SCRIBER CREEK
CORRIDOR MANAGEMENT PLAN
STATE ROUTE 99 TO SCRIBER LAKE

SCRIBER CREEK, LYNNWOOD, WASHINGTON

Prepared for
City of Lynnwood

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

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ACKNOWLEDGEMENTS

This Corridor Management Plan was adopted by the Lynnwood City Council on November 16, 2016. This plan represents an updated surface water management strategy for the corridor of Scriber Creek between State Route (SR) 99 to the north and Scriber Lake to the south, and builds upon recommendations for addressing flooding problems included in the City of Lynnwood Surface Water Management Comprehensive Plan prepared in 2009. This Corridor Management Plan was produced through the combined efforts, ideas, and cooperation of Lynnwood citizens and the following City staff and appointed and elected officials.

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Nicola Smith, Mayor
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Benjamin Goodwin, Council Vice President
Ian Cotton, Councilmember
George Hurst, Councilmember
Ruth Ross, Councilmember
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Chris Nyhus, Business Owner
Matt Pease, Business Owner
David Plodwick, Citizen
Ed dos Remedios, Citizen
Roz Smith, Casa Del Rey Condominiums
Eric Whitehead, Casa Del Rey Condominiums

ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
CIP	Capital Improvement Program
City	City of Lynnwood
CMP	corrugated metal pipe
Ecology	Washington State Department of Ecology
GIS	geographic information system
Herrera	Herrera Environmental Consultants, Inc.
HPA	Hydraulic Project Approval
HPSF	Hydrological Simulation Program-FORTRAN
LMC	Lynnwood Municipal Code
LWD	large woody debris
NPDES	National Pollutant Discharge Elimination System
SEPA	State Environmental Policy Act
SR	State Route
USACE	US Army Corps of Engineers, Seattle District
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife

EXECUTIVE SUMMARY

Scriber Creek is one of the main drainages in Lynnwood, Washington. The corridor of Scriber Creek between Scriber Lake and State Route 99 (the planning corridor), which is the subject of this Corridor Management Plan, has experienced repeated and significant flooding for several decades, resulting in severe impacts on private residences, businesses, streets, and other public infrastructure. The City of Lynnwood 2009 Surface Water Management Comprehensive Plan (2009 Comprehensive Plan) identified several creek culvert replacements as a partial solution to flooding problems in the planning corridor. However, the 2009 Comprehensive Plan also recognized that further hydraulic and geomorphic analysis would be needed to ensure that conveyance improvements in the planning corridor would not exacerbate peak flows downstream of the planning corridor.

The primary goal of this Corridor Management Plan is to define a proposed sequence for implementing projects through the planning corridor that collectively improve upon existing flooding conditions while not worsening flooding conditions downstream of Scriber Lake.

This plan represents the culmination of two phases of work. The first phase focused on public engagement, project planning and project chartering. Results of Phase 1 guided the Phase 2 effort, which was devoted to engineering analysis of the existing flooding and sedimentation problems, and development and evaluation of flood reduction alternatives. A consultant team, led by Herrera Environmental Consultants, Inc. (Herrera) and supported by subconsultants (Louis Berger, Triangle Associates, HWA GeoSciences, and AHBL), assisted the City of Lynnwood (the City) in the analyses, documentation, and public and stakeholder involvement completed for this plan

This Corridor Management Plan includes five main sections:

- Advisory Committee Coordination and Outcomes
- Existing Corridor Conditions Characterization
- Development and Evaluation of Flood Reduction Modeling Scenarios
- Flood Reduction Alternatives Evaluation
- Recommended Plan for Flood Reduction

Each section is summarized below.

Advisory Committee Coordination and Outcomes

Phase 1 involved developing a project charter to guide the City's work in the planning effort, convening an advisory committee to help shape the flood reduction alternatives to be evaluated in Phase 2, and beginning to compile and analyze available information that would be used in Phase 2. The Advisory Committee's input confirmed that persistent flooding problems exist throughout the planning corridor. It also guided development of a suite of recommended flood reduction alternatives for further technical analysis and advancement, listed in Table ES-1.

Table ES-1. Advisory Committee Recommended List of Flood Reduction Alternatives for Future Evaluation.

Recommendation #1: Regional flood storage site at Edmonds School District property.
Recommendation #2: Culvert replacements and channel improvements at Casa Del Rey.
Recommendation #3: Increased flood storage at Scriber Lake.
Recommendation #4: Hydraulic model evaluation of flood prone properties and necessary culvert replacements.
Recommendation #5: SW 196th Street culvert replacements.
Recommendation #6: Increased flood storage upstream of 188th Street SW.
Recommendation #7: Raised and/or replaced portions of Old 196th Street SW, associated driveways, and bridges.
Recommendation #8: Development of a comprehensive and continuous sediment removal program.

Existing Corridor Conditions Characterization

Phase 2 began with research, modeling, and analysis pertinent to understanding existing conditions. The effort included hydrologic and hydraulic modeling and geomorphic evaluation of current flooding and sedimentation problems. The existing conditions characterization illustrated the following key findings.

- The Old 196th Street SW Bridge has less than a 10-year level of protection.
- The crossing at the driveway near Great Floors has less than a 100-year level of protection, and the driveway at Casa Del Rey Condominiums a short distance upstream has less than a 10-year level of protection.
- With the exception of 191st Street SW, which has less than a 25-year level of protection, the crossings at 190th, 189th and 188th Streets SW all have less than 10-year levels of protection. In addition, the hydraulic analysis indicates significant overbank flooding between 191st Street SW and 188th Street SW.
- At Flynn's Carpet Cents upstream of 188th Street SW and near State Route (SR) 99, the creek overtops its banks in the 10-year flood event, causing flooding of adjacent areas. Topographic contours in available mapping indicate the out-of-bank flood flows would move south on the east side of SR 99 and flood the parking lot to the south of Flynn's Carpet Cents.

- The planning corridor is underlain by a sequence of glacial till and glacial outwash soils with recent, non-glacially consolidated deposits, primarily consisting of artificial fills, alluvial silts, sands, and peats, overlying the glacial deposits. Geotechnical investigations at the City property north of 188th Street SW and the Edmonds School District Property both encountered groundwater elevations that echoed adjacent stream water surface elevations. Soils in these two locations are expected to be suitable for permanent slopes of 3H:1V (horizontal to vertical). A review of existing information and previous borings taken in the 196th Street SW vicinity confirmed the presence of compressible soils and peat of varying thickness, suggesting that future projects would need to consider deeper foundations, lighter fill material, or anticipate settlement from additional fill placement.

- Despite its built-out watershed, the Scriber Creek corridor continues to receive sediment supply and experiences excessive sediment deposition upstream of several undersized culverts, further exacerbating flooding conditions. The sediment mobility model estimated that only sediment of a size equal to or smaller than fine sand is continuously mobile through the planning corridor, and then likely settles out in a depositional area downstream of the Old 196th Street Bridge and upstream of the twin 196th Street SW culverts. The depositional trend of sediment deposition upstream of the 196th Street SW culverts was corroborated by field observations and feedback from City operations and maintenance personnel.

Development and Evaluation of Flood Reduction Modeling Scenarios

Guided by the Advisory Committee's recommendations and using the results from the existing conditions analysis, the consultant team identified individual flood reduction projects and grouped them into modeling scenarios for the planning corridor. The scenarios were intended to represent a range of capital investment and implementation feasibility, and to enable an exploration of the impacts associated with incorporating conveyance and flood storage improvement projects throughout the corridor. Each modeling scenario includes conveyance improvement projects and at least one flood storage project to offset the effective loss of storage resulting from conveyance improvements. The team assessed the relative performance of each modeling scenario according to the primary goal of this plan. Several scenarios achieved the goal using alternative strategies of culvert replacements or property acquisitions of flood-prone areas. Although all scenarios improved flooding conditions at 188th Street SW, none could reduce the overtopping frequency there to less frequent than a 25-year flood event without exacerbating flooding conditions elsewhere.

Analysis showed that conveyance improvement projects would reduce sediment accumulation upstream of replaced culverts and also upstream of 196th Street SW, although sediment accumulation would likely increase in new flood storage areas. Maintaining flood flow conveyance in the planning corridor over the long term is expected to require regular sediment management and maintenance in accumulation areas.

Flood Reduction Alternatives Evaluation

Four high-performing, modeling scenarios were selected for further evaluation according to six criteria developed with input from the Advisory Committee: community considerations, flood reduction performance, project cost, ease of construction/implementation, ease of maintenance, and habitat improvements. Two additional criteria deemed important for the City's interests were also used in the evaluation: ease of permitting, and life cycle and service life benefits. Upon completing the alternatives evaluation process, Alternative B+, was selected as the preferred flood reduction alternative. Alternative B+ modifies Alternative B (modeling scenario 2A) by adding a strategy for selective property acquisitions in the vicinity of identified flood control projects, if and when property owners are willing sellers. The preferred alternative achieves the flood performance objectives for a moderate investment, and scores "more favorable" or "average" on all evaluation criteria.

Recommended Plan for Flood Reduction

A recommended sequence for implementing the projects included in the preferred alternative was developed, and additional considerations for funding and public coordination were identified and described. One significant outcome of this plan was the conclusion that a long-term, effective, and cost-efficient approach to alleviating flooding and sedimentation problems cannot rely on one or two individual projects. Therefore, this plan recommends a phased approach that includes a combination of flood storage and conveyance improvements, coupled with strategic property acquisitions from willing sellers of flood-prone properties, as the best strategy for addressing the chronic flooding problems in the planning corridor.

The specific projects included in this plan, identified in Table ES-2, will yield direct flood benefits. They can be implemented over time as capital funding is available, and as specific project-level engineering analysis, design, permitting, and easement negotiations are completed.

Table ES-2. Recommended Project Implementation for the Planning Corridor.				
Project No.	**Recommended Implementation Order**	**Total Project Cost**	**Annual O&M**	**Project Description**
2	3	$320,000	$3,320	Remove Diversion Structure and Oil/Water Separator downstream of 196th Street SW
4	2	$450,000	$800	Raise Old 196th Street SW
5	2	$440,000	$1,080	Parkview Plaza Culvert Replacement
6	2	$630,000	$900	Scriber Creek Culvert Replacement at Casa Del Rey Condominiums Driveway
8	*Programmatic*	$1,900,000	$2,860	*Acquire Frequently Flooded Properties between 188th Street and 191st Street*
9a	6	$510,000	$900	Replace 191st Street SW Culvert
9b	6	$660,000	$900	Replace 190th Street SW Culvert
9c	6	$550,000	$900	Replace 189th Street SW Culvert
10	1	$380,000	$360	188th Street SW Flood Wall
11	4 or 5	$640,000	$1,030	Maximize off-channel Storage on the property north of 188th Street SW
12	4 or 5	$210,000	$400	Install small berms near Eunia Plaza and Flynn's Carpet Cents
		$4,800,000	**$11,000**	**Total Cost Without Acquisitions**
		$6,700,000	***$14,000***	***Total Cost With Acquisitions***

INTRODUCTION

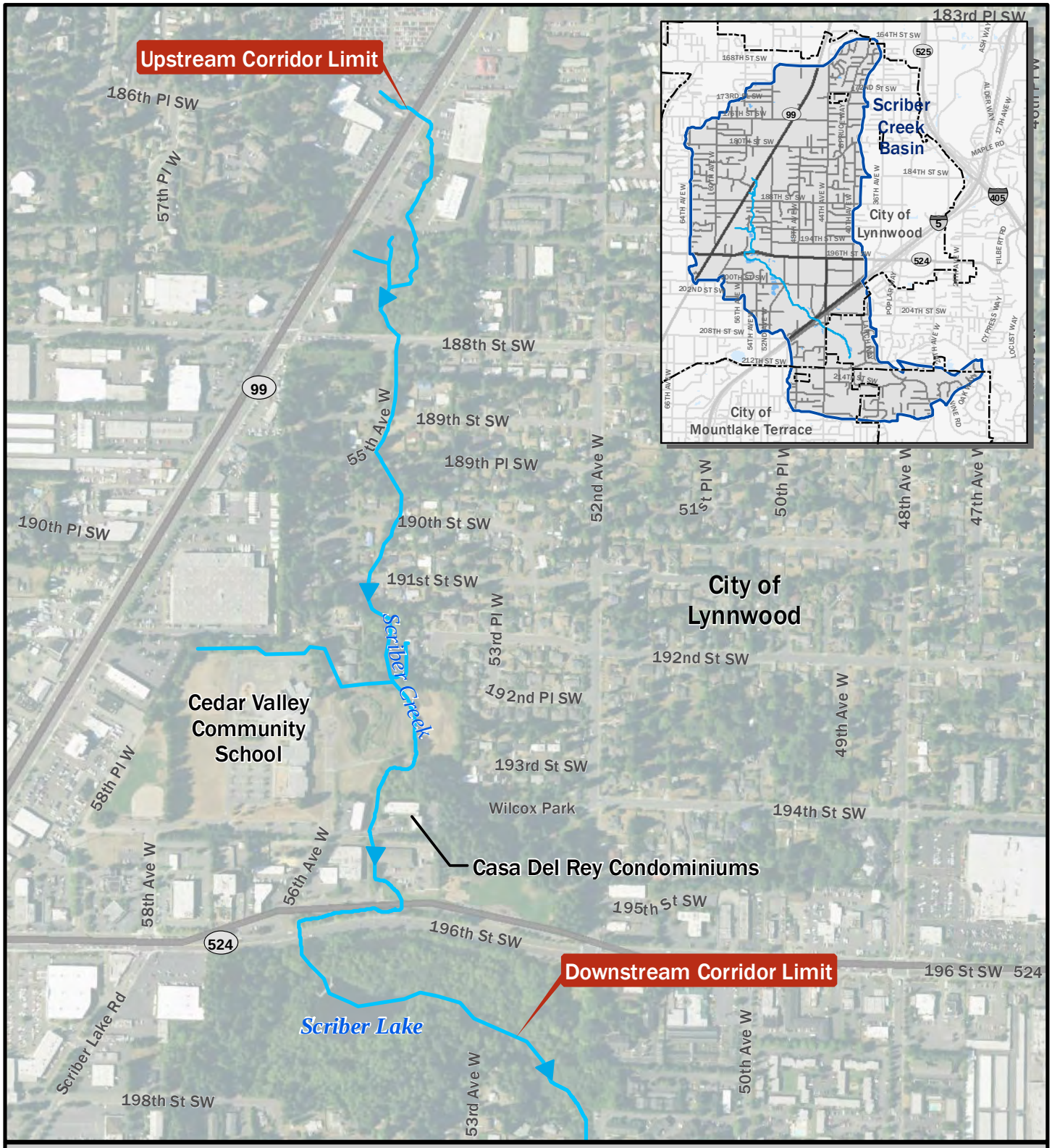
Much of the southern portion of Lynnwood drains to Scriber Creek. Scriber Creek is a tributary of Swamp Creek, which drains to the north end of Lake Washington. The Scriber Creek basin is densely developed with residential, commercial, transportation, and light industrial land uses. Because much of that development occurred prior to strict stormwater management regulations, increased stormwater runoff has resulted in flooding as a recurring problem in parts of the basin for several decades (R.W. Beck 1989, Herrera 2009a).

This Corridor Management Plan (this plan) for the reach of Scriber Creek between Scriber Lake and State Route (SR) 99 (the planning corridor) was developed to guide the City of Lynnwood (the City) in implementing a long-term, effective, and cost-efficient approach to alleviating flooding and sedimentation problems within the planning corridor. This plan documents public and stakeholder involvement, as well as the analyses of flooding and sedimentation under existing and potential future conditions. It also provides a recommended sequence of flood reduction actions and a description of funding options and recommendations, and it suggests future interactions with stakeholders and the public that will be needed as the City implements the recommendations in this plan. Funding for this plan was provided by the Surface Water Utility Fund 411 budget.

PLANNING CORRIDOR

The planning corridor is entirely within Lynnwood jurisdiction. It includes the reach of Scriber Creek between Scriber Lake to the south and SR 99 to the north, as shown on Figure 1, and areas that lie within or are adjacent to the Scriber Creek floodplain. Much of the adjacent area is developed with businesses, a school, street rights-of-way, and residential neighborhoods.

Starting at the upstream end of the planning corridor at SR 99 and moving downstream, Scriber Creek flows past several businesses, including Flynn's Carpet Cents (Flynn's Carpets) and Eunia Plaza, before entering a vacant parcel north of 188th Street SW that is owned by the City of Lynnwood Parks Department and includes a wetland mitigation site adjacent to the creek. Downstream of 188th Street SW, Scriber Creek passes through a residential area and is conveyed through several small, residential roadway culverts before entering another City-owned riparian enhancement area, roughly located between 191st Street SW and 192nd Place SW. Continuing along its southerly course, Scriber Creek flows through another vacant parcel near 56th Avenue W and 193rd Place SW that is part of the Cedar Valley Community School property owned by the Edmonds School District. Farther south, the creek flows within an extremely confined floodplain as it is conveyed through the Casa Del Rey Condominiums property, and between the businesses at Parkview Plaza and Great Floors. The creek is forced to make 90-degree turns as it passes under the Old 196th Street Bridge and the twin 196th Street SW (State Route 524 [SR 524]) culverts before entering the northwest corner of Scriber Lake.



Legend

- Scriber Creek Basin Boundary
- Scriber Creek

Figure 1.
Vicinity Map for the Scriber Creek Planning Corridor: State Route 99 to Scriber Lake.

N

0 300 600 1,200 Feet

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Problem Statement

The portion of the Scriber Creek basin contributing drainage to the planning corridor has undergone significant development and land use change since Lynnwood was incorporated in 1959 (Puget Sound Regional Council 2008). As much of this development occurred prior to strict stormwater management regulations and other development regulations affecting environmental conditions near the creek, flooding has plagued the Scriber Creek planning corridor for several decades. The flooding problems have taken the form of standing water in public rights-of-way, stream flooding over arterial and residential streets, and stream flooding that affects private property. Figure 2 identifies some of the major problems that have been identified in the Scriber Creek planning corridor during flood response, stormwater maintenance, field observations, and hydrologic modeling efforts described in previous studies (Herrera 2009b).

The City of Lynnwood 2009 Surface Water Management Comprehensive Plan (2009 Comprehensive Plan) identified several creek culvert replacements as a partial solution to reducing flooding within the planning corridor. However, without also providing additional flood storage, those conveyance improvements would potentially induce increased flows downstream of the planning corridor, worsening flooding problems downstream.

Goals and Objectives

The primary goal of this plan is twofold: to reduce flood risks within the planning corridor without worsening flooding conditions downstream of Scriber Lake. To accomplish this goal, the planning effort for this Corridor Management Plan included three key objectives:

1. Conduct a more focused analysis of flooding and potential flood improvements within the planning corridor.

2. Work with the community to gain further information about flooding issues and to solicit their input on potential improvements within the planning corridor.

3. Develop a practical plan for implementing flood reduction projects.

The objectives were intended to ensure that this Corridor Management Plan for Scriber Creek could function as a guidance document for the City. Additionally, these objectives are intended to guide this plan to include a clear list of projects and associated costs, propose a project implementation order, and support the City moving directly toward implementation of projects that reduce flooding problems in the planning corridor.

Public and Stakeholder Involvement

Because the flooding problems within the planning corridor have historically affected both public and private properties, the City made a concerted effort to collaborate with affected land

owners, residents, businesses, and other interested parties to identify specific flooding problems (primarily during Phase 1 of the planning effort) and to evaluate a range of solutions (primarily during Phase 2 of the planning effort). On January 15, 2014, City of Lynnwood Mayor Nicola Smith authorized the formation of the Scriber Creek Flood Reduction Advisory Committee (the Advisory Committee). The Advisory Committee's purpose was twofold:

1. Document where community members have seen flooding and the severity of that flooding.

2. Collaborate with the City and technical consultant team to identify and provide community perspectives on the plan's flood reduction goals and objectives, flood reduction alternatives, alternative evaluation criteria, and recommendations to be carried forward during the process of project planning and implementation.

The City sought advice and innovation from the Advisory Committee, which met six times between March 2014 and March 2016 while this plan was being developed. The Advisory Committee's input was incorporated into the decision-making process and this plan to the maximum extent feasible.

Document Organization

The remainder of this document is divided into five main sections:

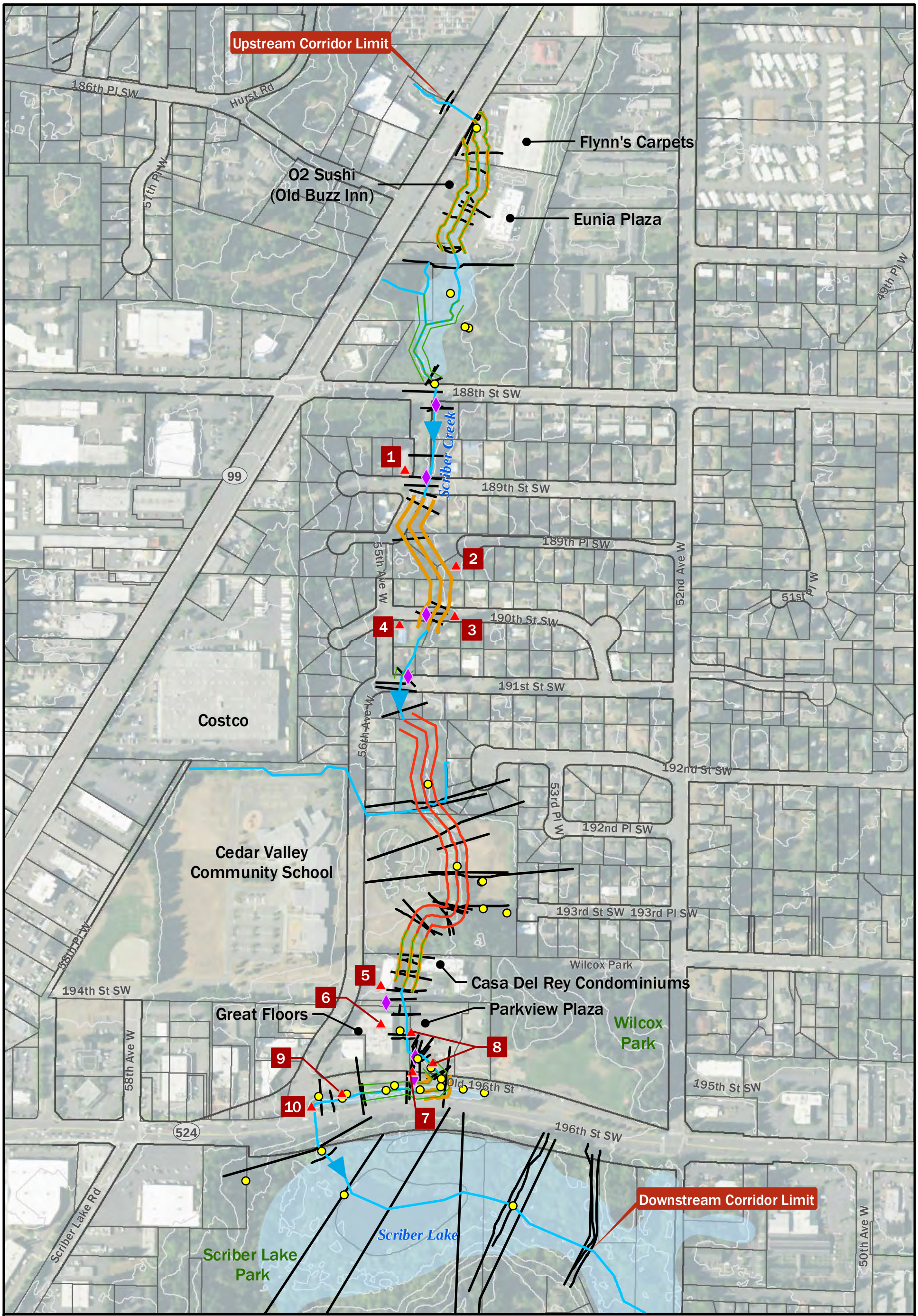
- **Advisory Committee Coordination and Outcomes**, which summarizes Advisory Committee feedback obtained during the first phase of Corridor Management Plan development and the Advisory Committee's preferred suite of flood reduction alternatives, which set the stage for the Phase 2 evaluation.

