Draft Pre-Design Report - Volume I

25th Avenue NE Flood Reduction Project

City of Shoreline

Louis Berger

In association with BergerABAM, Herrera, Perteet and Terracon

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HERRERA

Perteet

Terracon

March 2017

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25th Avenue NE Flood Reduction Project

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EXECUTIVE SUMMARY

Introduction

The City of Shoreline (City) has prepared this Draft Predesign Report for the 25th Avenue NE Flood Reduction Project (hereafter referred to as the project) to assess options to reduce flooding of Ballinger (West Lyon) Creek in the vicinity of 25th Avenue NE and NE 195th Street. The area has been subject to recurrent flooding of public rights-of-way and public and private property. The City retained a consulting engineering team led by Louis Berger to assist in the evaluation of the flooding problem and identify and evaluate feasible alternatives to reduce flood hazards.

This Executive Summary presents a condensed version of the study's core elements, including project background, efforts to date, alternatives under consideration, and next steps. More detailed information on pre-design efforts can be found in subsequent sections of the report.

This Draft Predesign Report does not include a recommended approach. Rather, feedback from a broad range of project stakeholders will be solicited, obtained, and weighed in the selection of a preferred approach, which will be presented in the Final Predesign Report.

Background

The study area (see Figure ES-1) includes locations of recurring flooding and potential improvements to reduce such flooding, generally defined as the area along Ballinger Creek piped and open channel segments located between the southeast corner of Brugger's Bog Park and Ballinger Way NE approximately 300 feet south of NE 195th Street.

A portion of the study area is within the City of Lake Forest Park (south of the boundary running along the north right-of-way line of NE 195th Street) because the existing Ballinger Creek culvert at NE 195th Street is undersized and contributes to upstream flooding within the City of Shoreline. This culvert and the Ballinger Creek channel running for approximately 500 feet downstream are also within the Washington State Department of Transportation (WSDOT) right-of-way associated with Ballinger Way NE (State Route 104).

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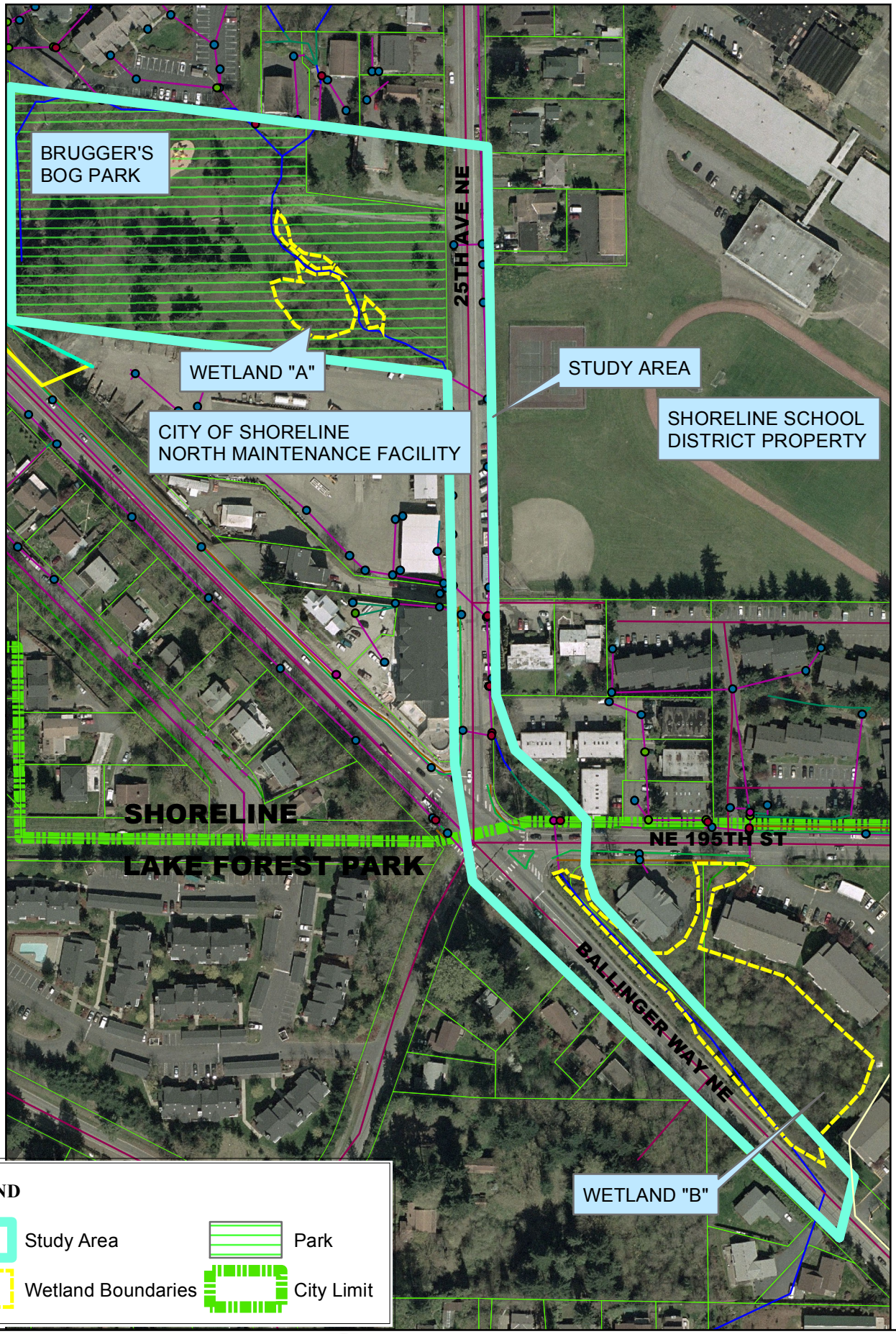

