1- Gather Necessary Project Information.

Gather and tabulate drawings/information on existing and final site layout, total site size, existing and proposed impervious areas, and disturbed area. Figure 5 shows the existing and proposed site layout. Table 5 summarizes the project information needed to proceed to Step 2.

Table 5. Summary of project information for determining minimum stormwater requirements.

Key	Component	Value	Notes
A	Project Site Area	6,000 SF	
B	Existing Impervious Area	2,266 SF	
C	Existing Impervious Coverage	38%	Calculated as B/A * 100%
D	New Impervious Area	1,212 SF	New roof area, patio, and walkway
E	Replaced Impervious Area	1,910 SF	Existing roof, patio, and a portion of the walkway
F	New Plus Replaced Impervious Area	3,122 SF	Calculated as D+E
G	Proposed Impervious Area	3,626 SF	
H	Converted pervious: Native vegetation converted to lawn or landscape	0 SF	N/A
I	Converted pervious: Native vegetation converted to pasture	0 SF	N/A
J	Total Area of Land Disturbing Activity	6,000 SF	Extensive construction project; Entire site will be disturbed

Step 2- Determine Which Minimum Requirements Apply.

Figure 6 highlights the project's path through the flow chart in Figure 2.2 in the SWES. This flow chart is used to determine whether new development or redevelopment requirements apply to the project. Because the existing impervious coverage **C** is greater than 35 percent, redevelopment requirements apply and the Applicant must proceed to Figure 7 (Figure 2.3 in the SWES).

MRs #1-5 apply to the new and replaced impervious surfaces **F** and the land disturbed **J**. This is because the new plus replaced impervious surface area (1,212 SF new + 1,910 SF replaced = 3,122 SF new + replaced) **F** is greater than the 2,000 SF threshold. Note that if impervious surface area is removed, that removed impervious surface area is not subtracted from **F** in determining the applicability of MR #1-5. Removed impervious surface area is not included in the tabulation or in the determination of MR applicability in any way.

As illustrated in Figure 7, the project does not trigger any of the other MR thresholds. Therefore, only MR #1-5 apply to the project. Discussion of how to address MRs #1-5 for the project is provided below.

Step 3 - Address Applicable MRs in Site Design and Permit Submittals

General information on how to comply with MR #1-4 was provided above. Specific information on how to address MR #5 for this project is provided here.

On-site BMPs to satisfy MR #5 were selected in accordance with Figure 8 (Figure 6.1 of the SWES). For Tier 1, Smart Site Design compost amended soils will be used in all disturbed pervious surfaces (all landscaped areas). The applicable and feasible principles of Smart Site Design (Section D6-03.1 (B) of the SWES), including Using Drainage as a Design Element and Comply with Land Use Code 20.20.460, Impervious Surface Limits, were incorporated into the project designs.

For Tier 2, on-site BMPs for managing roof runoff were first evaluated. Roof downspout infiltration and roof downspout dispersion are not feasible for the site, based on the engineering feasibility criteria provided in Section D6 of the SWES. Also for Tier 2, on-site BMPs for managing other impervious surfaces must be evaluated. Neither sheet flow nor concentrated dispersion are feasible for the site. Next, bioretention was evaluated. Bioretention will not fit on the site within the allowable infiltration setbacks. Therefore, pervious pavement was selected to manage runoff from the new patio and walkway areas on-site. A 50-gallon rain barrel was also included in the design though not required, to provide water for landscape irrigation.

Finally, for Tier 3, perforated stub-out was evaluated and determined to not be feasible due to insufficient space for meeting infiltration setback requirements. Figure 5 shows the location of proposed on-site BMPs, including pervious pavement and rain barrel. Compost amended soils are included, but are not shown in the figure. Information on design, construction, inspection, and long-term maintenance of pervious pavement and compost amended soils for SFR projects can be found in the websites listed above in the section titled “On-Site Stormwater Management (MR #5)”.