- **Existing Corridor Conditions Characterization**, which outlines background information pertinent to understanding existing conditions, and provides highlights from the hydrologic and hydraulic modeling and geomorphic evaluation of current flooding and sedimentation problems.

- **Development and Evaluation of Flood Reduction Modeling Scenarios**, which describes the identification and grouping of individual flood reduction projects into modeling scenarios for the planning corridor and assesses their relative performance according to the primary goal of this plan.

- **Flood Reduction Alternatives Evaluation**, which describes the approach developed and criteria used in evaluating the flood reduction alternatives, as well as the City's process for selecting a preferred alternative.

- **Recommended Plan for Flood Reduction**, which includes a recommended sequence for implementing the projects included in the preferred flood reduction alternative and describes additional considerations for funding and public coordination.



Legend

- Flood observation by Advisory Committee (2014)
- 6 — Flood observation site number (see Table 1)
- 2015 Field Recon Locations
- Flooding problems identified by City (Herrera 2009a)
- 2015 aggrading channel
- 2009 aggrading channel
- 2009 eroding channel
- Cross-section
- Scriber Creek
- Snohomish County wetland
- 10-ft contour
- ROW
- Parcel

Figure 2.
Identified Existing Flooding and Sediment Problems in the Scriber Creek Planning Corridor.

N

0 160 320 640 Feet

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ADVISORY COMMITTEE COORDINATION AND OUTCOMES

During the initial stakeholder involvement and data gathering portion of the planning effort (Phase 1), the Advisory Committee met four times (for a combined 120 person-hours) to identify a suite of flood reduction projects that warranted thorough evaluation by the City. During their meetings, Advisory Committee members provided the City's planning team with narrative input about past flood events in the planning corridor; identified collective goals, objectives, and criteria for the planning effort; and outlined a preferred suite of flood reduction projects. The Advisory Committee compiled its recommendations in a report to the Lynnwood City Council, which is included in Appendix A.

Flooding Observations

During the Advisory Committee meetings, members provided information about the specific locations and timing of past flooding observations in the planning corridor. The information was important for developing a better understanding of the challenges facing flood reduction endeavors as well as for calibrating the hydraulic modeling, which is described later in this document. Flooding locations observed by the Advisory Committee members are shown in Figure 2 and described in Table 1; more detail is provided in the committee's full report (Appendix A). The photos below, provided by members of the Advisory Committee, illustrate conditions in two of the flooding locations.

Left photo: Roadway and residential flooding near the intersection of 55th Avenue W and 189th Street SW on November 19, 2012 (Site 2 in Figure 2; Table 1). Right photo: floodwaters overtopping the Casa Del Rey Condominiums roadway culvert on December 3, 2007 (Site 5 in Figure 2; Table 1).

Table 1. Flood and Sediment Observations Identified by the Advisory Committee.			
Site Number	**Site Location**	**Timeframe**	**Observations**
1	Northwest corner of 55th Avenue W and 189th Street SW	2012	Flooding of the garage and above the finished floor.
2	West end of 189th Place SW	2006	Flooding up to the back of the house.
3	Portions of the channel in the vicinity of 190th Street SW	On occasion	Rock armoring has been observed to be picked up by turbulent flood water and carried downstream.
4	Intersection of 190th Street SW and 55th Avenue W	More frequently than 2006 flood	Intersection floods more frequently than flooding of adjacent parcels.
4	Southeast corner of the intersection of 190th Street SW and 55th Avenue W	2006	The parcel at the southeast corner of the intersection was flooded above the finished floor.
4	Three parcels in the Brookmoore Estates development at the west end of 192nd Street SW	Up to 2014	Creek flooding has not affected the three parcels.
5	Casa Del Rey Condominiums	December 2007 flood event	The access road on the south side of the Casa Del Rey property was significantly overtopped, and vehicles could not pass through that area. The East building had flooding in the first floor hall and in the units, especially in the northwest Unit #110, which has severe flood damage from water that came from the property to the north through the fence. Additionally, during this flood, the roof gutters were unable to drain into the creek as they normally do, thus causing severe water leaks at every non-sealed joint.
5	Casa Del Rey Condominiums – Edmonds School District Detention Pond	During heavy rain events	Committee members from Casa Del Rey expressed that they do not think the Edmonds School District detention pond is working like it is supposed to.
5	Casa Del Rey Condominiums – storm drain emanating from the west that directs flow to the creek with an outlet along the north side of the Edmonds School District stormwater pond	During heavy rain events	When it rains hard, the storm drain "shoots" flow out under pressure.
5	Casa Del Rey Condominiums – storm drain emanating from the west that directs flow to the creek with an outlet along the north side of the Edmonds School District stormwater pond	Storm events that cause Scriber Creek to flood	When there is a flood event in the creek, the flow coming out of the storm drain wraps around the stormwater pond (between creek and stormwater pond), and does not enter the creek until it gets closer to Casa Del Rey. The pond outflow combines with overbank creek water and the aforementioned storm drain flow is a sheet of water as it flows over the floodplain toward Casa Del Rey.

Table 1 (continued). Flood and Sediment Observations Identified by the Advisory Committee.			
Site Number	**Site Location**	**Timeframe**	**Observations**
5	Casa Del Rey Condominiums – Scriber Creek channel approaching Casa Del Rey from upstream	Storm events that cause Scriber Creek to flood	When the creek is running high, the zigzag alignment of the creek channel approaching the Casa Del Rey fence line gets bypassed and the flow takes a wide diagonal swath/approach to Casa Del Rey.
5	Casa Del Rey Condominiums	November 2012	No overbank flooding here when significant flooding occurred upstream in the planning corridor.
6	Great Floors and Parkview Plaza Business Park	Up to 2014	Scriber Creek flooding has not been above the Great Floors finished floor elevation.
6	Great Floors and Parkview Plaza Business Park – building west of Great Floors	Up to 2014	This building has not been flooded above the finished floor but has been subject to sanitary sewer backups.
6	Great Floors and Parkview Plaza Business Park-upstream of the Old 196th Street SW Bridge	During high flows	The creek jumps out of the bank and into the Great Floors detention pond; from there, it spills onto Old 196th Street SW.
7	Old 196th Street SW, downstream of Parkview Plaza	December 2007 flood event	A high water mark was mentioned as water up to the second board of the Old 196th Street SW Bridge.
7	Old 196th Street SW, downstream of Parkview Plaza	Very frequently and not just during big storms	Old 196th Street SW is inundated.
8	Scriber Creek from upstream of the Old 196th Street SW Bridge, including the short section of channel within the business park and the section of channel paralleling 196th Street SW	By 2014	There is chronic sediment buildup.
9	Between the Old 196th Street SW Bridge and the culverts under 196th Street SW, where the creek flows west, parallel to the roadway	By 2014	Mitigation planting was done along the channel for the upstream regional detention pond project. The planting is overgrown and there is concern that it negatively affects the stream conveyance capacity.
10	Upstream end of the 196th Street SW culverts	By 2014	Culvert inlets may have settled to the extent that they are now at reverse grade and are negatively affecting conveyance capacity.

Recommended Projects for Flood Reduction Alternatives

Informed by the observations listed in Table 1, the Advisory Committee outlined community preferences for alternatives to be evaluated for the purpose of addressing flooding from Scriber Creek, as described in the committee's report to Lynnwood City Council (Appendix A). Table 2 presents the Advisory Committee's list of flood reduction alternatives, according to priority.

Table 2. Advisory Committee Recommended List of Flood Reduction Alternatives for Future Evaluation.
Recommendation #1: Regional flood storage site at Edmonds School District property.
Recommendation #2: Realign the culvert beneath the Casa Del Rey access roadway and improve the channel between Casa Del Rey and 196th Street SW.
Recommendation #3: Increase flood storage at Scriber Lake and reconfigure lake inlet and outlet controls.
Recommendation #4: Use a hydraulic model to evaluate flood prone properties at a specified level of service to determine where flood prone properties are both currently and if existing stream culverts are replaced. With this knowledge, the City can consider buyouts of flood prone properties and/or incorporate distributed detention/storage ponds where possible, such as locating small storage ponds on the properties that may be bought out, or other available properties such as the school district open area (also listed as a separate measure above).
Recommendation #5: Replace the culvert(s) under SW 196th Street.
Recommendation #6: Raise the road or otherwise install a dam-type structure to allow deeper flood water ponding upstream of 188th Street SW and possibly excavate upland areas around the wetland to create more storage.
Recommendation #7: Raise portions of Old 196th Street SW and driveway access to Park View Plaza and Great Floors and/or remove the Old 196th Street SW Bridge.
Recommendation #8: Develop a continuous sediment removal program that would remove sediment deposition before, during, and on an ongoing basis after construction. This effort can be combined with channel stabilization measures to help reduce the source of sediment deposition.

Recommendations for Project Goals and Flood Reduction Alternative Evaluation Criteria

The Advisory Committee also discussed other goals for the planning corridor, including the following.

- Improved aesthetics
- Taking advantage of partnership opportunities with community groups and public agencies

- Returning the holistic functionality of the corridor, including a return to native vegetation
- Improving the quality of life for those living and working in the planning corridor

Further, the Advisory Committee identified numerous criteria for the initial assessment of potential flood reduction alternatives and aggregated the criteria into six categories. The criteria were later revisited and incorporated into the evaluation of flood reduction alternatives and, as discussed later in this report, assisted the City in selecting a preferred alternative. The six criteria categories were:

- Community considerations
- Flood reduction performance
- Cost
- Ease of construction/implementation
- Ease of maintenance
- Habitat improvements

EXISTING CORRIDOR CONDITIONS CHARACTERIZATION

To accurately represent the potential flood reduction and sedimentation improvements that could be achieved from implementing proposed alternative actions, the existing flooding and sedimentation conditions first had to be characterized. This section briefly describes the information reviewed and analyses completed in order to characterize existing corridor conditions.

STUDIES REVIEWED AND REFERENCED

Several prior studies and plans have documented basin conditions, as well as flooding and erosion problems, along Scriber Creek. Those documents were reviewed to better inform the Phase 2 analyses and to help determine additional information that might be needed to address data gaps. The following documents were reviewed as part of the background assessment and existing conditions characterization.

- Scriber Creek Flood Study at 50th Avenue W and 200th Street SW (SAIC 2012)
- City of Lynnwood 2009 Surface Water Management Comprehensive Plan (Herrera 2009a)
- Scriber Creek Flood Study, 188th Street SW to 44th Avenue W (Herrera 2009b)
- Scriber Lake Park Masterplan (DEA 2005)
- Swamp Creek Drainage Needs Report (Snohomish County 2002)
- City of Lynnwood Comprehensive Flood and Drainage Management Plan (R.W. Beck 1998)
- Swamp Creek Watershed Management Plan and Technical Supplement (Snohomish County 1994)
- Scriber Creek Floodplain Mapping Study (NHC 1990)
- Scriber Creek Watershed Management Plan (R.W. Beck 1989)

Historical Context

Scriber Creek and Scriber Lake are named after a Danish immigrant, Peter Schreiber, who homesteaded the land around the lake in the early 1890s (DEA 2005). Other homesteads followed in the early 20th century, but much of current-day Lynnwood began its development trajectory in the 1950s when the area began to change from a quiet rural community into the center for regional growth it is today.

The original Scriber Creek channel was modified to route the creek around properties and roadways. At the same time, development was occurring within the Scriber Creek floodplain and adjacent wetland areas. During construction of the 196th Street expansion by the Washington State Highway Commission in 1967, the embankment fill that was intended to float over the peat layer on a bed of "hog fuel" (wood fragments) and brush displaced the peat and sank below the level of Scriber Lake. The displaced peat encroached into Scriber Lake and reduced the lake area by approximately 50 percent and caused the formation of the "North Lagoon" that no longer had a surface water connection to the lake (DEA 2005). The historical photograph, below, shows the displaced fill encroachment in Scriber Lake.

Reconstruction of 196th Street SW in the 1960s displaced peat moved into Scriber Lake and created the North Lagoon (photo source: DEA 2005).

Scriber Creek is now a core part of the City's stormwater network and receives runoff from the highly urbanized SR 99 corridor. Due to the built-out nature of its historical floodplain, Scriber Creek lacks natural resiliency for attenuating peak stormwater runoff flows that occur in large

rain events. The 1998 Comprehensive Flood and Drainage Management Plan (R.W. Beck) was the first plan to propose more comprehensive flood, drainage, and stormwater management regulations and objectives for the City. After adopting that plan, the City constructed two regional stormwater facilities in 2000, one of which, the North Scriber Creek Detention Facility, is located upstream of the planning corridor in the Scriber Creek basin at 172nd Street SW, just west of SR 99.

Survey and Topographic Updates

Supplemental survey of selected areas was completed to provide new and/or updated geometry for modeling (e.g., stream cross-sections, and culvert and bridge dimensions) and base map information to supplement areas that had been surveyed previously for the 2009 Comprehensive Plan (Herrera 2009a). The supplemental survey data, combined with prior information, was also used for updating the hydrologic and hydraulic models described later in this report. The effort also included surveying approximate high water elevations, which were identified from photographs, provided by the Advisory Committee, that were taken during extreme storm events. The photographs are provided in Appendix B, and an updated survey base map is provided in Appendix C. The cross-section survey locations are shown in Figure 3. The vertical datum used for the survey is NAVD 88 (North American Vertical Datum of 1988).

Geotechnical Investigation

HWA GeoSciences, Inc. conducted a geotechnical investigation in order to evaluate subsurface conditions in two locations within the planning corridor and determine whether excavation for additional flood storage is possible in those locations. Results of the investigation were also considered when developing the individual projects, and associated cost estimates, to be included and evaluated in the flood reduction alternatives.

The geotechnical investigation included two borings in addition to a review of historical and recent geotechnical investigations done for other nearby projects. One boring was located about 200 feet north of 188th Street SW near its intersection with 55th Avenue W; the other was located in the playfield east of Cedar Valley Community School, about 100 feet east of Scriber Creek. The boring locations are shown on Figure 3.

Some of the most important findings of the geotechnical investigation are summarized below. The entire geotechnical report is included in Appendix D.

General Geology

Scriber Creek and Scriber Lake are in the north-central portion of the Puget Sound Lowland, an elongated topographic and structural depression that was shaped during several glacial advances of the Quaternary Period, and filled with alluvium (stream) and lacustrine (lake) sediments deposited by runoff from the eastern slopes of the Olympic Mountains and western

slopes of the Cascade Mountains between glacial advances. The Scriber Creek channel is a former glacial outwash channel, formed by glacial meltwater. Scriber Lake lies within a glacial depression that developed into a bog pond. However, unlike most bogs, Scriber Lake receives inflows from Scriber Creek. In general, the planning corridor is underlain by a sequence of glacial till and glacial outwash soils with recent, non-glacially consolidated, deposits overlying the till and outwash soils. As described in the geotechnical report (HWA 2016), the recent non-glacial sediments typically consist of artificial fills, alluvial silts, sands, and peats.

Subsurface Soil Conditions

The Scriber Creek planning corridor is underlain by three major soil series (NRCS 2015; HWA 2016):

- McKenna gravelly silt loam, 0 to 8 percent slopes, underlies the main drainage way. These soils have low permeability, with slow runoff, and only slight erosion hazards.

- Alderwood-Urban land complex, 8 to 15 percent slopes, underlies the west portion of the drainage with a moderate potential for erosion due to the slope; Alderwood-Urban land complex, 2 to 8 percent slopes, underlies the east portion of the drainage, with a slight potential for erosion due to the slope. These soils formed in glacial till (which is typically low permeability) but have been altered by urban development and are obscured by structures and pavement that hinder more precise identification.

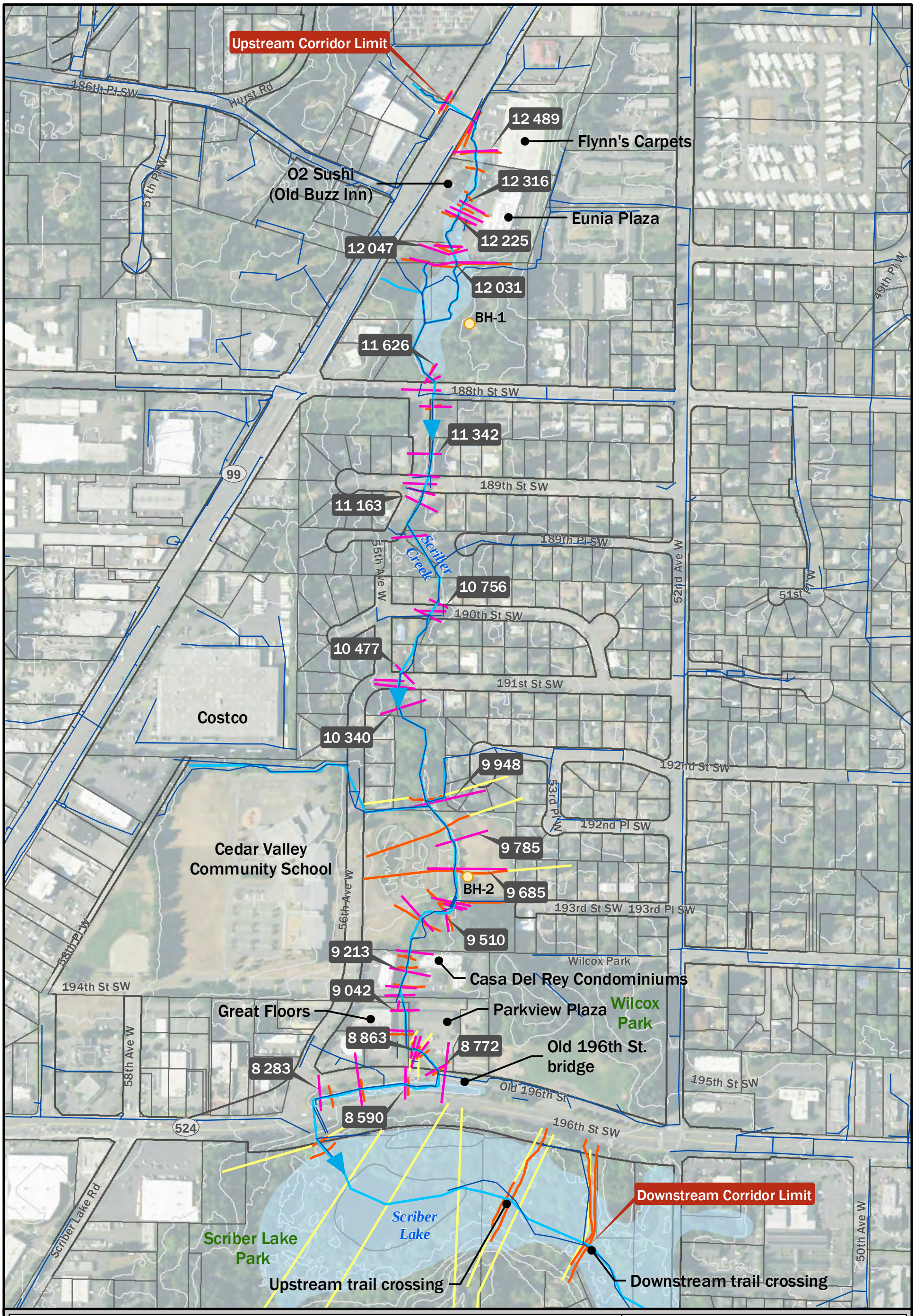
- Mukilteo Muck surrounds Scriber Lake. These soils are very deep, very poorly drained and form an organic material commonly referred to as peat (HWA 2016).

Review of the subsurface data collected from the two borings for this planning effort, described above, as well as the review of geotechnical studies from recent projects in the vicinity, yielded the following summary information for specific portions of the planning corridor. More detailed information is available in the geotechnical report in Appendix D.

- North of 188th Street SW: Varying thicknesses of fill were found to overlie alluvium and glacial till.

- Edmonds School District property at Cedar Valley Community School: Varying thicknesses of fill were found to overlie ablation till and glacial (lodgment) till.

- 196th Street SW and Scriber Lake: Varying thicknesses of fill were found to overlie varying thicknesses of peat that, in turn, overlies granular alluvium and/or outwash sands and gravels. North of the Old 196th Street SW Bridge, the peat layers below ground surface (bgs) were found to vary between 4 feet and 30 feet thick, with the thickness increasing towards the south. The thickness of peat layers was found to vary between about 21 feet at the west end of the bridge to about 7 feet at the east end of the bridge.



Legend

- Boring locations (HWA, 2016)
- Lynnwood storm network
- Surveyed cross-sections (Herrera, 2009b)
- Surveyed cross-sections (AHBL, 2015)
- GIS cross-sections and section extensions
- Cross-section
- 8 590 Cross-section label
- Scriber Creek
- Snohomish County wetland
- 10-ft contour
- Parcel

Figure 3.
Existing Conditions Analysis Updates for the Scriber Creek Planning Corridor.