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure ES-1 -
Study Area

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

0 75 150 300 Feet

Date: 12/1/2016
Author: jellis

Path: P:\PROJECTS\City of Shoreline\25th Ave NE\Data Analytical\GIS\Figures\Figure 1-1 - Study Area.mxd

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Since 2001, the City has received reports of Ballinger Creek flooding public rights-of-way and public and private properties along 25th Avenue NE between Brugger's Bog Park and NE 195th Street on at least 16 separate occasions. In 2015, the City of Shoreline's Lyon Creek Basin Plan concluded that flooding in this area was due to a lack of capacity within the existing piped stream conveyance system along 25th Avenue NE and the NE 195th Street culvert. In October 2016, WSDOT completed emergency repairs to failed retaining wall at the southern end of the NE 195th Street culvert, but did not make improvements to the culvert itself.

The City is currently evaluating a potential plan to redevelop a former King County Roads yard site within the study area, located at 19547 25th Avenue NE. This site would potentially serve as new primary maintenance and operations center for the City, known as the North Maintenance Facility (NMF). Overlapping areas of interest shared by both the NMF and 25th Avenue NE Flood Reduction City projects will require that timing and other issues are closely coordinated as these efforts develop.

Project Objectives

The purpose of this study is to analyze existing flooding issues and potential solutions and recommend the best overall approach to reduce flood hazards, based primarily upon consideration of the following objectives:

- **Effective:** Proposed improvements should reduce flood risk to the maximum extent feasible.
- **Affordable:** Proposed improvements should (1) be cost effective, such that the flood reduction benefit received is maximal relative to expenditures; and (2) obtain funding from grants and other sources, if possible.
- **Acceptable:** Project team will converse with a broad collection of all interested stakeholders to gather input and help to identify the best approach. Proposed improvements should be supported by a wide selection of stakeholders.
- **Permitable**: Proposed improvements must be configured so that all required permits and approvals from regulatory stakeholders are obtainable.
- **Beneficial**: Proposed improvements should protect and enhance the environment and provide amenities to the neighborhood to the maximum extent feasible.
- **Coordinated:** 25th Avenue NE and NMF projects must work together for optimal timing and configuration of improvements.
- **Responsible:** Proposed improvements should have little to no impacts to downstream areas and minimal adverse impacts overall.

Pre-Design Process and Alternatives

Figure ES-2 presents the project's pre-design process and timeline, to illustrate a summary of study efforts to date and expected next steps.

The initial steps of the project were undertaken during the summer of 2016. To further understand the existing stream conveyance system and flooding problems, the team: (1) gathered and reviewed available information and (2) performed multiple technical investigations, including: field topographical and utility surveying; environmental critical areas assessment; geotechnical investigations; and hydrologic and hydraulic modeling.

Key findings of these investigations were considered in further development and evaluation of project alternatives. A number of complex potential challenges to the project were discovered during these investigations and the development of conceptual solutions. For the sake of brevity, such potential challenges are not described here in detail, but are summarized in Table ES-1, appear in the Selected Alternative discussion below, and are discussed in depth within the main body of the report.

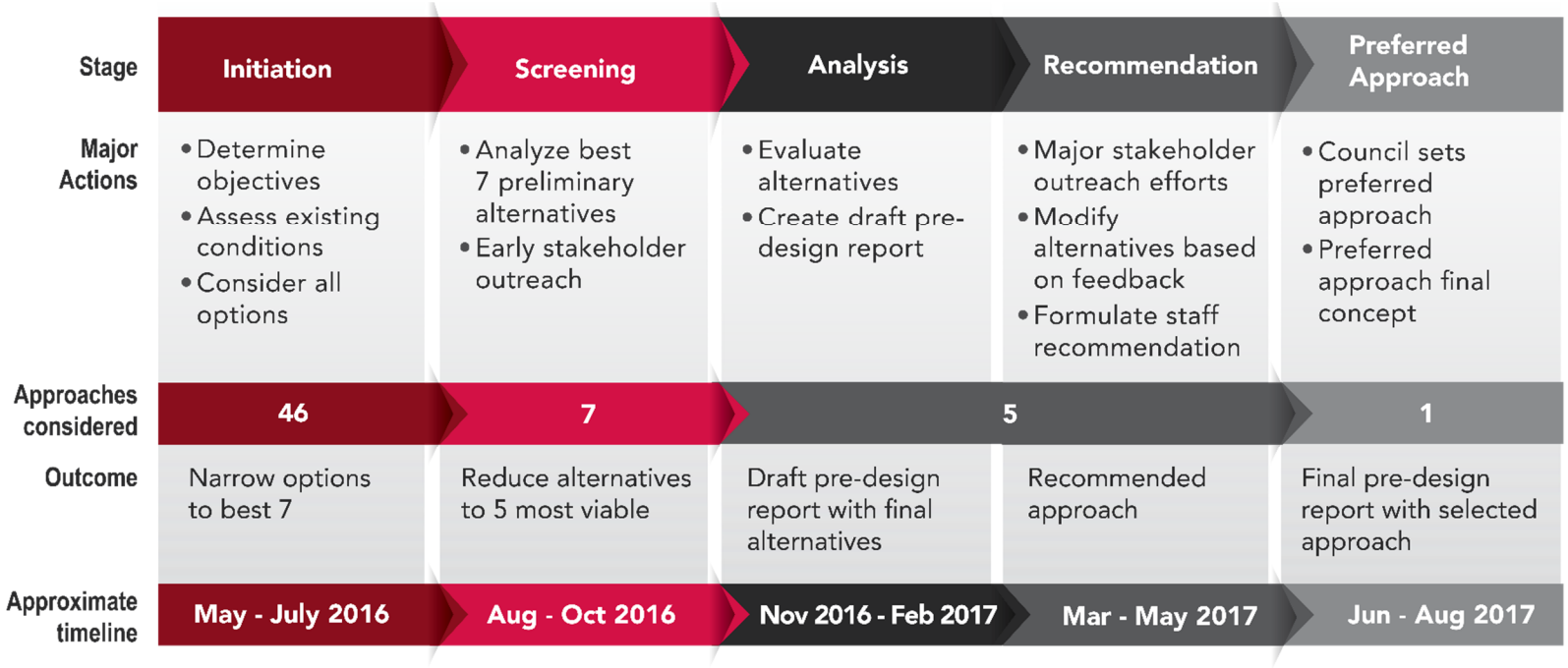
While the technical investigations were underway, the project team brainstormed a list of potential options numbering nearly 50 concepts, representing a wide range of conceivable solutions to flooding issues. A basic screening process using project objectives narrowed the matrix of brainstormed options to seven (7) preliminary alternatives deemed as the most feasible concepts for further consideration. (A full list of the initial options and screening outcome for each are summarized in Table 3-1.)