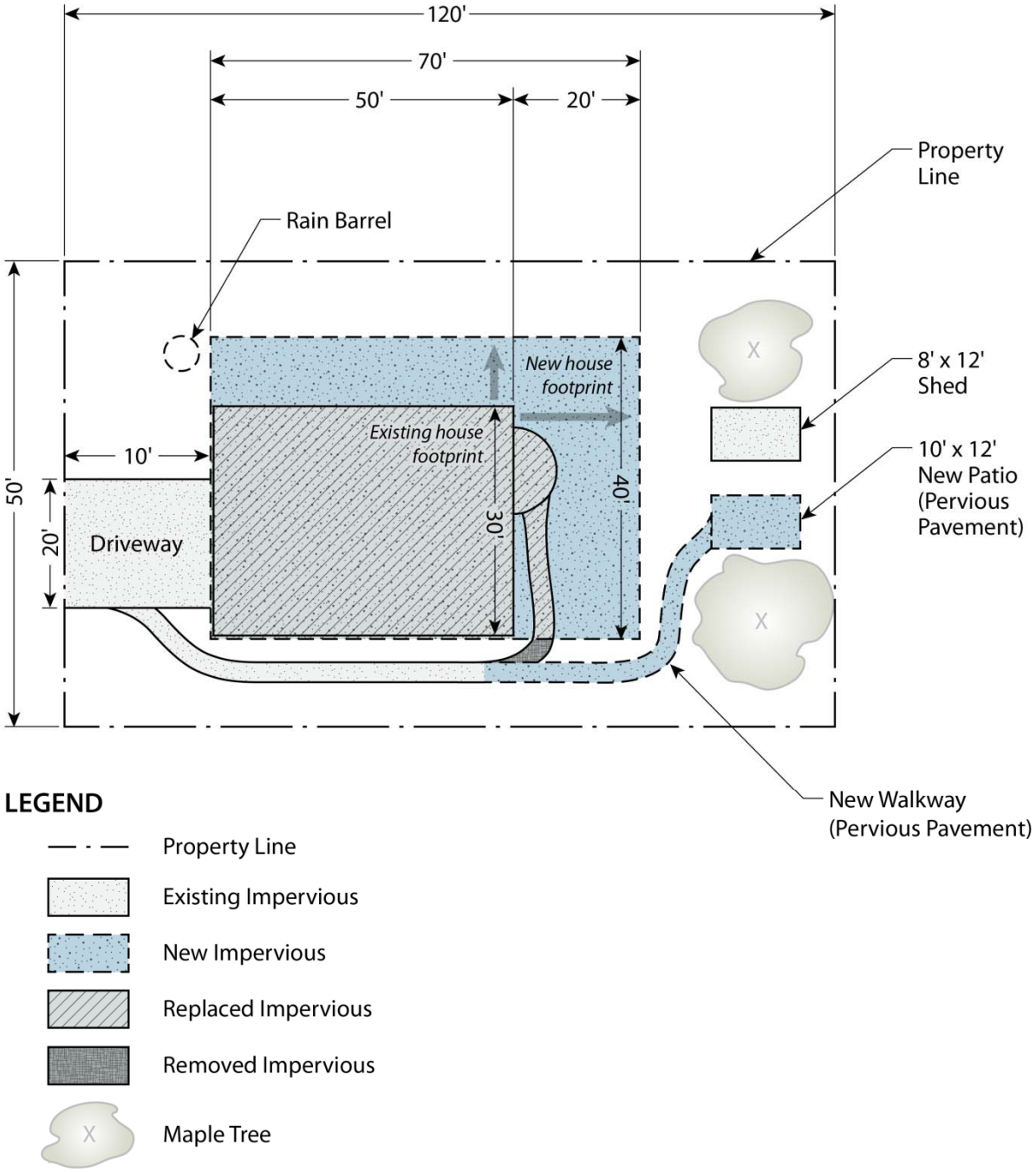

Figure 5. Existing and Proposed Site Layout.