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0 160 320 640 Feet

LYNNWOOD WASHINGTON

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Groundwater Conditions

Shallow groundwater was observed in nearly all subsurface explorations reviewed for this Corridor Management Plan. A monitoring well was installed in the borehole (BH-1) on the City-owned property north of 188th Street SW. Monitoring information from that well shows that the groundwater surface elevation fluctuates seasonally with the water level of Scriber Creek (see Appendix D).

Hydrologic and Hydraulic Model Updates

Louis Berger completed hydrologic and hydraulic analyses to support preparation of this Corridor Management Plan. This section briefly highlights some of the important aspects of the current conditions analyses. Complete documentation of the hydrologic and hydraulic analyses is included in Appendix E.

Hydrologic and Hydraulic Model Platforms

The hydrologic analysis for Scriber Creek was performed using the Hydrological Simulation Program-FORTRAN (HSPF) model developed by the US Environmental Protection Agency (US EPA 1989, Louis Berger 2016). The hydraulic analysis was performed using HEC-RAS, a one-dimensional step backwater computer model developed by the US Army Corps of Engineers (USACE 2010, Louis Berger 2016). HEC-RAS simulates stream water surface elevations for various flow rates taking into account losses from channel friction and stream culvert crossings.

Existing Hydrologic Conditions

Hydrologic analyses were conducted to determine the creek flows for select storm events as well as the one-half-the-2-year, 2-year, 10-year, 25-year, and 100-year return-period storm events, and to provide flow input for the hydraulic modeling. Peak flow estimates and simulated water surface elevations for the November 2012 and the December 2007 storm events were used to validate the hydrologic and hydraulic analyses. The return-period storm events were used to assess the level of flood protection along the planning corridor and to generate channel flow velocities for the geomorphic and sedimentation analysis.

In order to conduct the hydrologic analyses and provide flows at specific points of interest in the planning corridor, the HSPF model for the 2012 Scriber Creek Flood Study (SAIC 2012) was updated. The City was particularly interested in determining flow inputs at these locations:

- Scriber Creek inflow to the wetland upstream of 188th Street SW
- Scriber Creek crossing of 188th Street SW
- Scriber Creek near Cedar Valley Community School

- Scriber Creek crossing of 196th Street SW
- Scriber Lake outlet

Subbasin delineations were, therefore, updated in order to provide flows at these particular locations. The subbasin delineations are shown in Appendix E. The HSPF model was also updated by extending the precipitation record through 2012. Once all HSPF model modifications were made, the model was run to extract the peak flows from the selected November 2012 and December 2007 storm events (shown in Table 3). The peak flows from those two events were input to the HEC-RAS model for validation. Once the hydraulic model was satisfactorily validated, the HSPF model was used to run a long-term flow simulation spanning the years 1948 through 2012. The validation of the hydraulic model is discussed in the subsequent section on *Existing Hydraulic Conditions*.

Table 3. HSPF Peak Flow Estimates for Selected Flood Events.

Subbasin/ Reach	Location	Simulated December 2007 Peak Flow (cfs)	Simulated November 2012 Peak Flow (cfs)
632	188th Street SW	134.0	125.0
630	Downstream side of Cedar Valley Community School	132.4	126.5
629	196th Street SW	133.8	131.0
628	SR 99 Subbasin	87.1	79.5
628+629	Scriber Lake Inflow	206.9	206.2
799[a]	Scriber Lake Outlet	181.0	169.4
625	200th Street SW	177.5	134.2
624	Interstate 5	188.9	145.2

[a] Scriber Lake is defined by Reach 799 in HSPF. There is no separate subbasin for Scriber Lake.

cfs = cubic feet per second

A Log-Pearson Type III flow frequency analysis was conducted on the HSPF-simulated annual peak flows following the protocol in the United States Geologic Survey Bulletin 17B ("Guidelines for Determining Flood Flow Frequency" 1982) to estimate peak flows with a recurrence interval of 2, 10, 25, and 100 years. Table 4 shows the resultant return-period flows at key locations.

Table 4. Peak Flow Estimates for Return-Period Storms Under Existing Conditions.						
Subbasin/ Reach	**Location**	**½-the-2-Year Peak Flow (cfs)**	**2-Year Peak Flow (cfs)**	**10-Year Peak Flow (cfs)**	**25-Year Peak Flow (cfs)**	**100-Year Peak Flow (cfs)**
631	188th Street SW	26.0	52.0	83.1	101.1	131.0
630	Downstream side of Cedar Valley Community School	26.7	53.4	82.8	98.7	123.9
629	196th Street SW	27.9	55.8	85.4	100.8	124.5
628	SR 99 Subbasin	20.0	39.9	69.3	86.1	113.6
628+629	Scriber Lake Inflow	47.9	95.7	154.7	186.9	238.1
799[a]	Scriber Lake Outlet	38.4	76.8	116.1	135.3	163.6
625	200th Street SW	32.7	65.4	102.0	119.7	145.4
624	Interstate 5	35.6	71.2	114.1	136.1	169.5

[a] Scriber Lake is defined by Reach 799 in HSPF. There is no separate subbasin for Scriber Lake.

cfs = cubic feet per second

Existing Hydraulic Conditions

The survey information gathered for the planning effort (see Figure 3) was used to update the HEC-RAS hydraulic model prepared for the 2009 Scriber Creek Flood Study (Herrera 2009b), which focused on the portion of the planning corridor between 188th Street SW and 44th Avenue W. Details of the hydraulic model updates are described in Appendix E.

Once the HEC-RAS model was updated, the peak flows from the December 2007 and November 2012 storm events (Table 3) were used to validate the analysis against photographic and anecdotal evidence provided by the City and the Advisory Committee. The hydraulic model validation is described in Appendix E. After necessary adjustments were made to the model, the simulated and observed surface water elevations corresponded well, indicating that the model provides a reasonably accurate representation of the existing creek system.

Existing Conditions Model Results

Using the validated hydraulic model, the one-half-the-2-year, 2-year, 10-year, 25-year, and 100-year water surface profiles were simulated using the return-period peak flows listed in Table 4. The water surface elevation results are presented in Table 5, and additional flood water surface elevation profiles are included in Appendix E. The tabulations and graphics illustrate the following key findings for existing conditions.

- The Old 196th Street SW Bridge has less than a 10-year level of protection. Flood flows at the bridge will tend to overtop the west bank of the channel upstream of the bridge first, and will flow over Old 196th Street SW at a low spot to the west of the bridge near Great Floors. As flows continue to increase, as occurred during the December 2007 storm event, the bridge will become inundated. See Photo 2 in Appendix E.

- The crossing at the driveway near Great Floors has less than a 100-year level of protection and the driveway at Casa Del Rey Condominiums has less than a 10-year level of protection. The backwater from the Casa Del Rey driveway crossing would cause floodwaters to reach a nearby patio in a 100-year event. However, the unusual configuration of the existing culverts at Casa Del Rey allows debris to partially or fully block the culverts, which further reduces the level of protection at Casa Del Rey.

- With the exception of 191st Street SW, which has less than a 25-year level of protection, the crossings at 190th, 189th and 188th Streets SW all have less than 10-year levels of protection. In addition, the hydraulic analysis indicates significant overbank flooding between 191st Street SW and 188th Street SW. The overbank flooding in this area includes:

    - Both the east and west banks of the channel between 191st and 190th Streets SW for the 25-year storm event.

    - Upstream of 190th Street SW, the west bank is overtopped in the 10-year storm event for the first 100 feet or so, and then the water surface profile transitions to overtopping the east bank in the 2-year event until it reaches 189th Street SW. Where 55th Avenue W parallels the creek north of 189th Place SW and downstream of 189th Street SW, the hydraulic analysis shows flows overtopping it for the 100-year event.

    - Between 189th Street SW and 188th Street SW, the hydraulic model shows the west bank, including 55th Avenue W overtopped in the 10-year event.

- At Flynn's Carpet Cents upstream of 188th Street SW and near SR 99, the creek overtops its banks in the 10-year event, causing flooding of adjacent areas. Topographic contours in available mapping indicate the out-of-bank flood flows would move south on the east side of SR 99 and flood the parking lot to the south of Flynn's Carpet Cents.

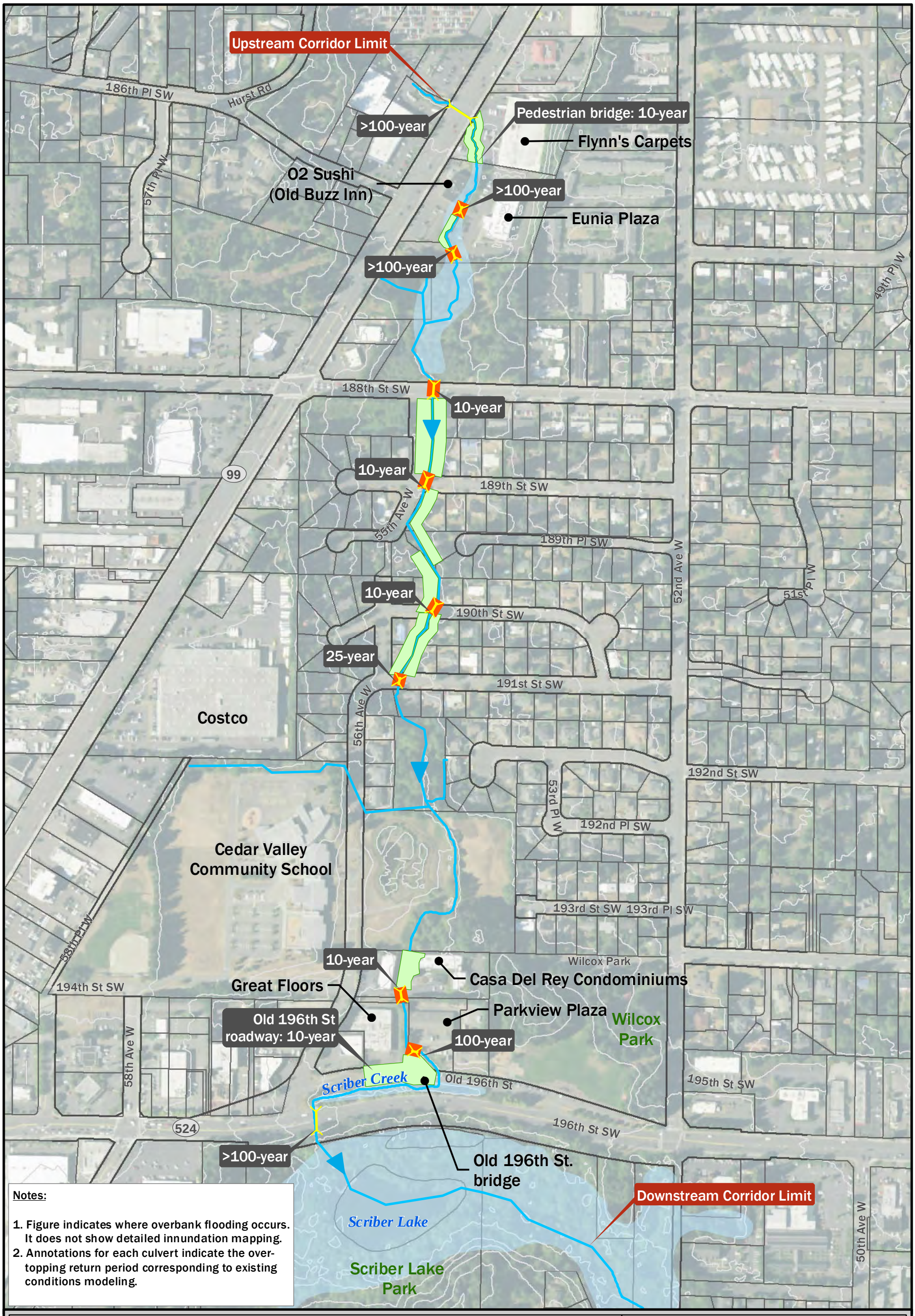
Figure 4 presents a summary of the creek culverts that overtop, as well as where more significant overbank flooding occurs according to the existing conditions modeling results. Table 6 presents a summary of average stream flow velocities at various locations for the various return-period flows modeled. This information is helpful for the sediment management assessment, described in the *Flood Reduction Alternatives Evaluation* section, below.

Table 5. Existing Conditions Hydraulic Model Results.

Location	Description	Crossing Top Elevation (feet)	Water Surface Elevation (feet) 1/2-Year	2-Year	10-Year	25-Year	100-Year	Overtopping Return Period	HEC-RAS December 2007 Water Surface Elevation (feet)	HEC-RAS November 2012 Water Surface Elevation (feet)	Overtopping/Flooding? December 2007	November 2012	December 2007 Surveyed High Water Elevation (feet)	November 2012 Estimated Water Surface Elevation[a] (feet)
Scriber Lake	Downstream trail crossing	337.51	336.96	337.91	338.75	339.11	339.44	2-Year	339.69	339.28	Yes	Yes		
Scriber Lake	Upstream trail crossing	338.27	337.35	338.17	338.9	339.21	339.53	10-Year	339.73	339.35	Yes	Yes		
196th Street SW	Twin 42″ x 68″ CMP arches	345.77	339.76	340.51	341.34	341.8	342.54	>100-Year	342.48	342.32	No	No		
Old 196th Street	Bridge	341	339.9	340.81	341.67	342.07	342.76	10-Year	342.7	342.56	Yes	Yes	Between 342.51 and 343.05[b]	
Driveway Culvert Near Great Floors	60″ dia. CMP	342.91	340.2	341.25	342.22	342.75	343.47	100-Year	343.45	343.34	Yes	Yes		
Casa Del Ray	Twin 42″ dia. CMP[a]	346.12	342.4	345.34	346.44	346.52	346.67	10-Year	346.7	346.71	Yes	Yes	346.86	
Roz Smith	Corner of patio[c]	n/a							346.71	346.71	Yes	Yes	346.73	
191st Street SW	48″ dia. CMP	357.24	354.39	355.51	356.74	357.37	357.57	25-Year	357.57	357.55	Yes	Yes		
190th Street SW	6′-W x 4′-H box culvert	357.1	355.04	356.07	357.33	357.55	357.73	10-Year[d]	357.73	357.72	Yes	Yes		357.6[e]
189th Street SW	42″ dia. concrete culvert	360.73	358.51	359.72	360.94	361.06	361.15	10-Year[d]	361.15	361.14	Yes	Yes		
188th Street SW	3′ dia. concrete culvert	363.14	360.67	362.07	363.46	363.6	363.73	10-Year[f]	363.72	363.68	Yes	Yes		
Driveway 1 near Flynn's Carpet Cents	Twin 4′ dia. CMPs	368.24	363.9	364.35	365.2	365.61	366.31	>100-Year	366.15	366	No	No		
Driveway 2 near Flynn's Carpet Cents	Twin 4′ dia. CMPs	368.29	365.34	366.04	366.71	367.12	367.87	>100-Year	367.68	367.52	No	No		
Bridge at Flynn's Carpet Cents	Pedestrian bridge	367.59	366.4	367.12	367.76	368.14	368.8	10-Year[g]	368.64	368.51	Yes	Yes	368.63[h]	
SR 99	8.5′-W x 4′-H box culvert	370.62	367.02	368.01	368.41	368.77	369.62	>100-Year	369.41	369.23	No	No		

CMP = Corrugated Metal Pipe
dia. = Diameter
W = Wide
H = High
WSE = Water Surface Elevation

[a] Culverts include a greater than 90-degree bend between the inlet and outlet. See Photo 1 in Appendix E.
[b] Between the curb and first railing on the bridge. See Photo 2 in Appendix E.
[c] See Photo 3 in Appendix E
[d] Overtopped 55th Avenue W to the west of the creek upstream of crossing.
[e] High water elevation estimated using GIS and photographs. See Photo 4 in Appendix E.
[f] Significant overbank flooding east of creek upstream of crossing.
[g] Significant overbank flooding to the west of creek upstream of bridge.
[h] See Photo 5 in Appendix E.



Notes:

1. Figure indicates where overbank flooding occurs. It does not show detailed innundation mapping.
2. Annotations for each culvert indicate the over-topping return period corresponding to existing conditions modeling.

Legend

- Roadway/driveway culvert
- Roadway/driveway culverts that overtop
- Stream bank overtopping
- Scriber Creek
- Snohomish County wetland
- ROW
- Parcel
- 10-ft contour

Figure 4.
Existing Conditions Hydraulic Model Stream Bank and Roadway Culvert Overtopping.

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Table 6. Existing Conditions Velocities for Return Period Storms.								
Model Subbasin/ Reach	From	To	Cross-Section	1/2 2-Year	2-Year	10-Year	25-Year	100-Year
				Velocity (ft/s)				
632	SR 99	Bridge at Flynn's Carpets	12489	2.70	3.22	3.43	3.22	2.7
631	Bridge at Flynn's Carpets	Driveway 2 near Flynn's Carpets	12316	3.30	3.50	3.62	3.61	3.44
630	Driveway 2 near Flynn's Carpets	Driveway 1 near Flynn's Carpets	12225	2.03	2.88	3.73	4.11	4.57
629	Driveway 1 near Flynn's Carpets	188th Street SW	11626	1.73	1.49	0.73	0.83	0.96
628	188th Street SW	189th Street SW	11342	1.34	1.20	1.14	1.27	1.47
628+629	189th Street SW	190th Street SW	11163	2.12	2.55	2.82	3.07	3.51
799[a]	190th Street SW	191st Street SW	10557	1.77	2.03	2.04	2.08	2.4
625	191st Street SW	Cedar Valley Community School	10340	3.26	3.59	4.06	4.33	4.69
			9965					
			9840					
			9679					
624	Cedar Valley Community School	Casa Del Rey	9510	3.35	3.37	2.75	3.07	3.5
			9413					
			9284					
			9213					
620	Casa Del Rey	Driveway Culvert Near Great Floors	9042	4.31	5.14	5.81	5.73	5.38
			8966					
615	Driveway Culvert Near Great Floors	Old 196th Street	8863	1.97	2.66	3.2	3.41	1.44
615	Old 196th Street	196th Street SW	8590	0.85	1.18	1.32	1.34	1.33
			8427					
			8283					
615	Scriber Lake	Scriber Lake	7271	0.72	0.59	0.42	0.39	0.36
615	Upstream Trail Crossing	Downstream Trail Crossing	7071	2.02	1.23	0.76	0.65	0.62

ft/s = feet per second

[a] Scriber Lake is defined by Reach 799 in HSPF. There is no separate subbasin for Scriber Lake.

GEOMORPHIC OBSERVATIONS

A basic geomorphic assessment was performed for the Scriber Creek planning corridor. The primary goals of the assessment were:

1. To provide sufficient information to inform the comparison of flood reduction alternatives (Herrera 2016) according to operations and maintenance efforts for sediment removal

2. To inform the City of Lynnwood as to whether sediment removal in and of itself could be beneficial for reducing flooding impacts

The geomorphic assessment expanded upon similar work previously completed for the Scriber Creek Flood Study (Herrera 2009b) as part of the City's Surface Water Management Comprehensive Plan update in 2008–2009 (Herrera 2009a). In the assessment done for this corridor plan, Herrera completed the following:

- A rapid assessment field reconnaissance of the Scriber Creek channel in the planning corridor to determine if sediment sources have changed since similar reconnaissance was performed in 2008 and to characterize the grain size of sediment in the channel bed.

- Spreadsheet calculations of sediment grain size mobility for a range of flows, allowing for estimation of whether changes in flow velocities and depths expected to result from specific flood reduction actions will encourage local-scale or greater sediment movement or deposition.

- A comparison of creek channel survey data collected in 2015 (AHBL 2015) with channel survey data from 2008–2009 (Herrera 2009b) to assess whether the channel bed has aggraded or incised at several locations in the corridor and the approximate amount of sediment accumulation or loss at those locations.

- A mapping comparison of field observations with the sediment mobility results for existing conditions and sediment transport capacity modeling results to identify locations of likely sediment deposition.

The highlights of the geomorphic analysis are presented in this plan, and the more detailed discussion of the analysis and findings is included in Appendix F.

Geomorphic Context and Rapid Field Reconnaissance Results

The results of the geomorphic and channel condition survey conducted in 2015 indicate that Scriber Creek within the planning corridor appears to be responsive and sensitive to both watershed-wide drivers (e.g., hydrologic change, reduction of bedload sources) and local drivers

(e.g., bank armoring and culverts with inadequate flow and sediment conveyance capacity). The findings (Appendix F) suggest that the natural morphology of Scriber Creek is one that is more sensitive than resilient to watershed changes in hydrology and sediment supply.

For most riffles, (i.e., in reaches of the creek that are not backwatered by undersized culverts downstream), the primary substrate material was consistently either sandy gravel or cobble. In contrast, sandy substrate and even finer-grained material was common within areas known to experience backwater, including within the channel adjacent to the wetland mitigation area on the City-owned property north of 188th Street SW and also within the channel between Old 196th Street SW and 196th Street SW (SR 524; see photos below). Similarly, the channel profiles based on cross-section surveys for the hydraulic modeling work (Appendix E) indicate consistent trends of sediment deposition upstream of particular, undersized culverts or backwatered areas, including upstream of the driveway culvert to Eunia Plaza, upstream of 189th Street SW and 191st Street SW, and within the corridor between the twin 196th Street SW culverts and the Parkview Plaza driveway culvert.

Large woody debris (LWD) was consistently lacking throughout the corridor, and most locations rated as either "fair" or "poor/simple" according to the stream complexity metric (McBride 2001). Further, all riffle locations showed evidence of at least some level of either bank or bed instability; in many cases, local conditions that inhibit channel restabilization were observed (Simon 1995; e.g., development that encroaches in the floodplain or confines the channel, or bank armoring that hard-fixes some banks but transmits erosive energy toward the channel bed or toward unprotected banks downstream).

The field reconnaissance observations suggest that the Scriber Creek channel within the planning corridor is still adjusting to altered watershed drivers (e.g., altered hydrologic regime) and, at most locations, does not have adequate LWD supply, an intact riparian corridor, or adequate space for lateral adjustment that would be needed to restabilize naturally (Simon 1995). Where possible, the flood reduction projects implemented as part of this Scriber Creek Corridor Management Plan could incorporate some of those physical habitat improvement elements, which also reduce channel aggradation or erosion problems and associated maintenance needs.

Photos taken at selected locations during the geomorphic reconnaissance are shown on the following page.