These seven preliminary alternatives were evaluated in more depth than the initial 46 options, but remained at a relatively high concept level without development of detailed conceptual plans and profiles, detailed modeling, or detailed cost analysis.

In the fall of 2016, these preliminary alternatives were presented to key stakeholders, including:

- City of Shoreline departments (in three separate meetings), with representatives from Public Works, Parks, and Planning and Community Development;
- City of Lake Forest Park departments (in a single meeting), with representatives from Engineering, Public Works, and Planning and Building; and
- Regulatory Stakeholders (in a single meeting), with representatives from U.S. Army Corps of Engineers (USACE), Washington Department of Fish and Wildlife (WDFW), and Washington Department of Ecology (Ecology). (Muckleshoot Indian Tribe Fisheries Division (MITFD) was unable to attend but was included on all meeting-related communications).
- Concept-level coordination efforts were also started with WSDOT, Seattle Public Utilities (SPU), Seattle City Light (SCL), Shoreline Public Schools, and the City's NMF project team.

Figure ES-2 Pre-Design Process Approach



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Discussion topics focused on the various areas of interest and/or expertise for these key stakeholders, so that the preliminary alternatives could be most effectively vetted for viability, feasibility, or other major concerns, which could affect the details of further development for each alternative.

Because of this early stakeholder outreach the preliminary alternatives received some adjustments to various concepts proposed. Two of the seven preliminary alternatives were dropped altogether from further consideration: Alternative 4 (closed conveyance improvements) and Alternative 5 (bypass improvements) were concluded to be effectively infeasible based upon comments from the regulatory stakeholders. *(Because of this elimination from further consideration, Alternatives 4 and 5 are not described in the Executive Summary; for more information see Section 3.1.3).*

Five Selected Alternatives

The remaining five Selected Alternatives emerged from the initial investigation, conceptual development, and early vetting process as the best, most feasible candidates to potentially fulfill the project objectives. *(More detailed alternative descriptions including plan and profile figures are provided in Section 3).* Figure ES-3 presents schematic alignments and extents of the five alternatives.

- **Alternatives 1 and 2: Daylight Ballinger Creek within the 25th Avenue NE right-of-way and replace the NE 195th Street culvert.** Alternative 1 proposes daylighting the creek along the west side of the 25th Avenue NE right-of-way to minimize impacts to existing roadside parking and avoid major utility conflicts (both existing parking and utilities are concentrated on the east side). Alternative 1 daylighted channel begins near the southeast corner of Brugger's Bog and extends south along the west side of 25th Avenue NE, including alongside the existing large residential building at 19500 Ballinger Way NE, crossing 25th Avenue NE near the southern end of this building.

  The Alternative 2 alignment along 25th Avenue NE matches the Alternative 1 alignment along the west side of the right-of-way for most of the length of the NMF property, then crosses to the east side of 25th Avenue NE around NE 195th Place to avoid construction adjacent to the foundation of 19500 Ballinger Way NE (built with no setback from the 25th Avenue NE right-of-way).

  Photo ES-1 (below) from a recent City of Bothell project with some similar concepts shows what the daylighted channel along 25th Avenue NE may look like: a daylighted stream sharing public right-of-way with other dedicated uses, utilizing traffic barrier and pedestrian railing to protect roadway and sidewalk users.

Photo ES-1. Example of 3-Sided Open Channel with Concrete Walls

Both Alternatives 1 and 2 also propose replacing the NE 195th Street culvert, which will require addressing some notable challenges, including:

- Need for the replacement culvert to pass beneath an existing 66-inch diameter SPU water distribution main (Tolt Pipeline), which will require special structural and construction considerations.
- Need to deepen the channel downstream of NE 195th Street (so the culvert can go under the water pipeline), which raises issues related to the narrow corridor available to the stream located between private property and a failing WSDOT gabion wall along the SR-104/Ballinger Way NE roadway. A new easement on private property would be required to avoid this work impacting the WSDOT wall.