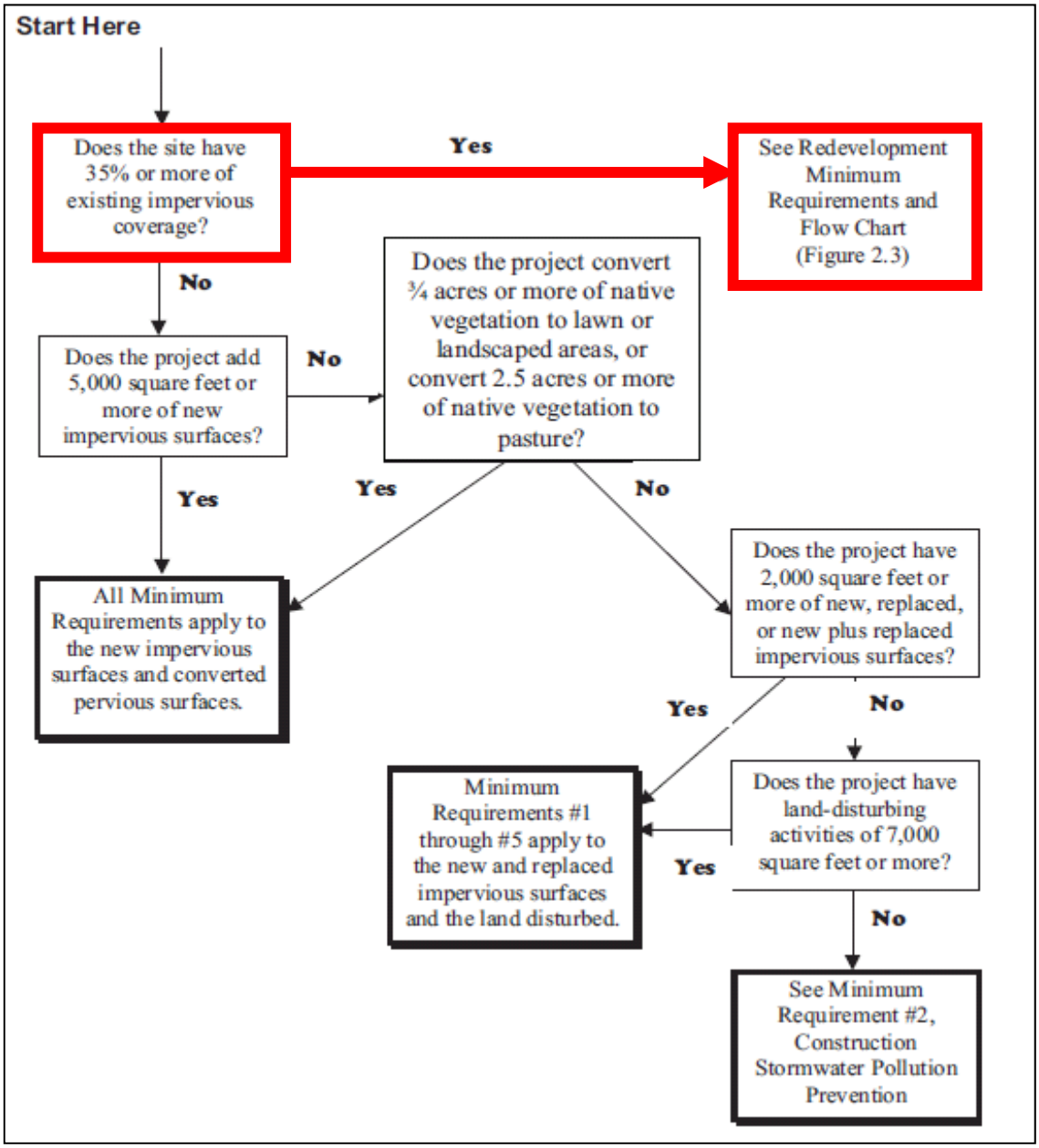

Figure 6. Redevelopment requirements for the example project.