Existing Conditions Sediment Mobility Results

The sediment mobility analysis used output of existing conditions from the hydraulic modeling completed for the study (Appendix E). Sediment mobility was estimated by plotting modeled depth-velocity coordinates on a modified Hjulstrom-Sundborg diagram (Sundborg 1956). Areas of field-observed erosion and deposition (Figure 2) mapped in 2008–2009 (Herrera 2009b) were compared with existing conditions sediment mobility estimates to corroborate expected existing-conditions sediment deposition locations. Detailed assumptions and methods used for

the sediment mobility modeling are provided in Appendix F. Some of the key results for existing conditions are as follows:

- During the 2-year peak flow (Figure 5) only sediment of a size equal to or smaller than fine sand is continuously mobile from the upstream end of the planning corridor to the depositional area downstream of the Old 196th Street SW Bridge.

- Medium to coarse sand drops out between 188th Street SW and 189th Street SW, but is mobile again downstream of 189th Street SW. Sediment between very coarse sand and medium gravel is predicted to be mobile at several locations along the planning corridor, but only for short distances. During typical years, therefore, sediment is likely to accumulate primarily between the Old 196th Street SW Bridge and the culverts under 196th Street SW, with smaller amounts of coarser sand accumulating between 188th Street SW and 189th Street SW and, possibly, discontinuous gravel movement above 188th Street SW, below 191st Street SW, and between the Parkview Plaza driveway culvert and Old 196th Street SW Bridge, as indicated on Figure 5.

- During the 25-year peak flow, no sediment is continuously mobile throughout the planning corridor (see detailed cross-section results in Appendix F). The model indicates that all sediment fractions drop out in the backwater that occurs upstream of 188th Street SW while, downstream of 188th Street SW, the sand and smaller fractions of the sediment are mobile downstream to just above the Old 196th Street SW Bridge, where any sand mobilized past 188th Street SW again drops out.

- Results for the 10-year recurrence peak flow are similar to those for the 25-year, suggesting that, during years with higher than usual peak flows, most sediment will accumulate upstream of 188th Street SW. This result is consistent with the hydraulic modeling results, which showed that the culvert under 188th Street SW is only capable of conveying flows less than a 10-year return period flow and creates backwater for less frequent, greater magnitude flow events (Herrera 2009a, Louis Berger 2015).

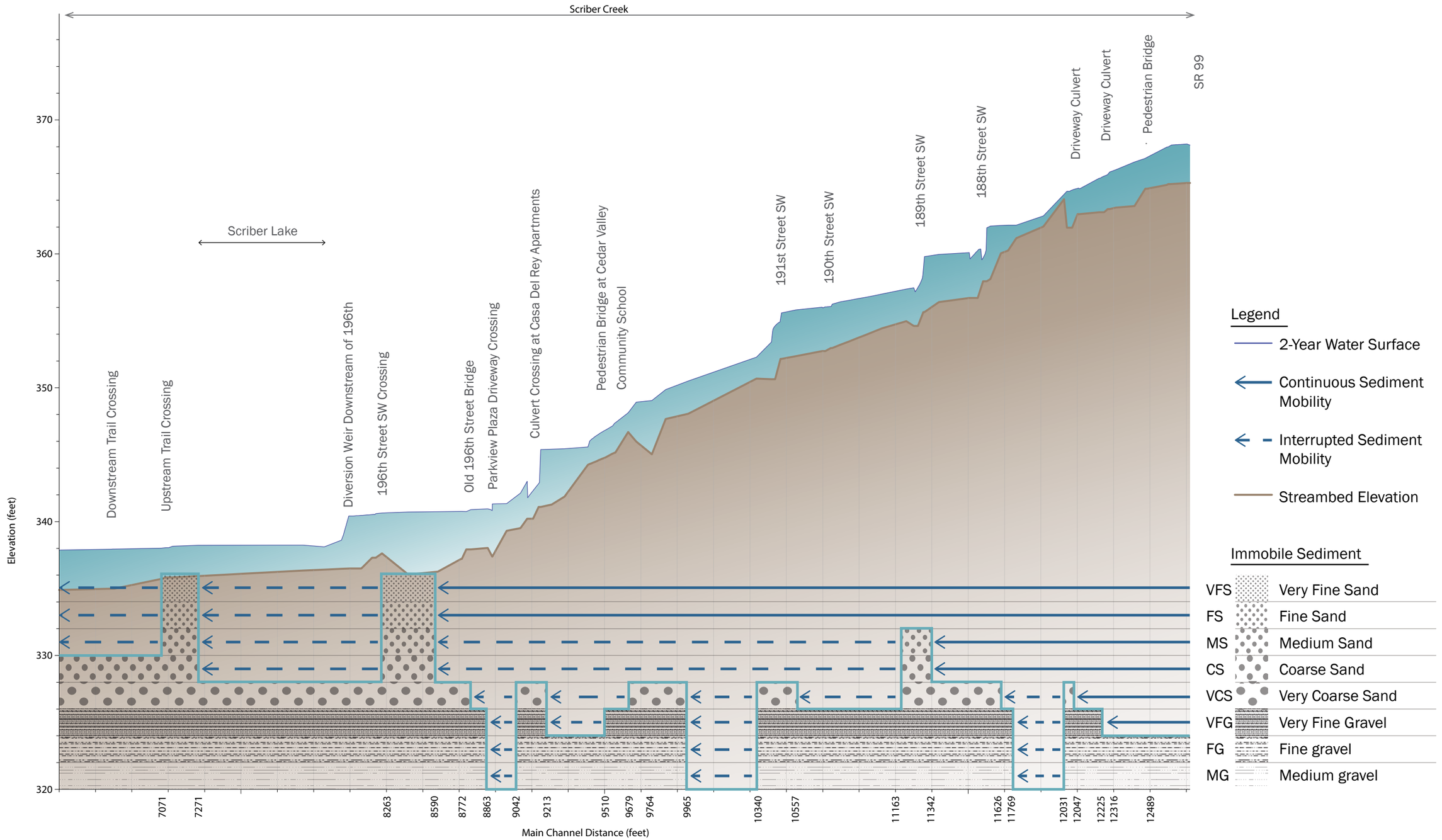

Figure 5. Existing Conditions 2-Year Water Surface and Sediment Mobility Model Profile.

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Photos showing more than 2 feet of silt deposition upstream of 196th Street SW (top) and cemented streambed gravels with old erosion scars along the toe of bank adjacent to the Edmonds School District property (bottom).

The existing conditions sediment mobility modeling results are broadly consistent with the locations of 2009 and 2015 field-observed areas of aggradation (Figure 2), especially at the downstream end of the planning corridor, from the Casa Del Rey Condominiums downstream to 196th Street SW. Disagreement between the modeling and field observations can be explained by the fact that the streambed elevations used for the 2015 modeling (Louis Berger 2015) to generate the water depth and velocity output for the sediment mobility analysis already reflect the aggradation that may have occurred between 2008 and 2015, and were noted during the 2015 field reconnaissance. That aggradation is evidenced by humps in the streambed elevation profile (see Figure 5), often located upstream of undersized culverts. Thus, the sediment mobility modeling essentially evaluates how much more aggradation or sediment transport could be experienced in the future on top of the channel elevations surveyed in 2015.

Sediment Supply Estimation

Sediment supply was approximated for the reach near "Old 196th Street SW" by estimating the average annual accumulation rate from a comparison of channel survey data from 2008 (Herrera 2009b) and 2015 (AHBL 2015). The interpolated volume of sediment accumulation was added to the average sediment transport capacity at that location. Several adjacent cross-sections (XS 8772, XS 8590, XS 8427, XS 8283/8263) near "Old 196th Street SW" are depositional, and accumulated fine sediment (silt, very fine sand, etc.) between the 2008 and 2015 surveys. Average annual sediment supply to these cross-sections was estimated to be approximately 148 tonnes (163 tons) of fine sand and smaller material, acknowledging that according to the existing conditions sediment mobility results, medium and coarse sand fractions drop out between 189th Street SW and upstream of 188th Street SW.

Flood reduction projects that improve conveyance capacity under 189th Street SW are likely to result in decreased accumulation rates upstream of 189th Street SW assuming such improvements result in an increased mobility and transport capacity for medium sand and smaller sediment sizes.

DEVELOPMENT AND EVALUATION OF FLOOD REDUCTION MODELING SCENARIOS

Based on the results of the existing conditions assessment, flood reduction scenarios that could reduce the potential for flooding in the planning corridor were developed. For purposes of this plan, a flood reduction scenario includes a combination of streamflow conveyance improvements, flood flow storage improvements, and/or sediment management to work together along the planning corridor to reduce flooding while attempting to limit increases in downstream peak flows that would exacerbate known flooding problems near SW 200th Street. Because individual projects are affected by both downstream and upstream conditions, and because a single flood flow conveyance improvement (such as replacing an undersized culvert) can potentially increase downstream flows during flood events, each scenario included flood storage improvements to help offset the effects of conveyance improvements, and to simulate them as they would work together.

Following review of the existing conditions modeling results and integrating prior recommendations from the Advisory Committee, the consultant team met with City staff to identify flood reduction scenarios to be modeled using the existing conditions hydrologic and hydraulic models previously developed and validated for the planning effort. The scenarios were developed to represent a range of capital investment and implementation feasibility, and to enable an exploration of the impacts associated with incorporating conveyance and flood storage improvement projects throughout the corridor. The initial suite of scenarios evaluated included Modeling Scenarios 1, 2, and 3. Scenario 1 provided some flood benefit for minimal capital investment and a high level of feasibility; Scenario 3 maximized flood benefit but included more complicated and expensive projects; and Scenario 2 was somewhere in the middle. Upon reviewing preliminary results, two variations of Modeling Scenario 2, referred to as Modeling Scenarios 2A and 2B, were added to the analysis in order to optimize storage options for the corridor. The five modeling scenarios are summarized in Table 7. The project elements referenced in Table 7 are also shown on Figure 6.

HYDROLOGIC AND HYDRAULIC ANALYSIS OF FLOOD REDUCTION SCENARIOS

The following subsections provide additional details about the project elements included in the flood reduction scenarios, along with brief descriptions of potential effects and design considerations. In general, whenever culvert replacements are proposed, they need to be sized to provide fish passage in accordance with Washington Department of Fish and Wildlife (WDFW) recommendations (WDFW 2013), which often results in culverts being larger than what would otherwise be needed to pass peak stream flows. In accordance with the WDFW guidelines,

culvert replacements must also be countersunk below the existing stream grade such that the bottoms of the new culverts can be partially filled with natural stream gravels.

Modeling Scenario 1

Flood reduction Modeling Scenario 1 reflects a combination of conveyance improvements, acquisitions of frequently flooded properties, and adds a modest amount of flood storage to reduce flood risks while attempting to limit any increases in downstream flows. Scenario 1 project elements are described below, moving from downstream to upstream portions of the planning corridor.

Project Element 2: Remove Diversion Structure and Oil/Water Separator Downstream of 196th Street SW

The existing diversion vault located immediately downstream of the 196th Street SW culvert crossing is not working properly and also backs up flow into and upstream of the culverts under 196th Street SW. According to City staff, the connected oil/water separator does not function well and, unless it is frequently maintained, has the potential to release accumulated oils during periods of significant precipitation.

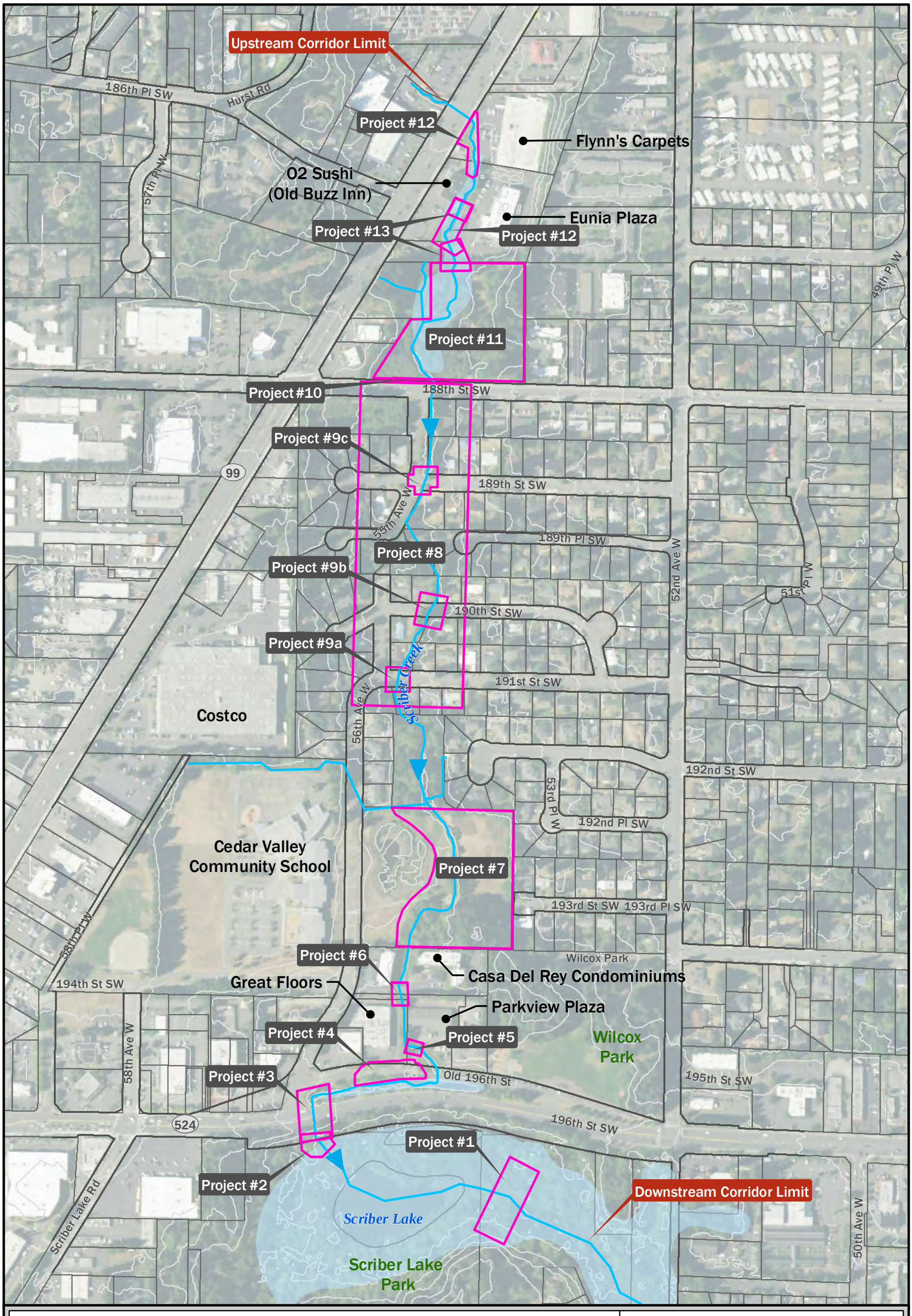
This project element would remove both the diversion vault and the oil/water separator. It would replace the existing oil/water separator with a different type of stormwater treatment device (which would not affect the water surface profiles and is to be defined later by the City). Removing the diversion vault could reduce water levels in the 196th Street SW culverts and thereby create a fish passage barrier during low flows. To avoid affecting fish passage, the diversion structure replacement should be done in combination with adding a low fish weir that would back water up into the culverts at low flows but would not create added head loss during high flows.

Project Elements 4 and 5: Raise Old 196th Street SW and Replace Culvert at Driveway to Parkview Plaza

Even with the removal of the diversion structure downstream of 196th Street SW, Scriber Creek will continue to flood Old 196th Street SW because of high water levels and because the culvert beneath the access driveway to Parkview Plaza is undersized. If the driveway culvert is not replaced with a larger culvert, it will continue to back up Scriber Creek such that the creek will frequently overtop its banks. The combination of high water surface profiles in the creek and overbank flooding from the Parkview Plaza culvert results in overtopping of Old 196th Street SW.

Table 7. Project Definitions and Combinations Included in Each Modeling Scenario.

Corridor Location	Project No.	Project Definition	Modeling Scenario				
			Scenario 1 (Minimum)	Scenario 2A (Minimum Plus)	Scenario 2B (Minimum)	Scenario 2 (Medium)	Scenario 3 (Maximum)
South Corridor: Scriber Lake – Storage Improvements							
	1	Scriber Lake Trail and Berm Improvements: Increase storage in Scriber Lake by raising a trail (use walls to minimize wetland impacts from fill)				X	X
	1A	Increase storage in Scriber Lake by excavation (limited upland areas, possibly integrate with parks amenity)					X
South Corridor: 196th Street Vicinity – Conveyance Improvements							
	2	Remove Diversion Structure and Oil/Water Separator downstream of 196th Street SW: Oil/Water Separator is replaced with equivalent stormwater treatment type and fish passage improvements (i.e. fish passage weir or boulder riffle) are incorporated to make the existing 196th Street Culverts fish-passable without the backwater from the weir	X	X	X	X	X
	3	Replace 196th Street SW Culverts in Existing Location					X
	4	Raise Old 196th Street SW: Raise portion of roadway and associated driveways located west of the trail bridge	X	X	X	X	X
South Corridor: Parkview Plaza/Great Floors/Casa del Rey – Conveyance Improvements							
	5	Parkview Plaza Culvert Replacement: Replace Driveway and culvert to Parkview Plaza (Lighthouse Diving Center) and build up bank on west side of culvert	X	X	X	X	
	6	Scriber Creek Culvert Replacement at Casa Del Rey Condominiums Driveway: Replace culvert at Casa Del Rey	X	X	X	X	X
South Corridor: School District Property – Storage Improvements							
	7	Maximize off-channel storage on Edmonds School District Property: Maximize off-channel Storage on School District property – discuss options – see marked up map			X	X	X
Mid-Corridor: Residential area between 191st and 188th Streets – Conveyance and Flood Hazard Reduction Improvements							
	8	Acquire Frequently Flooded Properties between 188th Street and 191st Street	X				
	9a	Replace 191st Street SW Culvert		X	X	X	X
	9b	Replace 190th Street SW Culvert		X	X	X	X
	9c	Replace 189th Street SW Culvert		X	X	X	X
Mid-Corridor: 188th Street and City Parcel to the North – Storage Improvements							
	10	188th Street SW Flood Wall: Build Short wall (about 1.5 feet) on 188th Street to add storage	X	X		X	X
	11	Maximize off-channel storage on the property north of 188th Street SW: Excavate upland areas north of 188th Street to connect floodplain-channel habitat and provide flood storage		X		X	X
North Corridor: Flynn's/Eunia Plaza – Conveyance and Flood Hazard Reduction Improvements							
	12	Install small berms near Eunia Plaza and Flynn's Carpets – Berm open channel between driveway culverts near Flynn's Carpets and Eunia Plaza, and incorporate backflow prevention on drainage outfalls to the channel	X	X	X	X	X
	13	Replace Driveway Culverts near Eunia Plaza					X
Corridor-Wide							
	14	Basin Sediment Management and Maintenance Program: Implement a continuous sediment management/maintenance program	Modeling assumes consistent postconstruction sediment O&M to maintain channel geometry at construction completion				



Legend

- Proposed project area
- Scriber Creek
- Snohomish County wetland
- ROW
- Parcel
- 10-ft contour

Figure 6.
Scriber Creek Potential Flood Reduction Projects.

N

0 160 320 640 Feet

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This project element would raise the grade (by about 1 foot) of low portions of Old 196th Street SW in the local area, and it would replace the Parkview Plaza culvert with a 12.5-foot-wide by 5.5-foot-high fish passable box culvert. The culvert would be countersunk by 30 percent to provide a natural gravel stream bottom for fish passage, which could affect the water quality/detention system serving the adjacent property (Great Floors). Avoiding such an effect may require, for example, installing a backflow prevention device where the water quality/detention system discharges to the creek. An analysis of potential impacts on the Great Floors water quality/detention system as well as potential upstream or downstream impacts, should be done later in the design phase, after detailed topographic survey of the project area is complete. However, in general, the proposed culvert replacement is expected to lower the tailwater elevation affecting the Great Floors water quality/detention system.

Project Element 6: Casa Del Rey Condominiums Culvert Replacement

The existing Scriber Creek crossing at the Casa Del Rey Condominiums consists of twin 42-inch-diameter corrugated metal pipes (CMPs). However, both the inlet and outlet of the culverts are askew from the north-south alignment of the creek, and about half way across the street, they take a sharp (approximate 90-degree) bend. The result is that there is significant head loss through this crossing and a high risk for material clogging the culverts. A 12.5-foot-wide by 5.5-foot-high fish passable box culvert is proposed at this location to reduce flooding and provide capacity for the 100-year flood event. The box culvert would be countersunk by 30 percent to provide a natural stream bottom through the culvert for fish passage.

Project Element 8: Acquire Frequently Flooded Properties Between 191st Street SW and 188th Street SW

The objective of this element is to acquire properties that are already subject to frequent flooding and then continue to use them for flood storage. The properties could also be used for other corridor-wide improvements, such as trails, riparian and stream habitat enhancement, or environmental mitigation that may be required for impacts related to other project elements within the planning corridor. In addition, the City may want to consider purchasing additional properties in order to obtain a contiguous strip of land for a trail. The specific parcels that would be acquired have not been selected. In general, they would include areas that are already known to flood and that were shown to flood in the modeling described previously. In particular, they would include parcels on which structures have been flooded, as well as those for which the property owners are willing sellers.

One advantage of acquiring properties known to flood is that it would preserve existing creek flood storage that can help to avoid increasing downstream peak flows. The potential benefits of property acquisition could include the ability to:

- Add more flood storage through excavation
- Improve creek riparian buffer and habitat, which could be used as mitigation for impacts caused by improvements elsewhere in the planning corridor

- Provide public property for trail development (a City goal is to extend the existing Scriber Creek trail system northward; property acquisition would help achieve that goal.)

Properties in the vicinity of 191st Street SW to 188th Street SW are typically flooded at the 10-year to 25-year flood event. The identification of properties for acquisition is preliminary. Additional research, including survey of finished floors in structures, would be required to confirm the parcels and structures affected by flooding.

To preserve flood storage in frequently flooded areas, the existing roadway culvert crossings would not be replaced. Therefore, they would continue to be overtopped during the 10- to 25-year event. In addition, 55th Avenue W along the creek in this project area would be subjected to flooding unless additional flood storage is provided on acquired properties. For this corridor plan evaluation, no new flood storage was added to the model in this area, but the City could elect to re-evaluate such flood storage benefits in the future.