- **Alternative 3: Daylight Ballinger Creek and create floodplain storage within the NMF property.** Viability of this alternative is completely contingent upon the NMF project team modifying their design concept in a significant manner (such as selecting an alternative NMF project site) which would, at minimum, free much of the eastern half of the NMF site to be used for surface water purposes; the current NMF design concept would not allow implementation of Alternative 3 by any means. In addition to allowing a more naturally-meandering daylighted stream channel with sloped banks, Alternative 3 could also potentially include floodplain storage, constructed wetland, water quality enhancement, and fish habitat improvements. Daylighting within the NMF site rather than the 25th Avenue right-of-way would also reduce impacts to other potential right-of-way uses (such as sidewalks, roadway lanes, and parking) and ease constructability. However, there is also some potential chance of contaminated soils at this location, which could add high costs to the project if encountered.

Downstream of NE 195th Place, Alternative 3 would follow the alignment of either Alternative 1 or Alternative 2 – including replacement of the NE 195th Street culvert and all associated work elements and challenges.

The Alternative 3 concept within the NMF site is also roughly analogous (as a mirror image) to what the daylighting configuration could potentially look like within the southwest-most corner of the Shoreline Schools Aldercrest Annex property on the east side of 25th Avenue NE. Early contact with the school district indicated that permission for project use of this property may be difficult to obtain so this option was not considered for further development at this time. If permission is somehow obtained in the future, the Alternative 3 concepts as presented would need to be reconfigured to account for conditions specific to the Aldercrest Annex property.

- **Alternative 6: "Buyout" to acquire frequently-flooding property.** Alternative 6 would target the most frequently-flooding areas within private properties to be purchased by the City and converted to floodplain storage features. This is a dual approach which eliminates some of the highest-risk flood problems and provides some additional flood storage, while also potentially avoiding in the near term the many complex challenges required to replace the stream conveyance system along 25th Avenue NE and/or the NE 195th Street culvert. The area initially selected for such a buyout approach would be the western half of the property at 2518 NE 195th Street (including one four-plex multifamily residential building – the building address of which is 19510 25th Avenue NE). The existing building would be demolished with the western half of the property converted to a floodplain storage facility, allowing of a small length of channel to be daylighted. The Alternative 6 overall flood reduction effectiveness is less than Alternatives 1, 2, and 3, and it also does not address the long-term need to ultimately replace the 25th Avenue NE conveyance system (within 20 to 40 years) due to eventual pipe deterioration.

- **Alternative 7: Small-scale flood proofing measures.** Alternative 7 would reduce the frequency and magnitude of flooding in small increments by implementing an array of lower-cost improvements. This approach avoids the cost and challenges of full system replacement. Such improvements would include repairing and extending the existing bypass system, berms, and providing better overflow pathways. The existing system floods during a 2-year storm (i.e. once every two years on average); Alternative 7 could increase the flooding interval to about a 5-year storm (i.e. once every five years on average). This approach would also attempt to improve control of floodwater pathways to minimize potential flooding damage for events when system capacity is exceeded. Alternative 7 overall flood reduction effectiveness is less than Alternatives 1, 2, 3, and 6; and (similar to Alternative 6) does not address the long-term need to ultimately replace the 25th Avenue NE conveyance system.

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BRUGGER'S BOG PARK

WETLAND "A"

25TH AVE NE

SHORELINE SCHOOL DISTRICT PROPERTY

19533 25TH AVE. NE

19500 BALLINGER WAY NE

2500 NE 195TH PL

2518 NE 195TH ST

NE 195TH ST

2525 NE 195TH ST.

WETLAND "B"

2609 NE 195TH ST.

BALLINGER WAY NE

BALLINGER WAY CULVERT

COLOR CODE
~~LEGEND~~

- Alternative 1 — *Daylighting Creek within 25th Ave. NE ROW (West side) and replace NE 195th Culvert*
- Alternative 2 — *Daylighting Creek within 25th Ave NE ROW (west and east side) and Replace NE 195th Culvert*
- Alternative 3 — *Daylight Creek in NFM and Transition to Alt 1 or Alt 2 (Alt 1 shown in graphic)*
- Alternative 6 — *Buy Out Alternative*
- Alternative 7 — *Flood Proofing Alternative*
- Shoreline City Limit

LINE TYPE

- Open Channel
- Closed Pipe
- Line Existing Pipe with Smooth Interior
- Berming/Raising Height of Driveway "Speed Bumps"
- Improving Conveyance of Existing Roadway Shoulder and Pipe System
- Limits of Buy-Out Property Acquisition
- Limits of Floodplain Storage

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure ES-3
Alternatives Overview

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Date: 2/2/2017
Author: James Ellis
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Detailed Alternative Evaluation

A detailed alternative analysis was performed for the five Selected Alternatives. Project objectives shaped these criteria for evaluation of alternatives:

- Project Cost (Estimated)
- Flood reduction performance
- Downstream impacts
- Fish Passage
- Impacts to Critical Areas
- Permitting Complexity
- Other Environmental Factors including Mitigation
- Constructability
- Property Impacts
- Permanent Parking Impacts
- Community Considerations (pedestrian improvements/environmental/aesthetic/ recreational)
- Property Acquisition Needs
- Maintenance
- Temporary Traffic Impacts
- Opportunities for Grant Funding

Table ES-1 summarizes the key differences between the alternatives. *See Section 3 for detailed discussion of criteria and how the various alternatives were assessed*.

Some important considerations regarding the alternatives are noted below:

- Alternative 3 is viable as a potential alternative only in the event that the City does not proceed with the NMF site development as currently planned. However, if the site is available, Alternative 3 would be the best long-term, holistic approach to eliminate flooding for up to the 100-year event, restore the creek, and provide an amenity to the community, assuming that potential risks from contaminated soil are determined to be negligible.