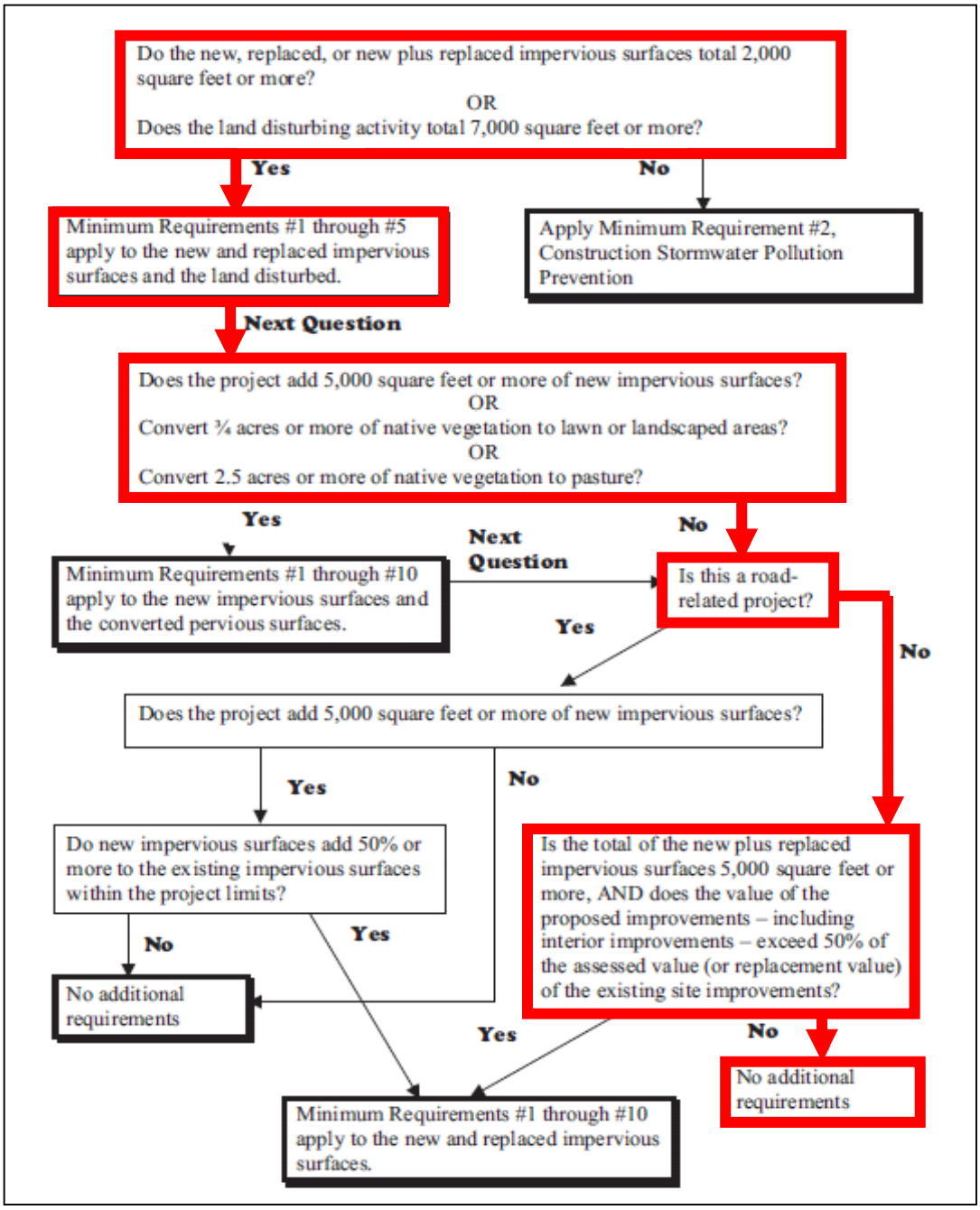

Figure 7. Flow chart for determining requirements for redevelopment.