Project Element 10: 188th Street SW Flood Wall

The stream reach just upstream of 188th Street SW crosses a City-owned, 4.05-acre parcel. Most of the parcel is upland area, but part of it is a wetland adjacent to Scriber Creek. Currently, the 188th Street SW culvert crossing is a constriction and backs up flow into the wetland area north of 188th Street SW until the roadway is overtopped. The existing road is overtopped in the 10-year flood event.

The objective of this project element is to add creek flood storage north of 188th Street SW by constructing a short wall (about 1.5 feet high) on the north side of the street, a few feet behind the back of the sidewalk. By constructing such a wall, approximately 2.9 acre-feet of flood storage would be added for the 100-year event. The wall would have to weave around existing improvements in the area (such as a fire hydrant), but it would be a relatively low cost method of adding flood storage. Increasing the wall height would result in backing up the creek to an elevation that could exacerbate flooding of upstream properties.

The proposed wall would not create enough flood storage to eliminate roadway overtopping, which would still occur at the 25-year event, but it would reduce downstream creek peak flows. The wall could be configured with a weir overflow at a desired location in order to optimize the primary overflow location.

Project Element 12: Install Small Berms near Eunia Plaza and Flynn's Carpet Cents

Flood reduction Modeling Scenario 1 also includes constructing a berm along the west side of the Scriber Creek channel between the two culverts at Eunia Plaza (see Figure 6). The crest of the berm would need to be at approximate elevation 368.3 feet, which would not provide any freeboard for the 100-year flow. Any higher and the berm crest would be higher than the driveway over the culvert. In addition, berms would be added on both sides of the creek near

Flynn's Carpet Cents (Figure 6). The berms near Flynn's Carpet Cents would be set to about elevation 369.5 so as to provide 0.5 foot of freeboard for the 100-year event through that area.

Modeling Scenario 2

Flood reduction Modeling Scenario 2 reflects a combination of conveyance improvements and adding flood storage to reduce flood risks while attempting to limit any increases in downstream flows. The main difference between Scenario 2 compared to Scenario 1 is that it does not include any property acquisitions. Instead, it includes culvert replacements between 191st Street SW and 189th Street SW. In addition, it adds more flood storage along the creek corridor in three locations. The following paragraphs provide additional details about Modeling Scenario 2 project elements, beginning from downstream to upstream.

Project Element 1: Scriber Lake Storage Improvements

Scriber Lake is located within a City-owned 22-acre open space/park area. The lake and associated streams, wetlands, forest, and trail system offers a valuable setting for fish and wildlife, and opportunities for park visitors. The lake's history is well documented in the Scriber Lake Park Master Plan (DEA 2005). The margins of the lake are vegetated with marsh, bog and scrub-shrub wetland species. The trail system includes a portion that extends out over the lake on a boardwalk. Other portions of the trail are floating on the underlying peat. The 2005 master plan (DEA) reports that the floating boardwalk is nearing the end of its useful life. In addition, the hydraulic modeling shows that portions of the trail are inundated during the 2-year event.

Under Modeling Scenario 2, raising a portion of the existing recreational trails is proposed just downstream of the lake outlet. The location of the trail modifications is shown on Figure 6 and in Appendix E. Raising the trail would not only improve the deteriorated condition, but would also help back up creek flows upstream of the trail, creating more flood storage in Scriber Lake. It would also keep the trail above water during low frequency flood events. The proposed minimum trail elevation through this area is elevation 340.0, which requires the trail to be raised between 1 and 2.4 feet. This would also require that the existing footbridge over the creek be raised to match the new elevation of the trail. Because the trail does not fully cross the entire low area downstream of the lake, an additional small berm, 1 to 2 feet in height would also be needed to connect the raised trail to upland portions of the site. Portions of this berm would likely fall within wetland areas. Based on the hydraulic analysis results, this combination of improvements would increase flood storage by about 3 acre-feet in the 100-year event.

Project Element 2: Remove Diversion Structure and Oil/Water Separator downstream of 196th Street SW

The improvements at this location would be the same as described for Scenario 1.

Project Elements 4 and 5: Raise Old 196th Street SW and Replace Culvert at Driveway to Parkview Plaza

The improvements at this location would be the same as described for Scenario 1.

Project Element 6: Casa Del Rey Condominiums Culvert Replacement

The improvements at this location are the same as described for Scenario 1.

Project Element 7: Maximize Off-Channel Storage on Edmonds School District Property

The eastern portion of the Edmonds School District property is currently an open grassy area. The proposed improvements under Scenario 2 would include creating an off-channel flood storage/wetland area connected to the creek in this area. The City would acquire the portion of property to be used. The off-channel storage area would be excavated and planted with wetland vegetation and other habitat features could be included. The design attempts to maximize flood storage within the available space. The off-channel storage would be slightly sloped to drain to the creek so as to prevent fish stranding. Based on the hydraulic analysis, approximately 0.9 acre-feet of storage could be provided at about the 100-year event. The steep gradient through this portion of the creek (and shallow depth) makes it is difficult to back up flow into the storage area to a depth that would provide more significant storage volumes. Some alternative concepts could be considered including roughening the channel or providing a natural channel constriction (e.g., pinching the channel with rootwads) to increase depth and storage in the excavated area, but any in-channel modifications would need to provide fish passage and be acceptable to WDFW.

Project Element 9: Culvert Replacements from 191st Street SW to 188th Street SW

The objective of this element is to replace these culverts and lower the Scriber Creek water levels to reduce overbank flooding and roadway flooding. This would eliminate the need for property acquisition as described under Project 8 and Scenario 1. Each of these culverts would be replaced with a fish passable culvert. The dimensions of the culvert replacements were developed based upon WDFW fish passage criteria and reviewing the modeling results to verify they would have sufficient capacity to prevent roadway overtopping during the 100-year flow.

Project Elements 10 and 11: 188th Street SW Flood Wall and Maximize Off-Channel Storage on the Property North of 188th Street SW

Under Scenario 2, a wall would be added to the north side of 188th Street SW similar to Scenario 1. In addition, the City-owned parcel would be modified to provide a much larger wetland and increased flood storage than currently exists. An off-channel storage and wetland

area would be excavated and planted with wetland vegetation, and additional habitat features could be included in the design. The design attempts to maximize flood storage within the available space, while maintaining portions of the existing wetlands and areas of concentrated evergreen trees. This could be accomplished by excavating in select portions of the site to elevations just above the low water levels. The off-channel storage would be slightly sloped to drain to the creek so as to prevent fish stranding. Even with the added storage, the road would overtop in the 25-year event. However, the combination of adding the wall and the excavation described above would yield about 3.7 acre-feet of additional storage during the 100-year event and help to reduce downstream peak flows.

Project Element 12: Install Small Berms near Eunia Plaza and Flynn's Carpet Cents

These improvements would be the same for this scenario as described for Scenario 1.

Modeling Scenario 2A

Modeling Scenario 2A was developed based on the findings of Modeling Scenario 2. This adjustment to Scenario 2 sought to determine whether the flood reduction goals of the corridor planning effort could be sufficiently met without additional flood storage on the Edmonds School District property (Project 7) or at Scriber Lake (Project 1).

Modeling Scenario 2B

Modeling Scenario 2B was also developed based on the findings of Modeling Scenario 2, with adjustments to determine whether the flood reduction goals of the corridor planning effort could be sufficiently met with flood storage only at the Edmonds School District property (Project 7), excluding flood storage improvements at 188th Street SW (Projects 10 and 11) and at Scriber Lake (Project 1).

Modeling Scenario 3

Flood reduction Modeling Scenario 3 reflects a combination of conveyance improvements and adding flood storage to reduce flood risks while attempting to limit any increases in downstream flows. The main differences between Scenario 3 compared to Scenario 2 are that Scenario 3 adds more flood storage in Scriber Lake by excavation of some upland areas, replaces the culvert crossing of 196th Street SW, and modifies the approach to flood risk reduction in the most northerly stream reach in the vicinity of Flynn's Carpet Cents and Eunia Plaza. The following paragraphs provide additional details about Modeling Scenario 3 project elements, beginning from downstream to upstream.

Project Elements 1 and 1a: Scriber Lake Storage Improvements

Under Scenario 3, the improvements at Scriber Lake would include the trail and berm modifications described under Scenario 2 plus adding more flood storage by excavating select areas around the western perimeter of the lake. The potential locations for such excavation are shown in Appendix E. This area was selected because it is relatively low lying but generally above the 2-year water level, and because the location was also previously identified in the Scriber Lake Master Plan as being an area of planned shoreline access development (DEA 2005). Ideally, flood storage could be added in the elevation range between 338 and 340 feet because this is the elevation range that is inundated between the 2-year and 100-year flood events. The elevation of this area generally is in that range. The upland area between the main lake and the North Lagoon is too low and it is unlikely that excavating this area would result in much added flood storage. As noted previously, the perimeter of the lake is largely vegetated with marsh, bog and scrub-shrub wetland species. Substantial environmental permitting effort would be required to gain approval for excavation in this area. The excavation combined with raising the trail would add approximately 6 acre-feet of flood storage during the 100-year flood event.

Project Elements 2 and 3: Remove Diversion Structure and Oil/Water Separator Downstream of 196th Street SW and Replace 196th Street SW Culverts in Their Existing Location

Under Scenario 3, the removal of the diversion structure and replacement of the oil/water separator would be the same as in Scenarios 1 and 2. In addition, the existing 196th Street SW culverts would be replaced with a larger fish-passable culvert to further lower upstream water levels. Some thought was originally given to relocating the creek crossing of 196th Street SW to the east near the old 196th Street Bridge where it historically existed. However, research on the construction of the roadway embankment (HWA 2016) revealed that the embankment overlies peat and was constructed of logs and non-natural debris (e.g., old concrete) which would make boring through the embankment difficult. As a result, it was decided that it would be much more practical and cost effective to replace the culvert in its current location.

Project Elements 4 and 5: Raise Old 196th Street SW and Replace Culvert at Driveway to Parkview Plaza

The improvements at this location would be the same as described for Scenarios 1 and 2, except the culvert replacement at Parkview Plaza would not be required.

Project Element 6: Casa Del Rey Condominiums Culvert Replacement

The improvements at this location are the same as described for Scenarios 1 and 2.

Project Element 7: Maximize Off-Channel Storage on Edmonds School District Property

The improvements at this location would be the same as described for Scenario 2.

Project Element 9: Culvert Replacements from 191st Street SW to 188th Street SW

The improvements at this location would be the same as described for Scenario 2.

Project Elements 10 and 11: 188th Street SW Flood Wall and Maximize Off-Channel Storage on the Property North of 188th Street SW

The improvements at this location would be the same as described for Scenario 2.

Project Elements 12 and 13: Install Small Berms near Eunia Plaza and Flynn's Carpet Cents and Replace Driveway Culverts near Eunia Plaza

The improvements near Eunia Plaza and Flynn's Carpet Cents would be the same as described for Scenarios 1 and 2, with the exception that the berms could be reduced in height. In addition, the improvements would include replacing the two culverts at Eunia Plaza with fish-passable box culverts. The proposed culverts would have the capacity to convey the 100-year peak storm event.

HYDRAULIC PERFORMANCE OF MODELING SCENARIOS

All of the modeling scenarios achieve the flood control objectives for the corridor, although to varying degrees, while not increasing downstream peak flows. The water surface elevation results for existing conditions and each of the modeling scenarios are listed in Table 8. Tables of the simulated streamflow velocities and figures showing the water surface elevation profiles for both current conditions and the modeling scenarios are presented in Appendix E. Figure 7 illustrates the level of flood protection modeled at each of the major culvert crossings for the different modeling scenarios.

Modeling Scenario 1 Performance

For Scenario 1, the model results indicate that flow would still overtop the Old 196th Street Bridge in the 25-year flood event, however, by removing the diversion structure downstream of 196th Street SW and raising Old 196th Street, the roadway would be above the 100-year peak water surface elevation. In addition, replacing the culvert at Parkway Plaza would keep flow within the channel during the 100-year event. Replacing the culvert at Casa Del Rey Condominiums would also provide capacity for the 100-year event at this crossing. The model

results indicate that roadways would continue to overtop at 191st, 190th, and 189th Streets SW under Scenario 1, however that was expected for this scenario. Frequently flooded properties in this area would be acquired under Scenario 1 and the roadways would be allowed to overtop in high flows. Adding flood storage north of 188th Street SW would offset any increases in downstream flows from the conveyance improvements. In fact under this scenario, flows are predicted to decrease relative to existing conditions all along the corridor down to the outlet of Scriber Lake. In addition, the low wall constructed north of 188th Street SW would add enough storage to decrease the predicted likelihood of 188th Street SW being overtopped from about 10 percent annually to 4 percent annually. The model results indicate that the berms within Eunia Plaza and near Flynn's Carpet Cents would generally keep the 100-year flow off the parking lots and within the creek channel.

Modeling Scenario 2 Performance

For Modeling Scenario 2, as with Scenario 1, flow is predicted to overtop the Old 196th Street Bridge during the 25-year flood event, but the roadway would be protected from flooding up to the 100-year event, and the culvert replacements at Parkway Plaza and Casa Del Rey Condominiums would provide a 100-year level of protection at these crossings. However, under this scenario, the proposed improvements would also provide 100-year level of protection at 191st, 190th and 189th Streets SW. Similar to Scenario 1, 188th Street SW would still overtop in the 25-year flood event. Also similar to Scenario 1, the model results indicate that the berms within Eunia Plaza and near Flynn's Carpet Cents would generally keep the 100-year flow off the parking lots and within the creek channel.

The added flood storage at Scriber Lake resulting from raising the trail and the additional flood storage at the Edmonds School District property and north of 188th Street SW would adequately attenuate any increases in peak flows resulting from the conveyance improvements such that peak flows generally decrease relative to existing conditions throughout the corridor. In fact, reviewing the modeled peak flows for Scenario 2 along the corridor calls into question the need for added flood storage at all of these locations. From the results presented in Appendix E, the modeled inflows to Scriber Lake (Subbasin 628+629) are less under Scenario 2 than existing conditions, indicating that raising the trail at Scriber Lake to provide additional flood storage may not be required. In addition, the significant decrease in peak flow simulated at 188th Street SW (Subbasin 631, 106.5 cfs under Scenario 2 compared to 131.0 cfs in existing conditions calls into question the need for the added flood storage at the Edmonds School District property. Because there is such a marked decrease predicted in peak flow at 188th Street SW, the added storage north of this roadway may be enough to offset any increases in peak flows resulting from the scenario.

Table 8. Simulated Water Surface Elevations for a Range of Flows for Modeling Scenarios.									
Location	**Description**	**Conveyance Condition**	**Crossing Top Elevation (feet)**	**1/2 2-Year Water Surface Elevation (feet)**	**2-Year Water Surface Elevation (feet)**	**10-Year Water Surface Elevation (feet)**	**25-Year Water Surface Elevation (feet)**	**100-Year Water Surface Elevation (feet)**	**Overtopping Return Period**
Scriber Lake	Downstream Trail Crossing	Existing	337.51	336.96	337.91	338.75	339.11	339.44	<2-year
		Modeling Scenario 1	337.51	336.96	337.91	338.72	339.07	339.39	<2-year
		Modeling Scenario 2	337.51	336.95	337.9	338.72	339.08	339.4	<2-year
		Modeling Scenario 2A	337.51	336.96	337.91	338.74	339.1	339.43	<2-year
		Modeling Scenario 2B	337.51	336.96	337.91	338.76	339.12	339.45	<2-year
		Modeling Scenario 3	337.51	336.94	337.87	338.69	339.05	339.4	<2-year
Scriber Lake	Upstream Trail Crossing	Existing	338.27	337.35	338.17	338.9	339.21	339.53	10-year
		Modeling Scenario 1	340	337.32	338.11	338.82	339.14	339.44	>100-year
		Modeling Scenario 2	340	337.31	338.1	338.94	339.34	339.75	>100-year
		Modeling Scenario 2A	338.27	337.32	338.12	338.84	339.16	339.48	10-year
		Modeling Scenario 2B	338.27	337.32	338.11	338.85	339.18	339.51	10-year
		Modeling Scenario 3	340	337.3	338.07	338.89	339.3	339.74	>100-year
196th Street SW	Twin 42″ x 68″ CMP Pipe arches	Existing	345.77	339.76	340.51	341.34	341.8	342.54	>100-year
	Twin 42″ x 68″ CMP Pipe arches	Modeling Scenario 1	345.77	338.92	339.52	340.03	340.31	340.7	>100-year
	Twin 42″ x 68″ CMP Pipe arches	Modeling Scenario 2	345.77	338.93	339.52	340.09	340.41	340.87	>100-year
	Twin 42″ x 68″ CMP Pipe arches	Modeling Scenario 2A	345.77	338.94	339.54	340.09	340.39	340.79	>100-year
	Twin 42″ x 68″ CMP Pipe arches	Modeling Scenario 2B	345.77	338.94	339.54	340.18	340.53	341.06	>100-year
	12.5′ x 6.5′ Box Culvert	Modeling Scenario 3	345.77	338.76	339.28	339.76	340.04	340.41	>100-year
Old 196th Street	Bridge	Existing	341	339.9	340.81	341.67	342.07	342.76	10-year
		Modeling Scenario 1	342 [d]	339.42	340.17	340.82	341.2	341.72	25-year[e]
		Modeling Scenario 2	342 [d]	339.42	340.18	340.9	341.32	341.88	25-year[e]
		Modeling Scenario 2A	342 [d]	339.44	340.2	340.92	341.32	341.85	25-year[e]
		Modeling Scenario 2B	342 [d]	339.43	340.2	341.08	341.56	342.05	10-year[f]
		Modeling Scenario 3	342 [d]	339.39	340.09	340.75	341.15	341.67	25-year[e]
Driveway Culvert Near Great Floors	60″ Dia CMP	Existing	342.91	340.2	341.25	342.22	342.75	343.47	100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 1	342.91	339.74	340.46	341.06	341.33	341.79	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2	342.91	339.75	340.47	341.15	341.44	341.96	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2A	342.91	339.76	340.49	341.15	341.46	341.97	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2B	342.91	339.76	340.49	341.22	341.63	342.16	>100-year
	60″ Dia CMP	Modeling Scenario 3	342.91	340.21	341.2	342	342.36	342.8	>100-year

Table 8 (continued). Simulated Water Surface Elevations for a Range of Flows for Modeling Scenarios.

Location	Description	Conveyance Condition	Crossing Top Elevation (feet)	1/2 2-Year Water Surface Elevation (feet)	2-Year Water Surface Elevation (feet)	10-Year Water Surface Elevation (feet)	25-Year Water Surface Elevation (feet)	100-Year Water Surface Elevation (feet)	Overtopping Return Period
Casa Del Ray	Twin 42″ Dia CMP	Existing	346.12	342.4	345.34	346.44	346.52	346.67	10-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 1	346.12	342.03	342.66	343.29	343.61	344.04	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2	346.12	342.04	342.69	343.36	343.71	344.09	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2A	346.12	342.04	342.69	343.39	343.73	344.09	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 2B	346.12	342.04	342.7	343.53	343.94	344.35	>100-year
	12.5′ x 5.5′ Box Culvert	Modeling Scenario 3	346.12	342.02	342.57	343.42	343.79	344.09	>100-year
191st St SW	48″ Dia CMP	Existing	357.24	354.39	355.51	356.74	357.37	357.57	25-year
	48″ Dia CMP	Modeling Scenario 1	357.24	354.33	355.43	356.29	356.72	357.34	>100-year
	8′ x 5.5′ Box Culvert	Modeling Scenario 2	357.24	353.11	353.6	354.04	354.37	354.73	>100-year
	8′ x 5.5′ Box Culvert	Modeling Scenario 2A	357.24	353.11	353.61	354.06	354.38	354.73	>100-year
	8′ x 5.5′ Box Culvert	Modeling Scenario 2B	357.24	353.11	353.61	354.24	354.6	355.06	>100-year
	8′ x 5.5′ Box Culvert	Modeling Scenario 3	357.24	353.1	353.6	354.04	354.38	354.73	>100-year
190th St SW	6′ W x 4′ H Box Culvert	Existing	357.1	355.04	356.07	357.33	357.55	357.73	10-year[a]
	6′ W x 4′ H Box Culvert	Modeling Scenario 1	357.1	355.08	356.11	357.17	357.39	357.56	10-year[a]
	12′ W x 5.5′ H Box Culvert	Modeling Scenario 2	357.1	354.46	355.19	355.73	355.98	356.41	>100-year
	12′ W x 5.5′ H Box Culvert	Modeling Scenario 2A	357.1	354.47	355.21	355.74	355.99	356.41	>100-year
	12′ W x 5.5′ H Box Culvert	Modeling Scenario 2B	357.1	354.47	355.21	355.86	356.24	356.82	>100-year
	12′ W x 5.5′ H Box Culvert	Modeling Scenario 3	357.1	354.46	355.19	355.73	355.98	356.41	>100-year
189th St SW	42″ Dia Concrete Culvert	Existing	360.73	358.51	359.72	360.94	361.06	361.15	10-year[a]
	42″ Dia Concrete Culvert	Modeling Scenario 1	360.73	358.52	359.72	360.74	361.01	361.06	10-year[a]
	10′ W x 5.5′ Box Culvert	Modeling Scenario 2	360.73	356.72	357.2	357.65	357.87	358.07	>100-year
	10′ W x 5.5′ Box Culvert	Modeling Scenario 2A	360.73	356.73	357.21	357.66	357.87	358.07	>100-year
	10′ W x 5.5′ Box Culvert	Modeling Scenario 2B	360.73	356.73	357.21	357.79	357.99	358.28	>100-year
	10′ W x 5.5′ Box Culvert	Modeling Scenario 3	360.73	356.73	357.2	357.65	357.87	358.06	>100-year
188th St SW	3′ Dia Concrete Culvert	Existing	363.14	360.67	362.07	363.46	363.6	363.73	10-Year[b]
	3′ Dia Concrete Culvert	Modeling Scenario 1	364.64	360.41	361.8	364.3	364.77	364.85	25-year
	3′ Dia Concrete Culvert	Modeling Scenario 2	364.64	360.44	361.87	363.43	364.68	364.8	25-year
	3′ Dia Concrete Culvert	Modeling Scenario 2A	364.64	360.44	361.87	363.44	364.66	364.8	25-year
	3′ Dia Concrete Culvert	Modeling Scenario 2B	363.14	360.47	361.93	363.38	363.52	363.67	10-year[b]
	3′ Dia Concrete Culvert	Modeling Scenario 3	364.64	360.44	361.87	363.44	364.68	364.8	25-year
Driveway 1 Near Flynn's Carpet	Twin 4′ Dia CMPs	Existing	368.24	363.9	364.35	365.2	365.61	366.31	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 1	368.24	364.45	364.8	365.38	365.78	366.51	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2	368.24	364.45	364.81	365.38	365.78	366.51	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2A	368.24	364.45	364.81	365.38	365.78	366.51	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2B	368.24	364.46	364.82	365.4	365.79	366.51	>100-year
	10′ W x 5.5′ H Box Culvert	Modeling Scenario 3	368.24	364.34	364.37	364.81	365.01	365.34	>100-year