- Alternative 1 and 2 share many similarities. The key distinguishing factors are that Alternative 1 would require special construction practices (and associated costs) due to excavating the channel relatively close to the building at 19500 Ballinger Way NE; Alternative 2 avoids working in proximity to this building but instead faces challenges in the need to relocate several more major utilities and greater direct impacts to existing parking.

- Alternative 6 provides only a modest increase in flood protection relative to Alternatives 1, 2, and 3. However, in the event that NE 195th Street culvert replacement (and associated work) is deemed too expensive and/or fraught with risks and other complexities, Alternative 6 provides a reasonable approach to reduce the impacts of flooding caused by this culvert while avoiding its replacement (because the NE 195th Street culvert is not owned by the City, there is no long-term

obligation to replace it due to deteriorating pipe condition alone.) However, the 25th Avenue NE conveyance system would still continue to have capacity issues and need to be eventually replaced due to pipe condition; so upstream of the property to be acquired under Alternative 6 conveyance improvements similar to those proposed under Alternatives 1, 2, or 3 would be required in the long-term.

- Alternative 7 provides the smallest increase in flood protection among the alternatives. However, Alternative 7 could be implemented in the near future as either (1) interim improvements installed prior to a much larger scope preferred approach which will require (at minimum) two to three years to begin construction, or (2) as effectively "standalone" improvements in the event that the City opts to delay a near-term selection of a preferred approach in order to allow for more resolution of current uncertainties (such as potential availability of the NMF and/or Aldercrest Annex sites, securing sufficient funding, viability of other property and/or easement acquisitions, etc.).

Issue Draft Report

This Draft Predesign Report does not yet include a recommendation for the preferred alternative. Following issuance of this Draft Report, the City will solicit detailed input from the broad range of stakeholders; this input will be used as a key factor in evaluating the selection of the preferred approach.

Table ES-1:
Alternative Summary Comparison

Alt. No.	Brief Description	Est. Cost ($M)	Flood Reduction Benefit[1]	Fish Passage and Habitat Benefits	Permit Effort	Major Potential Challenges and Other Considerations
1	Daylight in 25th Ave ROW (west side), Replace NE 195th St Culvert	$7.2	100-year	**High:** Full fish passage, some habitat benefits	High	Proximity to "25th Place" building foundation WSDOT SR104 gabion wall protection, easement needed within LFP Culvert below SPU 66" diameter water pipeline
2	Daylight in 25th Ave ROW (west and east sides), Replace NE 195th St Culvert	$6.7	100-year	**High:** Full fish passage, some habitat benefits	High	SCL pole and other utility relocations needed on east side of 25th Ave NE WSDOT SR104 gabion wall protection, easement needed within LFP Culvert below SPU 66" diameter water pipeline
3	Daylight in NMF site, Alt 1 or Alt 2 south of NMF site, Replace NE 195th St Culvert	$6.6 (w/Alt 1) $6.4 (w/Alt 2)	100-year	**Highest:** Full fish passage, best habitat benefits	High	Only viable if NMF site is available (currently unknown) Potential contaminated soil cleanup at NMF site Proximity to "25th Place" building foundation (if Alt 1) OR SCL pole and utility relocations (for Alt 2) WSDOT SR104 gabion wall protection, easement needed Culvert below SPU 66" diameter water pipeline
6	Buyout: Obtain west half of property at 2518 NE 195th St, remove building, install floodplain storage	$1.9	8-year[2]	**Low:** No fish passage, some habitat benefits	Low	Requires property acquisition Does not address upstream 25th Ave NE capacity issues or eventual need for 25th Ave NE system replacement NE 195th St culvert replacement deferred Potential to expand effectiveness by future buyouts
7	Flood Proofing: Array of small improvements	$0.5	4-year[3]	None	Low	Does not address eventual need for 25th Ave NE system replacement Potential implementation as interim measures to support longer-term schedule for major improvements

Notes
1 Existing system provides a level of protection (LOP) against flooding of about a 2-year flood (i.e., 1 in 2 chance of flooding in any given year).
2 Provides up to about 8-year LOP for NE 195th ST and no improvement along 25th Ave NE
3 Provides up to about 4-year LOP for 25th Ave NE and reduced risk of structure flooding north of NE 195th St

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Select Preferred Approach

Following input from stakeholders, City staff and the project team will propose a recommended approach, which may or may not include nuances such an approach featuring phasing, contingencies, and/or implementation of more than one alternative. This staff recommendation will be presented to the City of Shoreline City Council for discussion and formal selection of a preferred approach, as authorized by Council. This process of selecting a preferred approach may also result in some modifications to elements of the alternative(s) included in the preferred approach.

Issue Final Report

Following City Council selection of the preferred approach, this draft report will be updated as a final pre-design report, which will serve as the basis for further project development and design leading to construction of improvements.

Section 1
Introduction

1.1 Introduction

The City of Shoreline (City) is preparing this Draft Predesign Report for the 25th Avenue NE Flood Reduction Project (hereafter referred to as the project) to assess options to reduce flooding of Ballinger (West Lyon) Creek in the vicinity of 25th Avenue NE and NE 195th Street. The area has been subject to recurrent flooding of roads, and public and private property. The City retained a consulting engineering team led by Louis Berger to assist in the evaluation of the flooding problem and identify and evaluate feasible alternatives to reduce flood hazards. This section provides a description of the study area, brief history of flooding within the area, a review of what prior work has been conducted in the area, project study goals and objectives, and a summary of the City's stakeholder involvement efforts.