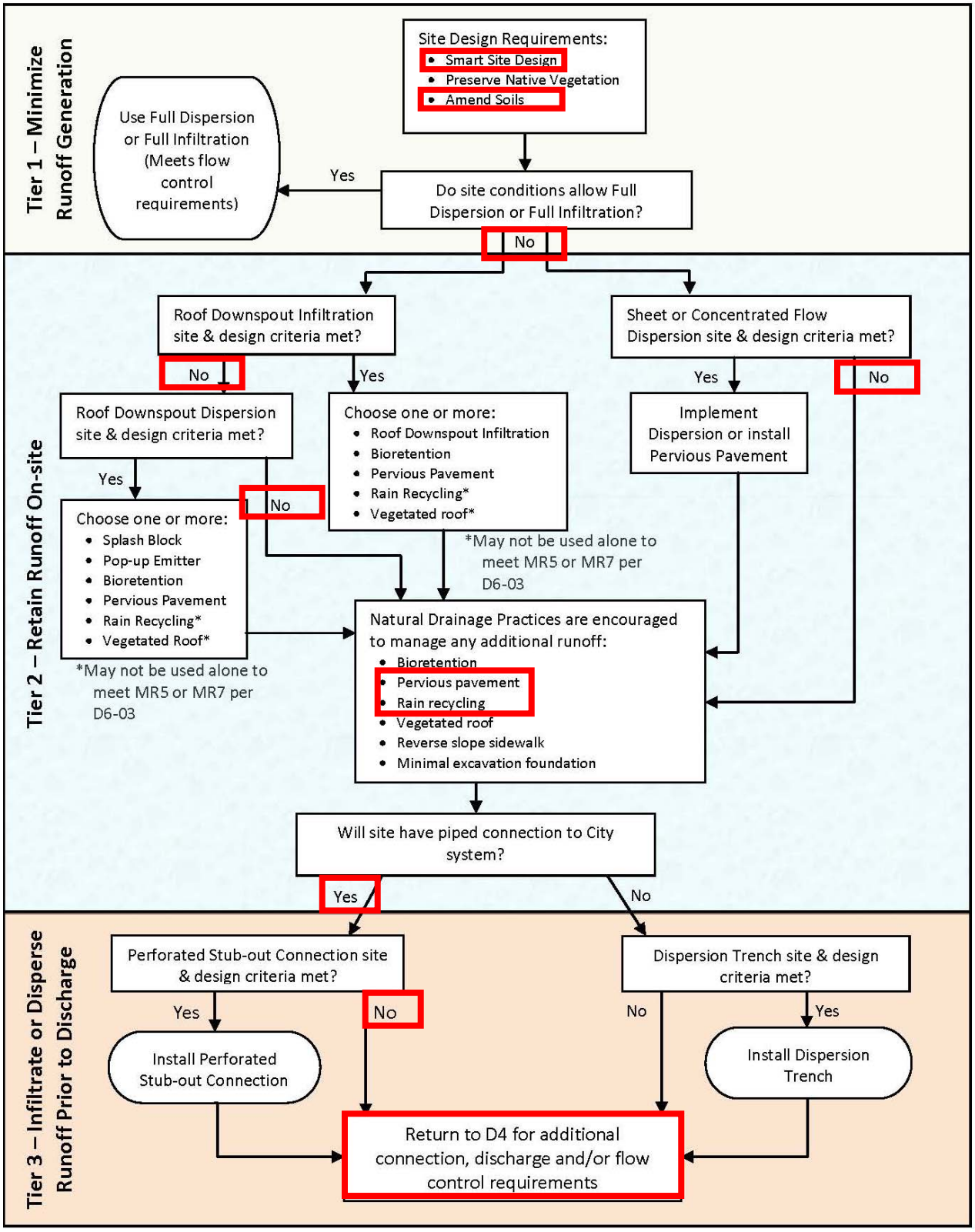

Figure 8. Flow Chart for Selecting On-Site BMPs (from Figure 6.1 in the SWES).