Table 8 (continued). Simulated Water Surface Elevations for a Range of Flows for Modeling Scenarios.									
Location	**Description**	**Conveyance Condition**	**Crossing Top Elevation (feet)**	**1/2 2-Year Water Surface Elevation (feet)**	**2-Year Water Surface Elevation (feet)**	**10-Year Water Surface Elevation (feet)**	**25-Year Water Surface Elevation (feet)**	**100-Year Water Surface Elevation (feet)**	**Overtopping Return Period**
Driveway 2 Near Flynn's Carpet	Twin 4′ Dia CMPs	Existing	368.29	365.34	366.04	366.71	367.12	367.87	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 1	368.29	365.37	366.07	366.86	367.29	368.1	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2	368.29	365.38	366.07	366.86	367.29	368.1	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2A	368.29	365.35	366.07	366.86	367.29	368.1	>100-year
	Twin 4′ Dia CMPs	Modeling Scenario 2B	368.29	365.38	366.07	366.86	367.29	368.1	>100-year
	10′ W x 4′ H Box Culvert	Modeling Scenario 3	368.29	365	365376	366.73	366.8	367.52	>100-year
Bridge at Flynn's Carpet	Pedestrian Bridge	Existing	367.59	366.4	367.12	367.76	368.14	368.8	10-year[c]
	Pedestrian Bridge	Modeling Scenario 1	367.59	366.45	367.18	367.89	368.3	368.97	10-year
	Pedestrian Bridge	Modeling Scenario 2	367.59	366.45	367.18	367.89	368.3	368.97	10-year
	Pedestrian Bridge	Modeling Scenario 2A	367.59	366.41	367.18	367.89	368.3	368.97	10-year
	Pedestrian Bridge	Modeling Scenario 2B	367.59	366.45	367.18	367.89	368.3	368.97	10-year
	Pedestrian Bridge	Modeling Scenario 3	367.59	366.45	367.18	367.85	368.22	368.78	10-year
SR-99	8.5′ W x 4′ H Box Culvert	Existing	370.62	367.02	368.01	368.41	368.77	369.62	>100-year
	8.5′ W x 4′ H Box Culvert	Modeling Scenario 1	370.62	367.09	368.08	368.52	368.96	369.86	>100-year
	8.5′ W x 4′ H Box Culvert	Modeling Scenario 2	370.62	367.09	368.08	368.52	368.96	369.86	>100-year
	8.5′ W x 4′ H Box Culvert	Modeling Scenario 2A	370.62	367.04	368.08	368.52	368.96	369.86	>100-year
	8.5′ W x 4′ H Box Culvert	Modeling Scenario 2B	370.62	367.09	368.08	368.52	368.96	369.86	>100-year
	8.5′ W x 4′ H Box Culvert	Modeling Scenario 3	370.62	367.09	368.08	368.51	368.94	369.8	>100-year

CMP = Corrugated Metal Pipe

Dia= Diameter

W = Wide

H = High

WSE = Water Surface Elevation

a Overtopped 55th Avenue W to the west of the creek upstream of crossing.

b Significant overbank flooding east and west of creek upstream of crossing.

c Significant overbank flooding to the west of creek upstream of bridge.

d Roadway raise to el 342.0 but bridge elevation not adjusted.

e Bridge overtops at this return period, but the roadway overtop in a greater than 100- year event.

f Bridge overtops at this return period, but the roadway overtop in a 100-year event.

Upstream Corridor Limit

Pedestrian bridge
Existing: 10-year
Scenario 1: 10-year
Scenario 2: 10-year
Scenario 2A: 10-year
Scenario 2B: 10-year
Scenario 3: 10-year

Flynn's Carpets

Existing: >100-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

O2 Sushi
(Old Buzz Inn)

Eunia Plaza

Existing: >100-year
(assuming opening in berm
is at curb elevation)
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Existing: >100-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Existing: 10-year
Scenario 1: 10-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Existing: 10-year
Scenario 1: 25-year
Scenario 2: 25-year
Scenario 2A: 25-year
Scenario 2B: >100-year
Scenario 3: 25-year

Existing: 25-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Existing: 10-year
Scenario 1: 10-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Costco

Cedar Valley
Community School

Existing: 10-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Existing: 100-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Old 196th St roadway
Existing: 10-year
Scenario 1: >100-year
Scenario 2: >100-year
Scenario 2A: >100-year
Scenario 2B: >100-year
Scenario 3: >100-year

Great Floors

Casa Del Rey Condominiums

Parkview Plaza

Wilcox Park

Wilcox
Park

Scriber Creek

Old 196th St.
bridge

Downstream Corridor Limit

Scriber Lake

Scriber Lake
Park

186th Pl SW
Hurst Rd
57th Pl W
188th St SW
189th St SW
55th Ave W
189th Pl SW
52nd Ave W
51st Pl W
190th St SW
191st St SW
53rd Pl W
192nd St SW
192nd Pl SW
193rd St SW
194th St SW
49th Pl W
99
56th Ave W
58th Pl W
58th Ave W
524
Old 196th St
196th St SW
195th St SW
50th Ave W

Notes:

1. Figure indicates where overbank flooding occurs. It does not show detailed innundation mapping.
2. Annotations for each culvert indicate the over-topping return period corresponding to existing conditions modeling.

Legend

- Roadway/driveway culvert
- Roadway/driveway culverts that overtop
- Stream bank overtopping
- Scriber Creek
- Snohomish County wetland
- ROW
- Parcel
- 10-ft contour

Figure 7.
Level of Flood Protection at Major Culvert Crossings for Modeling Scenarios.

N

0 160 320 640
Feet

LYNNWOOD WASHINGTON

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Modeling Scenario 2A Performance

As with Scenarios 1 and 2, Scenario 2A includes enough additional storage to offset any increases in downstream flows and yet provides further reductions in flood water surface elevations and peak flows throughout the corridor. However, unlike Scenario 1, Scenario 2A also provides a 100-year level of protection at the 191st Street SW, 190th Street SW, and 189th Street SW crossings.

Modeling Scenario 2B Performance

Scenario 2B model results indicate that, for flows greater in magnitude than the 10-year event, some increases in peak flows would occur downstream of Scriber Lake. Scenario 2B generally meets the primary goal of reducing flooding within the study corridor, with the exception of Old 196th Street, which would experience flood overtopping during the 100-year event near the driveway access to the Great Floors business. The Old 196th Street roadway would need to be raised another foot higher than that assumed for Project 4 in order to provide 100-year flood protection under Scenario 2B. However, unlike Scenario 1, Scenario 2B also provides a 100-year level of protection at the 191st Street SW, 190th Street SW, and 189th Street SW crossings.

Modeling Scenario 3 Performance

Similar to the results for Scenario 2, the model results for Scenario 3 indicate that flow would overtop the Old 196th Street Bridge in the 25-year flood event, but the roadway would be protected in the 100-year event, and the culvert replacement at Casa Del Rey Condominiums would provide a 100-year level of protection. However, due to the improved crossing at 196th Street SW, water surface elevations would be sufficiently lowered such that the culvert at Parkway Plaza would not need to be replaced to provide a 100-year level of protection. Similar to Scenario 2, this scenario provides 100-year level of protection at 191st, 190th and 189th Streets SW while 188th Street SW is predicted to overtop in the 25-year flood event. Improving the culverts at Eunia Plaza would reduce the water levels through this area, providing more freeboard at the driveway crossings in the parking lot, but berms would still be needed to keep flow off the parking lot areas. As with Scenarios 1, 2, and 2A, the model results indicate that the added flood storage would be sufficient to offset any increases in peak flow resulting from the conveyance improvements such that flows generally decrease when compared to existing conditions throughout the corridor. Because Scenarios 1, 2, and 2A achieve the goals of this project without the additional project elements proposed in this scenario, it appears that the added improvements in this scenario are not necessary.

Wetland Inundation Analysis

A separate analysis was done using the HSPF hydrologic model to assess changes in the durations of inundation within those wetlands/ponds considered in the alternative scenarios.

This information is helpful to inform future designers by allowing understanding of inundation durations for plant selection to ensure successful survival. Table 12 in Appendix E provides this information for Scriber Lake (Projects 1 and 1A), the alternative off-channel storage pond at Cedar Valley Community School (Project 7), and the alternative storage expansion north of 188th Street SW (Project 11, Scenarios 2 and 3).

For the two potential projects that affect existing wetlands (Scriber Lake and the 188th Street SW storage pond), the Washington State Department of Ecology (Ecology) provides guidance on allowable impacts to wetlands resulting from proposed projects that may alter their hydrology. Ecology guidance states that the daily volumes following project implementation should not be 20 percent lower or higher than pre-project daily volumes. In addition, the total volume of water entering a wetland on a monthly basis should not be more than 15 percent higher or lower than the pre-project volumes. The HSPF hydrologic model data was used to assess the project elements that would existing wetlands against that Ecology guidance. It was determined that, for both proposed storage areas, the change in daily volumes would meet Ecology's current criteria (Appendix E).

Sediment Mobility Performance of Modeling Scenarios

After preliminary modeling scenario results were available and reviewed with City staff, a follow-up meeting was held at the City on December 9, 2015, to discuss potential impacts of the different project elements on sediment transport and deposition patterns and maintenance needs. During this meeting, it was decided that sediment mobility should be evaluated for the modeling scenario with the greatest potential to be included in the corridor plan at the time, Scenario 2. The sediment mobility analysis was thus completed for Scenario 2, and detailed results are included in Appendix F.

Under Scenario 2, during the 2-year peak flow (Figure 8) the sediment mobility model indicates that sediment of a size equal to or smaller than medium sand would be continuously mobile from the upstream end of the planning corridor to downstream of 196th Street SW. Sediment coarser than medium sand is predicted to drop out in the reach from the backwatered zone upstream of 188th Street SW to 189th Street SW. Downstream of 189th Street SW, the model indicates that the conveyance improvements afforded by the culvert replacements would enable coarse sand to remain continuously mobile to downstream of 196th Street SW, while larger sediments would be expected to be intermittently mobile along the stream length in the corridor, as under existing conditions. The mobility results indicate that, during the 25-year peak flow, all sediment fractions would have lesser mobility under any of the scenarios in the backwater upstream of 188th Street SW, as under existing conditions, but any medium and finer sands mobilized downstream of 188th Street SW would be mobile all the way downstream past 196th Street SW. These results suggest that, under Scenario 2 during typical years, sediment would not accumulate between the Old 196th Street SW Bridge and the culverts under 196th Street SW, but would instead be passed through to Scriber Lake. These results further suggest that, during years with higher than usual peak flows, most sediment would still accumulate upstream of 188th Street SW, but none would accumulate above the Old 196th Street SW Bridge.

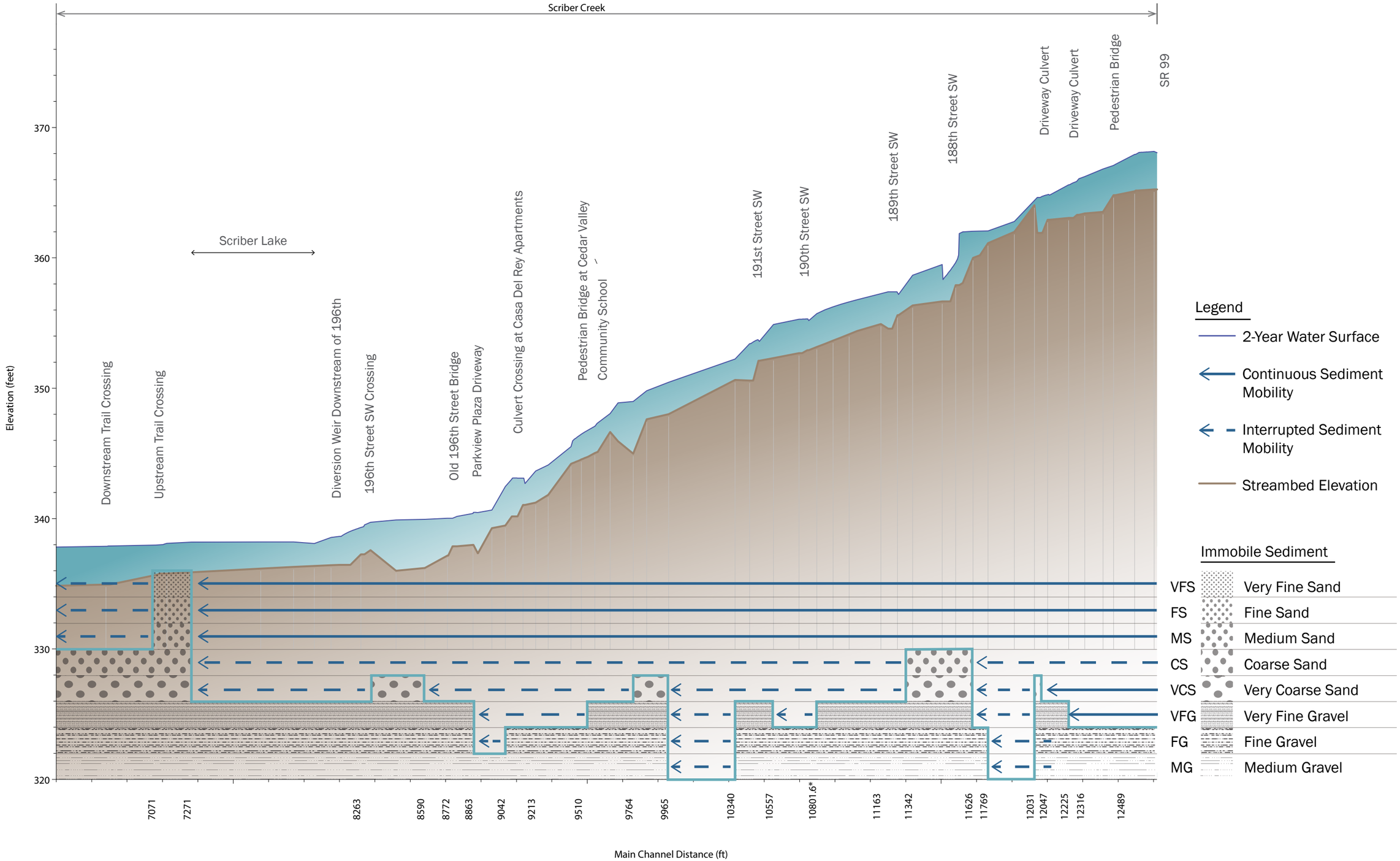

Figure 8. Scenario 2 Proposed Conditions 2-Year Water Surface and Sediment Mobility Model Profile.

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In summary, flood reduction and conveyance improvement actions consistent with the Scenario 2 modeling (Louis Berger 2016) are likely to reduce sediment accumulation upstream of replaced culverts and also upstream of 196th Street SW. Sediment accumulation is likely to increase within the flood storage area upstream of 188th Street SW if more storage is created there, and also downstream in Scriber Lake. Based on the results of the hydraulic modeling scenarios and the sediment analysis, the consultant team concluded that maintaining flood flow conveyance in the planning corridor will require regular sediment management/maintenance in areas of accumulation.

FLOOD REDUCTION ALTERNATIVES EVALUATION

Upon reviewing the scenario modeling results, the consultant team collaborated with the City to define several flood reduction alternatives (combinations of projects based upon the modeling scenarios described above) for further evaluation. The alternatives selected for additional evaluation address the two primary flood reduction goals of this plan and also more explicitly address input received from the Advisory Committee (2014).

Flood reduction Modeling Scenarios 1, 2, 2A, and 2B were carried forward. Scenario 3 was dropped from further consideration because of its anticipated higher costs and significant challenges in implementing and permitting some of the key projects included in that scenario (i.e., expanding the volume of Scriber Lake and replacing the 196th Street SW culverts in a deep embankment beneath a heavily used arterial roadway). The scenario modeling results (Louis Berger 2015) implied that the flood reduction goals of this plan could likely be met without requiring those more complicated and expensive projects.

The alternatives selected for detailed evaluation and their specific project combinations are listed in Table 9. To avoid confusion with the modeling scenario designations, the alternatives are named A, B, C, and D.

Conceptual Design and Cost Estimating

The consultant team worked with the City to develop conceptual design layouts for the 14 individual flood reduction projects. Each individual project would increase flood storage, improve flood conveyance, manage sediment, or accomplish a combination of those three objectives, thereby addressing priority concerns identified during the first phase of the planning effort (Advisory Committee 2014) and reducing flooding within the planning corridor. The individual project concept designs were based on updated base mapping of the corridor (AHBL 2015), the geotechnical analysis for the corridor (HWA 2015), and results of hydrologic and hydraulic modeling of current conditions (Louis Berger 2015). Table 6 describes the 14 projects that are evaluated and compared in this plan. Figure 6 depicts the location of each project in the planning corridor. Project "summary sheets," which briefly describe and show the dimensions and primary features of each project, are presented in Appendix G.

Public and Stakeholder Input

Two Advisory Committee meetings were held, on November 2, 2015, and March 15, 2016, during the course of flood reduction project development and evaluation. During these

meetings, the City and the consultant team presented the current status of project evaluation and addressed questions and comments from Advisory Committee members. Meeting summaries were forwarded to the entire Advisory Committee contact list so that all members could stay informed, regardless of whether or not they were able to attend the meetings. The consultant team also addressed e-mailed comments and questions from the Advisory Committee during this time, and this input was considered and incorporated into the flood reduction alternatives evaluation as described below.

Evaluation Criteria

The alternatives were qualitatively evaluated and compared using these criteria developed with input from the Advisory Committee (2014):

- Community considerations
- Flood reduction performance
- Project cost
- Ease of construction/implementation
- Ease of maintenance
- Habitat improvements

The consultant team developed and added two more criteria deemed important for the City's short- and long-term interests:

- Ease of permitting
- Life cycle and service life benefits

Table 9. Project Combinations Included in Each Alternative.

Alternative		Related Model Scenario	Storage Improvement Strategy	Conveyance Improvement Strategy	Included Projects														
					1	2	3	4	5	6	7	8	9a	9b	9c	10	11	12	13	14
A	Minimum Corridor Storage – With 188th St SW Property, Property Acquisition Approach	Scenario 1 (Minimum)	North Corridor: None	North-Corridor: improvements near Flynn's and Eunia Plaza																
			Mid-Corridor: Flood Wall at 188th Street SW	Mid-Corridor: property acquisitions		X		X	X	X		X				X		X		
			South Corridor: None	South-Corridor: improvements at Parkview and Casa del Rey																
B	Minimum Plus Corridor Storage – With 188th St SW Property, Culvert Replacement/Conveyance Improvement Approach	Scenario 2A (Minimum Plus)	North Corridor: None	North-Corridor: improvements near Flynn's and Eunia Plaza																
			Mid-Corridor: Flood wall and Maximize Storage at 188th Street SW Property	Mid-Corridor: culvert replacements		X		X	X	X			X	X	X	X	X	X		
			South Corridor: None	South-Corridor: improvements at Parkview and Casa del Rey																
C	Minimum Corridor Storage – School District Property Instead of 188th St SW Property, Culvert Replacement/ Conveyance Improvement Approach	Scenario 2B (Minimum)	North Corridor: None	North-Corridor: improvements near Flynn's and Eunia Plaza																
			Mid-Corridor: None	Mid-Corridor: culvert replacements		X		X	X	X	X		X	X	X			X		
			South-Corridor: Maximize Storage at Edmonds School District Property	South-Corridor: improvements at Parkview and Casa del Rey																
D	Medium Corridor Storage – Culvert Replacement/ Conveyance Improvement Approach	Scenario 2 (Medium)	North Corridor: None	North-Corridor: improvements near Flynn's and Eunia Plaza																
			Mid-Corridor: Flood wall and Maximize Storage at 188th Street SW Property	Mid-Corridor: culvert replacements	X	X		X	X	X	X		X	X	X	X	X	X		
			South-Corridor: Maximize Storage at Edmonds School Dist. Property and some at Scriber Lake	South-Corridor: improvements at Parkview and Casa del Rey																
B+ FINAL	Minimum Plus Corridor Storage – With 188th St SW Property, ***Property Acquisition Approach*** + Culvert Replacement/Conveyance Improvement Approach	***Scenario 2A+*** (Minimum Plus)	North Corridor: None	North-Corridor: improvements near Flynn's and Eunia Plaza																
			Mid-Corridor: Flood wall ***and*** Maximize Storage at 188th Street SW Property	Mid-Corridor: ***property acquisitions and*** culvert replacements		X		X	X	X		**X**	X	X	X	X	X	X		
			South Corridor: None	South-Corridor: improvements at Parkview and Casa del Rey																

Evaluation Approach

The alternatives were evaluated by qualitatively scoring each individual project included in each alternative, and then aggregating those scores to capture and rank the overall benefits, impacts, and implementation considerations of the group of projects comprising each alternative.

The summary sheets included in Appendix G provide more detailed information regarding each individual project's performance according to the eight evaluation criteria listed above. Each project summary sheet includes a summary of anticipated flood reduction benefits, an itemized planning-level cost estimate, a summary of maintenance considerations, a list of anticipated project permits, and notes on potential grant sources for project financing. Appendices H and I, respectively, provide more detailed information about the permitting requirements and grant opportunities applicable to individual projects.

Table 10 describes how each of the alternatives was qualitatively evaluated using each evaluation criterion. For each evaluation criterion, each flood reduction alternative was scored from 1 (red color) to 5 (green color), with 1 being the least favorable score and 5 being the most favorable score. The overall evaluation score for each alternative was then calculated as the average of the scores for all criteria, without using any weighting.