1.2 Study Area and Existing Drainage System

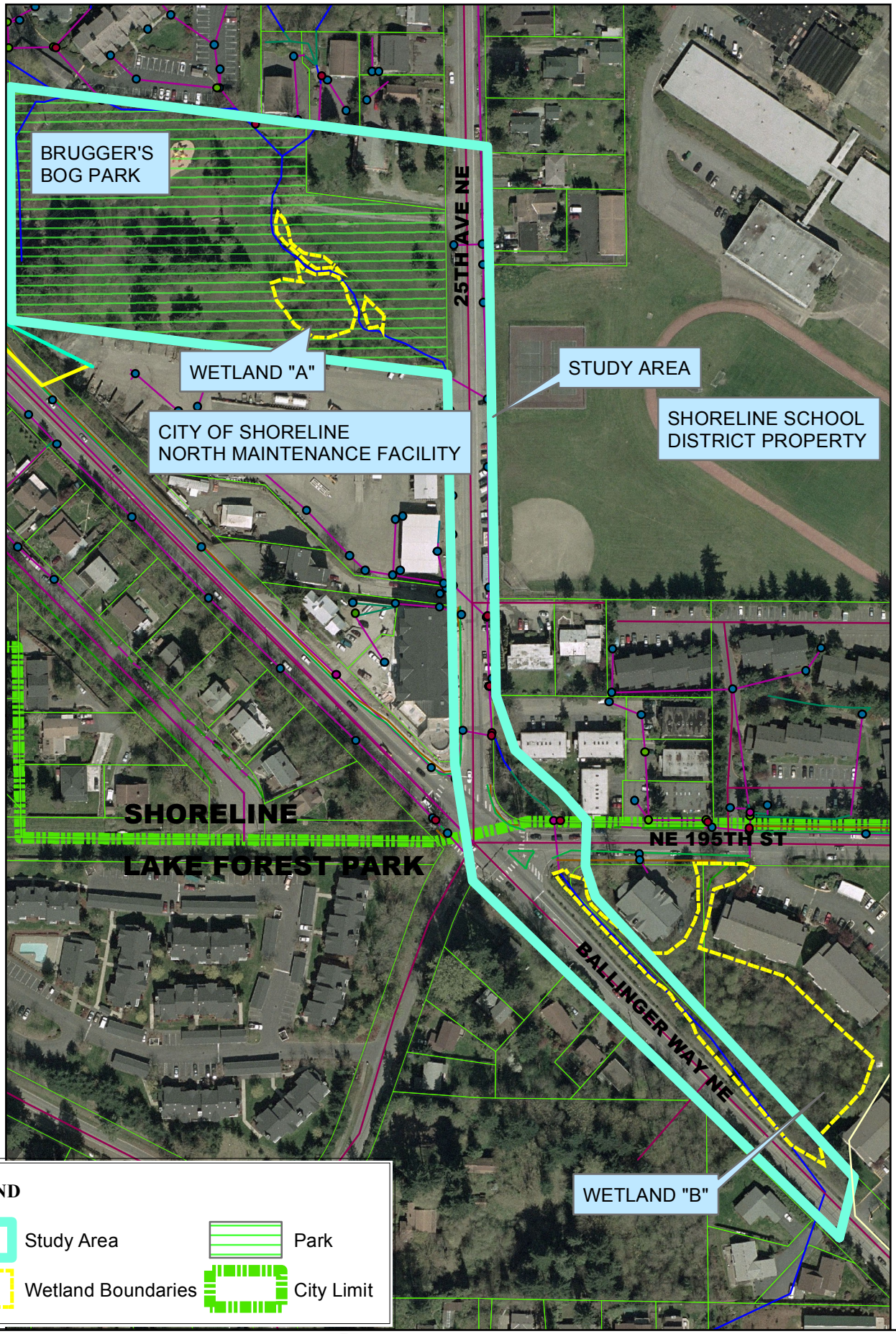
The study area is presented on Figure 1-1 and is generally defined as the Ballinger Creek system from the southeast corner of Brugger's Bog Park to approximately 300 feet south of NE 195th Street. The study area was defined to include the primary areas within which improvements may be proposed to reduce flooding.

Ballinger Creek originates in the City of Mountlake Terrace and enters the City of Shoreline at NE 205th Street. It continues south through backyard channels, crosses NE 203rd Street and enters the Ballinger Creek Open Space (a City Park property that is forested and not improved). It continues south through private property (Ballinger Creek Condominiums) and through the City's Brugger's Bog Park where two tributaries join the creek from the northeast and west. A wetland area exists within the park (Wetland A). It is important to note that in spite of the name "Brugger's Bog", there is no bog present as defined in Washington Administrative Code (WAC) 222-16-010; hence regulatory protection requirements for bogs do not apply to this area.

From the southeast corner of the park, the creek enters a 24-inch-diameter storm drain pipe system, crosses under 25th Avenue NE, and continues southward in a pipe system that varies in size from 24-inch to 30-inch-diameter on the east side of 25th Avenue NE. A separate 24-inch-diameter high-flow bypass system runs parallel to this system along the west side of 25th Avenue NE. Both pipes combine into a 40-inch wide x 30-inch high corrugated metal pipe (CMP) arch just south of NE 195th Place. Ballinger Creek daylights into a channel within a City of Shoreline surface water and storm drainage easement on private property (at 2518 NE 195th Street) and extends approximately 150 feet south before entering a 36-inch wide x 24-inch high CMP arch culvert crossing under NE 195th Street. The creek continues southeast along the east side of Ballinger Way NE within a large wetland (Wetland B). Downstream of the study area, the creek continues southeast within the wetland before crossing under Ballinger

Way NE through a 30-inch-diameter CMP culvert located about 500 feet southeast of NE 195th Street. The creek continues south and east ultimately joining the Lyon Creek main stem another 0.6 miles downstream of Shoreline city limits. Lyon Creek ultimately enters Lake Washington at the Lake Forest Park town center about 1.5 miles below the Ballinger-Lyon Creek confluence. The portion of the Ballinger Creek basin tributary to Ballinger Way NE is presented in Figure 1-2.

The study area includes portions of both cities of Shoreline and Lake Forest Park. The City of Shoreline corporate boundary is defined by the north right-of-way line of NE 195th Street. The portion of Lake Forest Park is included in the study area because past studies have indicated that the Ballinger Creek culvert at NE 195th Street is undersized and contributes to upstream flooding within the City of Shoreline and as such, improvements to this culvert are likely to be required. While the NE 195th Street culvert is within the City of Lake Forest Park, it is noted that it is also within the Washington State Department of Transportation (WSDOT) right-of-way associated with Ballinger Way NE (State Route 104).



City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 1-1 -
Study Area

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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Date: 12/1/2016
Author: jellis

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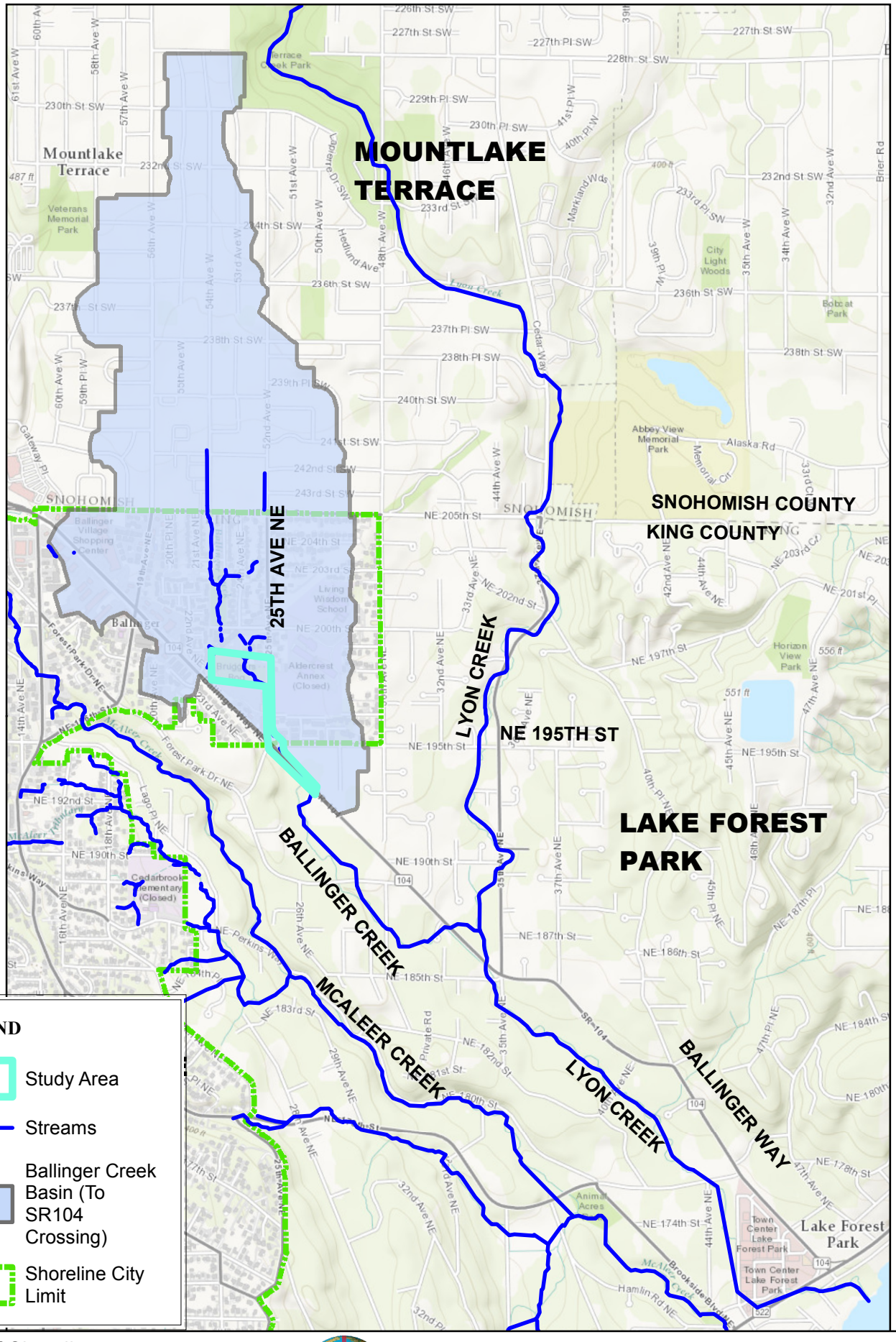

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 1-2 -
Ballinger Creek Basin

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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Date: 1/30/2017
Author: jellis

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1.3 History of Flooding

The project area was within unincorporated King County until City of Shoreline incorporated in 1995. Since 2001, the City has received reports of Ballinger Creek flooding along 25th Avenue NE between Brugger's Bog Park and NE 195th Street on at least 16 separate occasions. Service requests describe flooding of roadway, yards, parking lots, crawl spaces and in close proximity to (and at least in extreme events apparently intruding into) living space of multifamily buildings, and the City's North Maintenance Facility (NMF) site (formerly a King County Roads yard). Appendix A includes a summary spreadsheet and marked up map to summarize available flooding history service requests from 2001 to the present. Both City of Shoreline and King County records were searched for earlier instances of reported flooding but none were found prior to 2001; this may be due to under-reporting, under-recording, or other difficulties in accessing old records.