Evaluation Criterion: Community Considerations (Table 10, Column 1)

The community considerations criterion captures the following issues identified by the Advisory Committee (2014):

- Aesthetic impacts and benefits (appearance, odors, mosquitoes, etc.)
- Public safety considerations
- Land ownership and easements
- Partnership opportunities
- Potential to help management of future development near the creek
- Effects on property values

In its final recommendations report (Advisory Committee 2014), the Advisory Committee conducted a preliminary rating of some of the individual projects that were recommended for consideration at the time. The consultant team referred to those results when qualitatively ranking the individual projects per this criterion.

Table 11 presents the community considerations scoring results for the individual projects associated with each alternative. The aggregate community considerations score for each flood reduction alternative (including multiple projects) was calculated as the average of the individual project scores.

Evaluation Criterion: Flood Reduction Performance (Table 10, Column 2)

The flood reduction performance of each project was evaluated according to the scenario modeling results described previously. The results were referenced and qualitatively evaluated when assigning a relative score for each alternative.

Evaluation Criterion: Project Cost (Table 10, Column 3)

The project cost for each alternative was determined as the sum of the costs for each of the individual projects included in the alternative (as outlined in Table 9). The total project costs were then referenced in assigning a relative cost score for each alternative.

Evaluation Criterion: Ease of Construction/Implementation (Table 10, Column 4)

The consultant team collaborated with the City during preparation of the individual project summary sheets to identify important construction and implementation considerations for each of the individual projects considered. Those feasibility considerations are presented on the summary sheets in Appendix G. The consultant team referred to those considerations when qualitatively ranking the individual projects per this criterion.

Table 11 presents the scoring results for ease of construction/implementation for the individual projects associated with each alternative. The aggregate score for ease of construction and implementation for each flood reduction alternative (including multiple projects) was calculated as the average of the individual project scores.

Evaluation Criterion: Ease of Maintenance (Table 10, Column 5)

The consultant team met with City of Lynnwood surface water operations and maintenance (O&M) staff on December 9, 2015, to discuss the potential flood reduction projects being evaluated and to review the preliminary results of the sedimentation evaluation (described in the previous *Geomorphic Observations* and *Existing Conditions Sediment Mobility Results* sections of this plan). During and after this meeting, City staff provided input on actual operational observations of sedimentation and sediment removal. The consultant team used that input to calibrate the sediment mobility calculations (Appendix F), to generate O&M cost estimates for the projects described in the summary sheets (Appendix G), and also referenced this feedback in qualitatively scoring each of the individual flood reduction projects according to the project's ability to either improve the efficiency of maintenance, or reduce the frequency or cost of maintenance.

Table 10. Alternatives Analysis Results.

Score Color Code:	1	2	3	4	5
	Least Favorable	Less Favorable	Average	More Favorable	Most Favorable

Alternative	Evaluation Criteria									
	Community Considerations	Flood Reduction Performance	Project Cost (O&M not included)	Ease of Construction/ Implementation	Ease of Maintenance	Habitat Improvements	Ease of Permitting	Life Cycle/Service Life Benefits		Overall Score
A (Model Scenario 1)	4	2	5	3	3	2	4	2	Alt A	3.1
	Reflects average of individual projects	100-year flow = 156.34 cfs downstream of Scriber Lake; acquisitions remove properties from flood risk, but residential roadways allowed to overtop	$4,300,000	Reflects average of individual projects	Reflects average of individual projects	Some riparian habitat improvements on acquired properties – no floodplain projects	Reflects average of individual projects	Fixes focus on maintaining existing infrastructure		Bare minimum project for achieving flood performance standards, but still allows some residential roadways to overtop; least capital costs, but more maintenance and O&M costs
B (Model Scenario 2A)	5	4	4	3	4	4	4	3	Alt B	3.9
	Reflects average of individual projects	100-year flow = 161.11 cfs downstream of Scriber Lake; flood performance criteria met, but not as much storage as Scenario 2	$4,800,000	Reflects average of individual projects	Reflects average of individual projects	Includes floodplain project at 188th St Property	Reflects average of individual projects	Broader corridor-wide conveyance and infrastructure improvements, but relies on existing 188th St culvert		Achieves flood performance objectives for moderate capital investment
C (Model Scenario 2B)	5	2	2	3	4	4	5	4	Alt C	3.6
	Reflects average of individual projects	100-year flow = 167.82 cfs downstream of Scriber Lake; not as much storage as Scenario 2, generally good conveyance improvements, but Old 196th St overtops during 100-year	$6,900,000	Reflects average of individual projects	Reflects average of individual projects	Includes floodplain project on School District Property	Reflects average of individual projects	Broader corridor-wide conveyance and infrastructure improvements without additional storage relying on existing 188th St SW culvert		Mostly achieves flood performance objectives for greater capital investment; less reliance on existing infrastructure
D (Model Scenario 2)	4	5	1	3	4	5	4	5	Alt D	3.9
	Reflects average of individual projects	100-year flow = 156.09 cfs downstream of Scriber Lake; flood performance criteria met	$8,500,000	Reflects average of individual projects	Reflects average of individual projects	Includes floodplain projects at both the 188th St and School District Properties	Reflects average of individual projects	Biggest investment in infrastructure improvements		Best flood performance results for greatest capital investment; better long-term life-cycle performance

Table 11. Project Evaluation Results for Supporting Alternative Evaluation Results.						
Alternative	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
A	4.4	4.4	2.9	3.6	3.4	3.1
B	4.4	4.8	3.0	4.3	3.7	3.7
C	4.6	4.9	2.8	4.3	3.9	4.2
D	4.0	4.4	2.8	4.2	3.6	3.7
Project Component	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
1	1	1	1	3	1	2
Scriber Lake Trail and Berm Improvements	Very complicated	More ponded water; more mosquitos, potential flooding of existing trails, reduced access during floods	Park access and trail detours required during construction; limited equipment staging areas; streamflow bypass likely needed	Trail provides good maintenance access; existing settlement problems imply more frequent maintenance may be needed to preserve freeboard provided by project	Project will alter existing hydroperiod and may negatively impact existing vegetation	Potential for settlement reduces lifespan expectancy for project
2	3	5	3	3	5	5
Remove Diversion Structure and Oil/Water Separator downstream of 196th Street SW	Moderately complicated	Project in park, no impact on property values, currently, weir is an attractive nuisance, project will improve aesthetics	Some park access and trail detours required during construction; good equipment access and staging; streamflow bypass likely needed	Good maintenance access; relatively higher maintenance frequency expected considering stormwater facility in addition to new weir/boulder riffle	Project will improve fish passage and provide improved riparian habitat	Project improves service life of existing 196th Street SW culverts
3	1	1	1	2	5	4
Replace 196th Street SW Culverts in Existing Location	Very complicated	Significant traffic impacts during construction will pose complications to the community	Significant WSDOT coordination required; complicated traffic control; complicated utility considerations; streamflow diversion needed; roadway settlement concerns	Regular sediment maintenance upstream and downstream of culvert expected given location in channel profile; WSDOT and WDFW/HPA coordination required	Project will improve fish passage	Project designed for good service life; actual service life may be limited by existing sub-soils
4	5	5	2	3	2	1
Raise Old 196th Street SW	Fairly straightforward	Project will improve business access during floods, improve public safety	Some traffic control and coordination with business owners required during construction; roadway settlement concerns	Potential issues with sedimentation and roadway settlement in this area will require increased maintenance frequency; WDFW/HPA coordination would be required if sediment removal needed to maintain project freeboard	Project does not remove the maintenance need which will have regular habitat impacts	Potential for settlement reduces lifespan expectancy for project
5	5	5	2	5	4	4
Parkview Plaza Culvert Replacement	Fairly straightforward	Project will improve business access during floods, improve public safety	Some traffic control and coordination with business owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs compared to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life, but may outlast expected lifespan for adjacent buildings and infrastructure
6	5	5	2	5	4	4
Scriber Creek Culvert Replacement at Casa Del Rey Condominiums Driveway	Fairly straightforward	Project will improve residential access during floods, improve public safety	Some traffic control and coordination with property owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs compared to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life, but may outlast expected lifespan for adjacent buildings and infrastructure
7	3	4	3	4	5	5
Maximize off-channel storage on Edmonds School District Property	Moderately complicated	Project will enhance aesthetics; will be designed to drain after floods, so no standing water nuisance. Loss of publicly accessible grass fields when converted to floodplain habitat.	Significant pre-construction coordination with Edmonds School District required; minor streamflow diversion needed only when connecting new floodplain to existing channel	Project provides a good opportunity and good access for sediment maintenance and removal; there may be temporal habitat impacts from maintenance; project should be designed for off-channel sedimentation so no WDFW coordination, HPA or streamflow diversion required for maintenance	Project will improve channel and floodplain connectivity as well as physical instream and riparian habitat	Project capable of long service life

Table 11 (continued). Project Evaluation Results for Supporting Alternative Evaluation Results.						
Alternative	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
A	4.4	4.4	2.9	3.6	3.4	3.1
B	4.4	4.8	3.0	4.3	3.7	3.7
C	4.6	4.9	2.8	4.3	3.9	4.2
D	4.0	4.4	2.8	4.2	3.6	3.7
Project Component	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
8	5	3	3	1	4	2
Acquire Frequently Flooded Properties between 188th Street and 191st Street	Fairly straightforward	Project will improve aesthetics, property values, some community concern and dissention regarding the pros/cons of residential property acquisition and a potential future trail	Elongated pre-construction coordination required for acquisition; construction fairly straightforward once properties are acquired	As this project is proposed in-lieu-of conveyance improvements, more maintenance is expected to close roadways during overtopping flood events or address existing sedimentation problems in corridor	Project will improve riparian habitat	As this project is proposed in-lieu-of conveyance improvements, this investment might be pursued and other culvert replacements may still be needed in future once existing culverts meet service lives
9a	5	5	3	5	4	5
Replace 191st Street SW Culvert	Fairly straightforward	Project will improve residential access during floods, improve public safety	Some traffic control and coordination with property owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs in comparison to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life
9b	5	5	3	5	4	5
Replace 190th Street SW Culvert	Fairly straightforward	Project will improve residential access during floods, improve public safety	Some traffic control and coordination with property owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs in comparison to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life
9c	5	5	3	5	4	5
Replace 189th Street SW Culvert	Fairly straightforward	Project will improve residential access during floods, improve public safety	Some traffic control and coordination with property owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs compared to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life
10	3	3	4	4	2	2
188th Street SW Flood Wall	Moderately complicated	Project will improve residential access during floods, improve public safety, project will induce more backwater that could potentially lead to more mosquito habitat, but mostly during floods only	Minor traffic control and sidewalk closure during construction; potential for settlement and loading concerns during construction over existing culvert; construction schedule fairly short	Minimal maintenance expected; when maintenance required, potential closure of traffic lanes may be necessary	Some minor impacts to riparian habitat (concrete wall vs. vegetation) but no habitat benefits from project	Project capable of long service life, but this investment might be pursued and adjacent culvert replacements that may occur once their lifespans are met might reduce project significance
11	3	5	4	4	5	2
Maximize off-channel Storage on the property north of 188th Street SW	Moderately complicated	Project will enhance aesthetics; will be designed to drain after floods, so no standing water nuisance.	Straightforward coordination with Lynnwood Parks; streamflow diversion needed	Project provides a good opportunity and good access for sediment maintenance and removal; there may be temporal habitat impacts from maintenance; project should be designed for off-channel sedimentation so no WDFW coordination, HPA or streamflow diversion required for maintenance	Project will improve channel and floodplain connectivity as well as physical instream and riparian habitat	Project capable of long service life, but this investment might be pursued and adjacent culvert replacements that may occur once their lifespans are met might reduce project significance

Table 11 (continued). Project Evaluation Results for Supporting Alternative Evaluation Results.						
Alternative	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
A	4.4	4.4	2.9	3.6	3.4	3.1
B	4.4	4.8	3.0	4.3	3.7	3.7
C	4.6	4.9	2.8	4.3	3.9	4.2
D	4.0	4.4	2.8	4.2	3.6	3.7
Project Component	**Ease of Permitting**	**Community Considerations**	**Ease of Construction/Implementation**	**Ease of Maintenance**	**Habitat Improvements**	**Life Cycle/Service Life Benefits**
12	5	5	4	4	3	4
Install small berms near Eunia Plaza and Flynn's Carpets	Fairly straightforward	Project will improve business access during floods, improve public safety	Reduced parking availability and coordination with business owners required during construction; short construction schedule	Minimal maintenance expected; when maintenance required, potential closure of parking areas may be necessary	Some minor impacts to riparian habitat (concrete wall vs. vegetation) but also minor riparian habitat benefits from plantings	Project improves service lives of adjacent infrastructure
13	5	5	3	5	4	5
Replace Driveway Culverts near Eunia Plaza	Fairly straightforward	Project will improve business access during floods, improve public safety	Some traffic control and coordination with property owners required during construction; streamflow diversion needed	Project should improve sediment maintenance needs in comparison to existing conditions	Project will improve fish passage and provide improved riparian habitat	Project capable of long service life

Evaluation Criterion: Ease of Maintenance (Table 10, Column 5)

The consultant team met with City of Lynnwood surface water operations and maintenance (O&M) staff on December 9, 2015, to discuss the potential flood reduction projects being evaluated and to review the preliminary results of the sedimentation evaluation (described in the previous *Geomorphic Observations* and *Existing Conditions Sediment Mobility Results* sections of this plan). During and after this meeting, City staff provided input on actual operational observations of sedimentation and sediment removal. The consultant team used that input to calibrate the sediment mobility calculations (Appendix F), to generate O&M cost estimates for the projects described in the summary sheets (Appendix G), and also referenced this feedback in qualitatively scoring each of the individual flood reduction projects according to the project's ability to either improve the efficiency of maintenance, or reduce the frequency or cost of maintenance.

Table 11 presents the scoring results for ease of maintenance for the individual projects associated with each alternative. The aggregate score for ease of maintenance for each flood reduction alternative (including multiple projects) was calculated as the average of the individual project scores.

Evaluation Criterion: Habitat Improvements (Table 10, Column 6)

During preparation of the individual project summary sheets, the consultant team identified important habitat improvements that could be achieved with each of the projects considered. Those habitat improvements are outlined in the project description on each project's summary sheet in Appendix F. The consultant team referred to that information when qualitatively ranking the alternatives for the habitat improvements criterion.

Although Table 11 presents the scoring results for the individual projects associated with each alternative, the aggregate habitat improvements score for each flood reduction alternative was determined by comparing the extent to which the alternative would enable fish passage through the length of the planning corridor, would create additional floodplain habitat, and enhance instream habitat. A focus of this aggregate assessment for scoring the alternatives per the habitat improvements criterion was on the effects of Projects 7 and 11 (Table 7).

Evaluation Criterion: Ease of Permitting (Table 10, Column 7)

The consultant team collaborated with the City during preparation of the individual project summary sheets (Appendix F) to identify the permits likely to be required and the expected level of permitting complexity anticipated for each project (Appendix G). The consultant team referred to that information when qualitatively ranking the individual projects for ease of permitting.

Table 11 presents the scoring results for this criterion for the individual projects associated with each alternative. The aggregate score for ease of permitting for each flood reduction alternative (including multiple projects) was calculated as the average of the individual project scores.

The applicable regulatory requirements that affect ease of permitting are described below.

Regulatory Framework

Wetland, stream, and stormwater regulations imposed by state and federal agencies and the City of Lynnwood will apply to activities planned as part of the selected alternative for the planning corridor. Filling and other alteration of wetlands and streams is regulated under the federal Clean Water Act, the state Hydraulic Code, the State Environmental Policy Act (SEPA), and the City of Lynnwood Critical Areas Code. Upland clearing and ground-disturbing activities also require clearing and grading permits from the City, which oversees the implementation of the National Pollutant Discharge Elimination System (NPDES) Phase II stormwater regulations issued by Ecology under the federal Clean Water Act. The City of Lynnwood Municipal Code (LMC) also establishes required buffer widths for wetlands and streams. Federal, state, and City regulations require mitigation for impacts on wetlands and streams, and the City also regulates impacts on the buffers of wetlands and streams.

Federal

Clean Water Act Sections 404 and 401

Section 404 of the federal Clean Water Act regulates the placement or removal of soil or other fill, grading, or alteration (hydrologic or vegetative) in waters of the United States, including wetlands (33 USC 1344). USACE administers the permitting program under the act. The permits include nationwide (general) permits for specific types of projects (e.g., maintenance) involving small areas of fill, grading, or alteration. Individual permits are required for projects not covered under nationwide permits, including those with large areas of disturbance and/or quantity of fill. The USACE does not regulate wetland buffers.

Section 401 of the Clean Water Act requires that proposed dredge (removal) and fill activities permitted under Section 404 be reviewed and certified to ensure that such activities meet state water quality standards (i.e., Section 401 Water Quality Certification). In Washington State, this certification is administered by Ecology and applies to all Section 404 permits. The Section 401 Water Quality Certification is achieved for projects through the Section 404 nationwide permitting process subject to conditions of the nationwide permit. An Individual Section 401 Water Quality Certification and associated review is required if nationwide permit conditions are not met (e.g., greater than a half-acre of wetland disturbance) and typically in instances where an individual Section 404 permit is required.

State

State Hydraulic Code

WDFW administers the Hydraulic Project Approval (HPA) program under the state Hydraulic Code, which was specifically designed to protect fish life. An HPA permit is required for projects that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state.

State Environmental Policy Act

The SEPA review process provides a way to identify possible environmental impacts that may result from government decisions. Information provided during the process helps agency decision makers, applicants, and the public understand how a proposal will affect the environment including, but not limited to, aquatic resources (e.g., lakes, wetlands, and streams), shorelines, earth, plants, and animals. Under SEPA, the City of Lynnwood is the lead agency for the selected alternative (and associated proposed projects) and is responsible for identifying and evaluating potential adverse environmental impacts.

City of Lynnwood

City of Lynnwood Critical Areas Code

On May 23, 2016, the City of Lynnwood adopted Ordinance No. 3193 that amended the Critical Areas Regulations in Chapter 17.10 of the LMC. The new critical area regulations took effect on June 1, 2016.

Wetlands

The LMC requires that wetlands be classified according to Ecology's 2014 Washington State Wetland Rating System for Western Washington (LMC 17.10.052; Hruby 2014), as detailed in Washington Administrative Code (WAC) 365-190-090. This classification system categorizes wetlands according to specific attributes such as rarity; sensitivity to disturbance; hydrologic, water quality, and habitat functions; and special characteristics. For each classification of wetland category and habitat score (Types I, II, III, and IV), the code specifies a buffer width (LMC 17. 10.050) and wetland compensation ratios (LMC 17.10.056) that would be required as a result of impacts to wetlands and their buffers. In addition, a 15-foot building or impervious surface setback is required from the edge of wetland buffers (LMC 17.10.060).

Streams

Streams are also classified under LMC 17.10.070 and according to the WAC 222-16-030. Type S streams are considered "shorelines of the state," Type F streams represent all waters (perennial or seasonal) that are known to be used by fish or contain fish habitat as defined by Washington State Department of Natural Resources criteria. Type Np streams represent perennial waters that

do not contain fish or fish habitat, and Type Ns streams represent intermittent waters that do not contain fish or fish habitat and have intermittent flows.

Despite downstream fish barriers in the vicinity of Interstate 5, Scriber Creek in the planning corridor is classified as a Type F stream because it is a perennial stream that contains fish habitat used by resident salmonids. LMC 17.10.071(B) requires Type F streams to have a 100-foot-wide buffer, measured from the ordinary high water mark on each side of the stream. In addition, a 15-foot building or impervious surface setback is required from the edge of stream buffers (LMC 17.10.080).

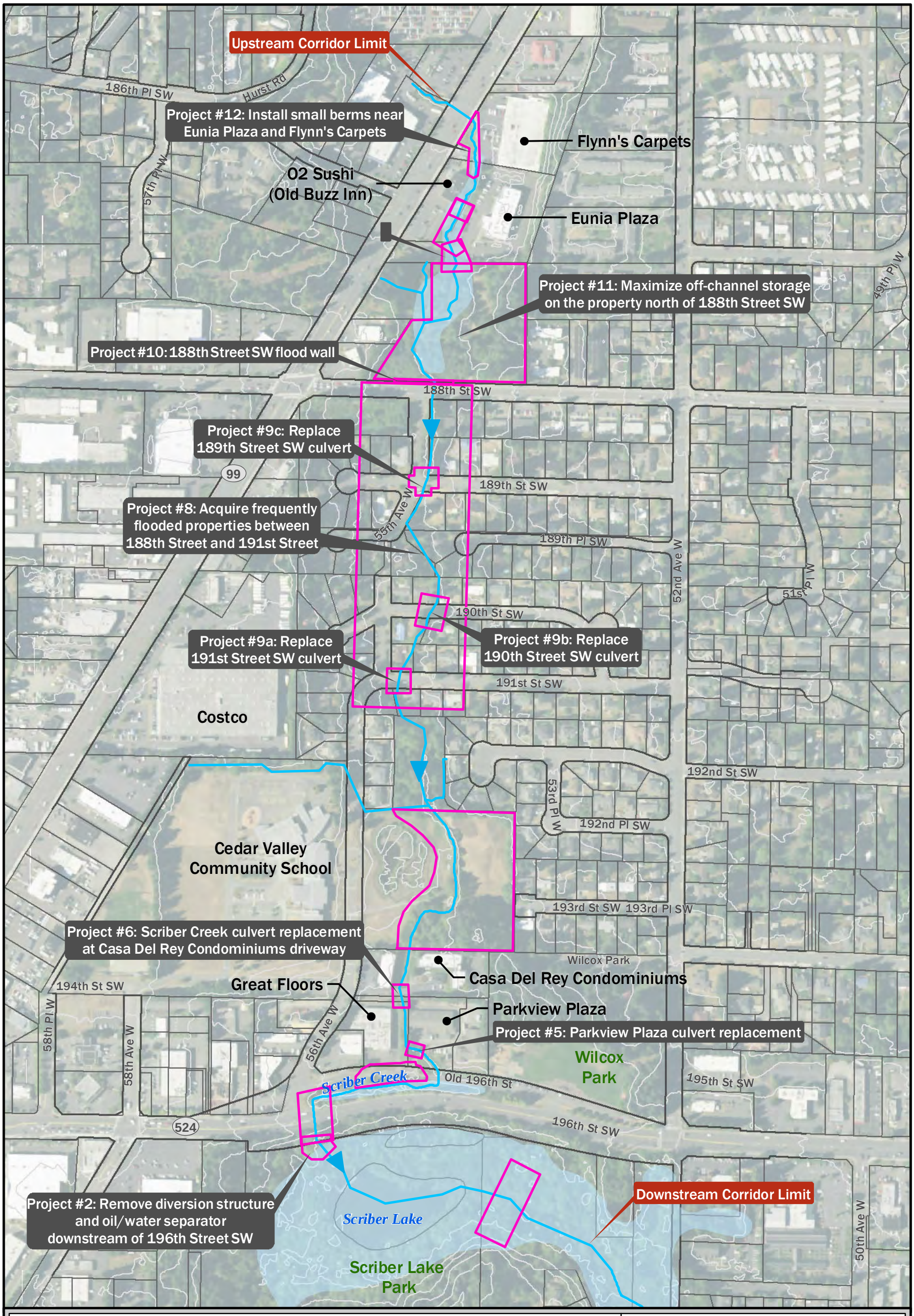
Evaluation Criterion: Life Cycle and Service Life Benefits (Table 10, Column 8)

The individual projects incorporated in each alternative would have varying service lifespans. This is an important consideration for the City in long-term management of Scriber Creek that is not captured by the other evaluation criteria. This criterion allows better differentiation of how each alternative would remain functional over the long term, whether some elements of an alternative might need to be replaced in the foreseeable future, and how the alternative incorporates improvements to key infrastructure features that would effectively extend the service life of the alternative (or otherwise). The aggregate score for life cycle/service life benefits for each flood reduction alternative (including multiple projects) focused on whether key infrastructure improvements would be accomplished, including the replacement of existing culverts that are likely nearing the end of their service lives.

Selection of a Preferred Flood Reduction Alternative

Through the alternatives evaluation process, the City, working with the consultant team, selected a variation of one of the alternatives, shown in Table 10 as Alternative B+, as its preferred alternative. Alternative B+ is also presented on Figure 9. Alternative B+ modifies Alternative B (Modeling Scenario 2A) by adding a strategy for selective property acquisitions within the vicinity of individual flood control Project 8 (Table 7) if and when property owners are willing sellers. This approach was selected to give the City flexibility with implementation of this alternative.

The City recognizes that funding is not currently available to implement all projects included in Alternative B+ at once. The construction and implementation of the proposed projects will have to be phased over time. Some of the projects, such as the culvert replacements, likely will not be implemented for several years due to the necessary order of implementation. Alternative B+ gives the City the flexibility to use the strategy of property acquisitions for willing sellers as an optional tool to help address ongoing flood hazards and risks in specific areas. It would give the City the opportunity of offering homeowners most at risk due to repeat flooding the option of moving out of the flood zone instead of having to wait until all projects in this plan are built.



Legend

- Proposed project area
- Scriber Creek
- Snohomish County wetland
- ROW
- Parcel
- 10-ft contour

Figure 9.
Projects Included in the Final Scriber Creek Flood Reduction Corridor Plan.

N

0 160 320 640 Feet

LYNNWOOD WASHINGTON

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An ancillary benefit of the acquisition strategy is that acquired properties could be used for other purposes (e.g., recreation, habitat improvements, flow control facilities, etc.). Should property acquisitions become more comprehensive, they may lessen the need for one or more of the Project 9 (Table 7), residential culvert replacements, and the need for those culvert replacements could be re-assessed over time.

Hydraulic Performance of Preferred Alternative

As noted above, the City's preferred alternative for this Scriber Creek Corridor Management Plan is Alternative B+ (Modeling Scenario 2A plus a strategy of acquiring property from willing sellers within the vicinity of Project 8). From a modeling perspective, the added component of property acquisitions would by itself have no real effect on stream hydraulics. As such, there was no need to update the model. For convenience, the modeling results for Scenario 2A, which correspond to the City's preferred Alternative B+, are incorporated into this plan as tables in the final Hydrologic and Hydraulic Report (Louis Berger 2016, see Appendix E).

With the potential property acquisitions added to Modeling Scenario 2A, one consideration is that such property acquisitions could later be used to provide additional flood storage. Flood storage could be added by excavating low areas adjacent to Scriber Creek, which would create additional floodplain connectivity. Additional flood storage would likely reduce downstream peak flows, water levels, and flow velocities slightly from that presented for Scenario 2A in Appendix E. The extent of flood storage that could be added via property acquisitions is not known at this time, and the additional excavations are not reflected in the cost estimates for the projects (Appendix G, Herrera 2016). Therefore, the potential effects of flood storage on acquired properties was not modeled.

RECOMMENDED PLAN FOR FLOOD REDUCTION

The current situation in the Scriber Creek corridor is one of degraded in-channel and floodplain habitat conditions; aging and undersized infrastructure, including culverts with inadequate capacity to convey peak storm flows; and challenges to a diverse community of residents, commercial business owners, and the Edmonds School District and its students that currently must deal with property and roadway flooding that endangers public safety. All of the flood reduction alternatives evaluated herein would provide varying levels of solutions for these problems. The alternatives include a core suite of projects (Projects 2, 4, 5, 6, and 12, Table 7) that could be pursued in the near future to start addressing these problems.

Future flood risk management actions in the Scriber Creek corridor must consider the ongoing and potentially increasing risk associated with taking no action. The combination of existing undersized culverts throughout the corridor and locally high rates of sedimentation associated with hydraulic constrictions will continue to exacerbate flooding problems and present additional risks of flood damage if no actions are taken.

A long-term, effective, and cost-efficient approach to the current situation cannot rely on one or two individual projects. The evaluation results indicate that Alternative B+ deserves to be considered as the best approach for flood reduction at the corridor scale. This alternative would provide sustainable flood reduction benefits, improve habitat, and address many community concerns. Further, Alternative B+ would require only a moderate level of investment compared to Alternative A (the alternative with the lowest project cost). Alternative B+ would rely heavily on the flood storage benefits provided at the City-owned property on the north side of 188th Street SW (through Projects 10 and 11), but other flood storage improvements (such as Project 7, which is one of the additional projects included in Alternatives C and D) could be added in the future for greater flood risk reduction if additional funding becomes available.

RECOMMENDED PROJECT IMPLEMENTATION ORDER

Implementation of the recommended Capital Improvement Program (CIP) projects will take several years. Individual projects will require more detailed survey, engineering analysis and predesign, permitting, and potentially property or easement acquisitions. Permitting alone for complicated environmental projects may take 1 to 2 years to complete. Funding for the individual projects will also be competing against other needs within the city. Thus, it is important to consider individual project implementation in a way that provides flexibility, but also meets the goal of not increasing downstream flows, which could worsen existing flooding problems.

Typically, implementing only conveyance improvements to solve flooding problems can increase downstream flows by eliminating flood storage. Flood storage attenuates peak flows. As a result, the sequencing of individual flood reduction projects must be done by incrementally adding flood storage to the creek system to offset the loss of flood storage resulting from conveyance improvements. After first implementing storage improvements, the City should then seek to prioritize the projects that can address the worst, chronic flooding problems and be completed without time-consuming permitting and property acquisition, so that those flood benefits can be realized sooner than later. All other things being equal, it is generally best to proceed with conveyance improvements from a downstream to upstream direction to reduce the risk of localized flood impacts in the middle of the corridor.

Keeping these factors in mind, a preliminary sequencing approach is described below, recognizing that this is preliminary and the sequencing could be impacted by factors beyond the City's control (such as inability to obtain easements) and available funding.

- **The first priority is Project 10 (188th Street SW Flood Wall).** This is a keystone project in the proposed Corridor Plan because it can cost-effectively add flood storage to the system and because it should be fairly straightforward to implement. Project 10 is on City property and does not trigger impacts below ordinary high water (OHW); therefore it avoids time-consuming property approvals and should have streamlined environmental permitting.

- **The second priority group of projects includes Projects 4, 5, and 6.** After Project 10 is brought on-line, this group of conveyance improvements should be prioritized in order to address the severe and chronic flooding around the Casa Del Rey Condominiums and north of 196th Street SW that affects several properties. This combination of individual flood reduction projects would be very similar to Modeling Scenario 1. Thus, a review of the modeling results for that scenario demonstrates that these projects, together, could be implemented without increased downstream flows as long as they are implemented after Project 10. From a hydraulics perspective, it would generally be best to proceed with constructing Projects 4, 5, and 6 in that order, from downstream to upstream. From a feasibility and construction perspective, the preferred order is likely similar. Project 4 would not trigger impacts below OHW but would require traffic coordination with business owners during construction. Projects 5 and 6 would be more complex than Project 4, requiring more preconstruction coordination with the private landowners, time to develop a cost-sharing agreement, and similar construction complexity with traffic coordination required and impacts below OHW. However, because the culverts in the vicinity of this second priority project group only provide a 10-year level of protection under existing conditions, the City should be prepared to quickly respond to opportunities for promoting the implementation of these projects as soon as possible.

  Project 2 can be implemented before or after this second priority group of projects. The key differences from Scenario 1 are that this combination of individual flood reduction projects may or may not include Project 2 (Remove Diversion Structure and Oil/Water

Separator Downstream of 196th Street SW), and would not include Project 8 (property acquisitions), nor Project 12 (berms near Eunia Plaza and Flynn's Carpet Cents). Project 8 had no effect on the modeling results. Project 12 would likely result in only slight increases in downstream flows because only a small volume of flood storage from previously inundated parking lots would be lost as a result of the berms. Thus, it can be inferred that this second priority group of projects could be implemented after Project 10 and not result in downstream flow increases.

- **The third priority is Project 2 (Remove Diversion Structure and Oil/Water Separator Downstream of 196th Street SW).** This project will require some coordination with Scriber Lake Park and will involve a streamflow bypass.

- **Project 12 (install berms near Eunia Plaza and Flynn's Carpet Cents) is a fourth or fifth priority project.** This project would benefit the north part of the corridor where creek bank overtopping occurs during more extreme flood events (the 100-year flood event currently overtops culverts, but the 10-year flood event currently overtops the pedestrian bridge near Flynn's Carpet Cents). The flooding at Eunia Plaza is less severe in comparison to other flooding problems downstream of it. Therefore, Project 12 could be implemented either before or after Project 11 as funding is available and as easements and access are coordinated.

- **Project 11 (off-channel storage on property north of 188th Street SW) is a fourth or fifth priority project.** Project 11 is the keystone project for providing sufficient storage to mitigate for the other large projects that could be constructed later, such as the culvert replacements between 191st Street SW and 189th Street SW (Project 9). Because Project 11 includes expanding the wetland north of 188th Street SW, it will take several years to implement due to complicated environmental permitting and required coordination with the City of Lynnwood Parks Department. Therefore, consideration should be given to initiating preliminary survey and predesign a minimum of about 3 years prior to when the City would like to have it constructed. Because the flooding at Eunia Plaza is less severe in comparison to other flooding problems downstream of it. Project 11 could be implemented either before or after Project 12 as funding is available and as easements and access are coordinated.

- **The three separate culvert replacements within the residential area between 191st Street SW and 189th Street SW and included in Project 9 represent the sixth priority set of projects.** These culvert projects are conveyance improvements that will tend to increase downstream flow, which is the reason they should be implemented following the 188th Street SW wetland expansion (Project 11). Each of these projects would require some time to acquire temporary easements for access during construction, but environmental permitting would be streamlined because replacement of undersized or aging culverts can be considered maintenance (streamlining the time and effort required to obtain State and federal permits) and most of the construction could be accomplished within the City-owned right-of-way. Putting construction

feasibility considerations aside, these projects could be constructed from downstream to upstream to minimize the potential for temporary flood impacts on properties located between culverts.

PROGRAMMATIC CONSIDERATIONS

In addition to implementing the proposed suite of CIP projects recommended by this plan, there are several programmatic, non-structural approaches to flood risk reduction that the City could pursue, and continue to pursue, in tandem. These programmatic solutions include actions such as policies, coordination strategies, ordinances, educational efforts, and maintenance practices. The City is already meeting the requirements of its NPDES Phase II permit today, but as it updates its comprehensive plan, the City could benefit from a re-evaluation of its programmatic stormwater management policies and procedures, such as addressing maintenance needs of privately owned stormwater facilities. For this Scriber Creek Corridor Management Plan, two programmatic considerations for flood reduction are emphasized, including the strategic acquisitions of flood-prone properties from willing sellers (Project 8), and strategies for sediment management within the corridor (Project 14).

Strategic Property Acquisitions for Willing Sellers

While implementing the proposed suite of capital projects recommended in Alternative B+, the City intends to develop a policy to enable the strategic acquisition of properties from willing sellers. As the Scriber Creek corridor developed prior to stringent stormwater management and critical areas regulations, many homes and businesses were built in the floodplain and in some cases right up against the stream bank. The time required to plan, coordinate, and construct capital projects for storage and conveyance improvements to then reduce flood risks for these homes and businesses can sometimes take several years. This property acquisition approach will provide the City with another tool for reducing flood risks. If the programmatic approach focuses on willing sellers, then the timing of the acquisition will be what works well for the landowner, and property condemnations can be avoided.

It is noted that the City may consider the acquisitions for reasons beyond flood risk reduction. For example, the City may elect to acquire property for a recreational trail or to be used to provide environmental mitigation for other City projects within the Scriber Creek basin. If the City is successful in acquiring several residential properties, the City could elect to incorporate additional flood storage or protection actions that could potentially lessen or even eliminate the need for one or more of the Project 9 culvert replacements. Depending on the extent of channel improvements that can be integrated into acquired properties, the City could evaluate other possible means of increasing the level of roadway protection by adding flood storage and/or some berming along with property acquisitions.

Sediment Maintenance Recommendations

Routine and comprehensive sediment maintenance is an important component of a well-functioning stormwater network. Challenges arise when, as is the case for this Scriber Creek corridor, the stormwater network is predominantly a stream channel or wetland in which permits are required for sediment removal. This plan recommends designing and constructing the proposed capital projects to help manage chronic sediment problems and also steer sediment maintenance where it can be most efficient and also reduce impacts to aquatic habitat.

Implementing the conveyance improvement CIP projects proposed in this plan (Alternative B+) represents the first step in the overall strategy for a more efficient and cost-effective sediment maintenance strategy. As shown by the sediment mobility modeling results, implementing flood reduction actions consistent with the Scenario 2 modeling is likely to reduce sediment accumulation upstream of replaced culverts and also upstream of 196th Street SW, especially if those actions incorporate physical habitat improvements that also reset a more stable channel cross-section and profile that is not prone to bank erosion, channel incision or degradation. At the same time, the hydraulic modeling scenarios and corresponding sediment analysis presented herein suggest that in order to maintain flood conveyance capacity over the long term, regular sediment removal is still expected to be necessary in some locations within the corridor regardless of whether flood risk reduction actions are implemented. Under existing conditions periodic sediment removal is likely to be needed upstream of the 196th Street SW culverts and between 188th Street SW and 189th Street SW. According to the sediment supply estimates and sediment mobility model results, up to approximately 100 to 150 tonnes (110 to 165 tons) of sediment per year may need to be removed, on average, with considerable variability between years. Implementation of Alternative B+ actions will shift the focus of sediment removal activities to the expanded flood storage area upstream of 188th Street SW, and will likely reduce the average annual volume of sediment removed. The design of all storage projects constructed as a part of this plan should consider siting sedimentation zones and constructing sediment maintenance access to off-channel areas where sediment removal activities can occur in isolation from the active stream channel and streamflow.

Funding Options Assessment

The expected breakdown of project costs for Alternative B+ is presented in Table 12 Supporting assumptions and cost-breakdowns for each of the individual projects is described in the summary sheets in Appendix G. In total, the City's implementation of the flood reduction projects proposed in this plan will require appropriate and substantial levels of funding. The City draws the majority of its funding for stormwater management program work from the Surface Water Utility Fund 411. The City also issues revenue bonds, which are paid by the Surface Water Utility, to implement storm and surface water capital improvement projects. The City can also elect to use its In-Lieu-Fee stormwater program to support previously identified storm and surface water management capital projects that have corridor-wide benefits, as would the projects identified in this plan.

Table 12. Cost by Project (based on 2016 dollars) for Implementing Flood Reduction Alternative B+.				
Project No.	**Recommended Implementation Order**	**Total Project Cost**	**Annual O&M**	**Project Description**
2	3	$320,000	$3,320	Remove Diversion Structure and Oil/Water Separator downstream of 196th Street SW
4	2	$450,000	$800	Raise Old 196th Street SW
5	2	$440,000	$1,080	Parkview Plaza Culvert Replacement
6	2	$630,000	$900	Scriber Creek Culvert Replacement at Casa Del Rey Condominiums Driveway
8	*Programmatic*	$1,900,000	$2,860	*Acquire Frequently Flooded Properties between 188th Street and 191st Street*
9a	6	$510,000	$900	Replace 191st Street SW Culvert
9b	6	$660,000	$900	Replace 190th Street SW Culvert
9c	6	$550,000	$900	Replace 189th Street SW Culvert
10	1	$380,000	$360	188th Street SW Flood Wall
11	4 or 5	$640,000	$1,030	Maximize off-channel Storage on the property north of 188th Street SW
12	4 or 5	$210,000	$400	Install small berms near Eunia Plaza and Flynn's Carpet Cents
		$4,800,000	**$11,000**	**Total Cost Without Acquisitions**
		$6,700,000	***$14,000***	***Total Cost With Acquisitions***

Because several of the proposed projects (Projects 4, 5, 6, and 12) will at least in part occur on private property, it is recommended that public/private cost-sharing agreements be developed for both capital construction and ongoing operations and maintenance. Estimated costs associated with the City's administrative time to develop these agreements have been built in to the overall project cost estimates included with the summary sheets in Appendix G. The outcome of each project-specific cost-sharing agreement will include some form of private financial sponsorship for the project.

To supplement these more traditional funding sources, the consultant team evaluated each of the potential flood reduction projects for their eligibility to obtain grand funding. There are several state, federal, and local resource protection grants available that could apply to many of the proposed projects, especially when projects are able to incorporate water quality or habitat improvements in addition to flood reduction benefits. A summary of these grants is summarized in Appendix I, by project.

Ongoing Public Education and Stakeholder Outreach

Through its efforts involving forming and convening the Advisory Committee and incorporating the committee's recommendations throughout the corridor planning process, the City has demonstrated its commitment to involving the public in decisions that affect the daily lives of

City residents and businesses. Although finalizing this plan concludes the official role of the Advisory Committee in helping to shape the final flood reductions solutions, it also marks the commencement of a new plan implementation phase, which will require ongoing public education and stakeholder outreach in order to be successful.

All of the projects proposed by this corridor plan will have some level of impact to either public spaces (whether parks or public rights-of-way) or private properties (whether through construction-related temporary access impacts or direct impacts to replace culverts on private property). Several of the proposed projects (Projects 4, 5, 6, and 12) will at least partly occur on private property and will require the development of public/private cost-sharing and legal agreements for both capital construction and ongoing operations and maintenance. The programmatic implementation of Project 8 will require public outreach and coordination efforts to be consistent with City-wide policies and strategies for any City acquisition of private property.

The extent, progress, and successful implementation of the projects identified within this Corridor Management Plan will be directly related to the effectiveness of public engagement, the success of public/private partnerships, and the willingness of private property owners to participate in and facilitate project development. Therefore, as the City proceeds with implementing this plan, it will be important that it continue to engage and inform the public and maintain established stakeholder relationships.

Coincident with plan adoption, the City should post a public announcement to the City's Scriber Creek Flood Reduction Study webpage (<http://www.lynnwoodwa.gov/City-Services/Engineering-Services/Public-Projects-and-Programs/Storm-Water-Projects/Scriber-Creek-Flood-Reduction-Study.htm>), in a final e-mail to the Advisory Committee, and in other city-wide publications, such as the City's printed quarterly newspaper, *Inside Lynnwood*, notifying the community and City residents of this plan's adoption, and where and how to find out more information about the planned projects as they progress.

Beyond this initial announcement, there are several additional ways of continuing to inform the public and stakeholders of the specific actions the City is taking as well as to alert them to schedule updates over time. Some recommended ongoing public education and stakeholder outreach actions relevant to the Scriber Creek Flood Study and Corridor Management Plan are discussed below.

First, the City will adhere to its municipal code regarding all required processes and forms of public notification about land use actions for specific flood reduction projects being completed as a part of this plan. Further, the City should capitalize on already established forums for public education and stakeholder outreach:

- Establishing and maintaining project pages on the City's website for the projects identified in this plan.

- Providing project-specific e-mail updates to interested residents and business owners.

- Providing opportunities for feedback and comment through project-specific public involvement processes, such as open houses.

- Providing project-specific information and public outreach by informational mailers, flyers, handouts, or/and door-to-door outreach.

- Communicating key project milestones by way of electronic publications such as *Lynnwood eNews*, *Inside Lynnwood*, *PW Infrastructure*, and project updates posted at the City website (<www.LynnwoodWA.gov>).

Beyond using its existing educational and outreach resources, the City could elect to also pursue any combination of the following public education and stakeholder outreach approaches, depending on the specific project needs.

- Providing information related to this Corridor Management Plan and planned projects via informational displays and handouts at City community events, such as the Fair on 44th, the bi-annual Citywide Open House, National Night Out, Lynnwood University, and the Sustainability Fair at Edmonds Community College

- Inclusion of information focused on protecting and improving the Scriber Creek and Scriber Lake watershed with regular updates of educational materials for supporting stormwater education for school children and the public. Specific efforts could include outreach to the Edmonds School District Cedar Valley Community School, and the placement of flyers or information boards within Scriber Lake Park.

- Providing regular plan implementation and project-specific updates using City of Lynnwood social media accounts.

By employing a combination of these public education and stakeholder outreach techniques, the City can provide the community with a variety of ways to remain informed and engaged as this plan is implemented.

Key Considerations for Plan Implementation

Implementation of the flood reduction actions recommended in this plan will require a concerted effort by the Public Works Department and coordination across several other City departments as well. Upon adoption of this plan by City Council, the City should focus on:

- Continuing to engage other City departments, especially the Community Development Department and the Parks and Recreation Department to pave the way for a smooth local permitting process and to discuss the land use and construction coordination issues regarding construction of the priority flood storage improvement projects that will occur on properties managed by those departments.

- Continuing public outreach efforts to residents and businesses to inform them of the actions the City is taking to implement the finalized plan and alert them to a proposed schedule of project implementation.

- Refining the City's implementation and funding strategies, and policy for property acquisitions for willing sellers.

- Incorporating the projects identified by this plan into other City-wide CIP project planning documents.

This corridor plan represents a comprehensive approach for reducing flood risks in the corridor between Scriber Lake and SR 99. As it is implemented, this plan should be revisited to ensure that it continues to be allocated adequate funding and priority so its goals will be realized.

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