In 2005, the City obtained an easement and constructed non-engineered improvements to a frequently-flooding portion of open channel at 2518 NE 195th Street (a copy of the easement is included in Appendix C). The project widened the channel and added stabilization features such as large woody debris which may have helped to confine more flow within the channel and reduce flooding for the more frequent, low intensity flood events. Asphalt berms across driveways on the east side of 25th Avenue NE and other raised elevations along the eastern right-of-way may have been installed around this time as flood protection measures. However, the area has continued to experience flooding during higher intensity large storm events, including reported flooding on at least six occasions since the 2005 improvements. The largest flood in this period occurred during the December 3, 2007, storm event that flooded the roadways of both 25th Avenue NE and NE 195th Street, damaged vehicles, and flooded (or threatened to flood) multiple buildings.

Through analysis of hydrologic and hydraulic modeling results, survey topography, field observations, anecdotal reporting by City staff and review of the drainage complaints, some presumed flooding patterns have been identified. The flooding pathways described below are conceptual and heavily reliant upon topographical survey; at this time they have not been verifiable by direct observations of actual flooding (although they do appear to fit with some flooding reports). The pathways described assume that the 25th Avenue NE system capacity has been exceeded and follow a simple topography-driven accounting of system surcharges. Real world flooding, of course, is driven by a number of conditions which can interact in complex manners and may be relatively unique to each event. However, it is helpful for this project to understand and visualize generalized existing flooding patterns at this location based upon best available information.

In this hypothetical flooding scenario, at the most upstream end of the 25th Avenue NE system, overtopping Ballinger Creek flows would spill across the NMF driveway and continue about 300 feet southward along the west side of 25th Avenue NE to a closed contour within the right-of-way by the southeast corner of the NMF property. At this location floodwaters could collect to form a ponded area of around 6,000 square feet and up to 1 foot deep within the shoulder, roadway, and adjacent properties. Ponding

floodwaters reaching a depth sufficient to spill across the 25th Avenue NE roadway crest would then flow east to NE 195th Place, which is a likely location for problematic entry of floodwaters onto private property. Surface topography indicates a small ponding capacity within the 25th Avenue NE right of way at the southern end of the NE 195th Place driveway, but once ponding depth exceeds one to two inches, floodwaters would spill to the east, entering private property and flowing east and south through parking and yard areas and near multiple residential buildings. The floodwaters from the major event on December 3, 2007, apparently followed this path, with flooding reported at 19530 NE 195th Place, 19512 25th Avenue NE, and 2526 NE 195th Street.

Another source of flooding issues is the lack of peak flow capacity in the NE 195th Street culvert, which leads to backwatering within the upstream channel, spreading to the east and threatening multifamily residences as ponding deepens. Flooding reports from 2008 and 2012 appear to indicate that floodwaters in this location may tend to overflow to the east along the north side NE 195th Street upon reaching an elevation just below the finished floor elevations of the multifamily residences at 2518 NE 195th Street. Overflows traveling about 280 feet east along the north side of NE 195th Street from the Ballinger Creek culvert would find another, smaller culvert below a low spot in the roadway. At this location, flood overflows originating from Ballinger Creek could turn south – either within the small culvert or as surface flows over the roadway -- across NE 195th Street and enter a relatively wide ditch/channel that reconnects to Ballinger Creek within Wetland B.

1.4 Current/Prior Studies and Projects Relevant to the Project Area

A comprehensive list of studies and other information relevant to the stream/storm system, flooding, and environmental and critical areas is summarized in Appendix B. The most detailed recent study of this system and flooding problem was conducted as a part of the City of Shoreline's Lyon Creek Basin Plan (AltaTerra 2015). This study completed a comprehensive examination of natural and built drainage infrastructure within the City's 0.26 square mile portion of the Lyon (Ballinger) Creek Basin, including drainage condition assessments and hydrologic and hydraulic analyses.

The Lyon Creek Basin Plan included an analysis of the 25th Avenue NE flooding problem. Hydrologic and hydraulic modeling efforts confirmed historical and anecdotal observations that this system floods at an approximate 2-year frequency. Modeling determined that the existing piped stream conveyance systems along 25th Avenue NE and the NE 195th Street culvert are far below needed capacity. The study concluded that in order to reduce flooding, the 25th Avenue NE piped stream conveyance system would need to be replaced with a 72-inch-diameter pipe (or equivalent) and that the NE 195th Street culvert would need to be replaced with an approximate 11.6-foot wide x 5.2-foot high box culvert. Based on limited scope for the basin planning analysis and high level of potential project complexity, the City requested a basin plan recommended concept to resolve flooding without speculating upon the potential permit requirements of regulatory stakeholders.

Another project that is recent and impacts the study area is work completed by WSDOT. In early 2016, a gabion wall at the Ballinger Creek and NE 195th Street culvert outlet was observed to be failing. Excessive material piping occurred in between the gabion wall and the NE 195th Street roadway embankment resulting in total exposure of the vertical face of the roadway embankment and burial of the culvert outlet. The City coordinated with WSDOT on the design and provided input so that the replacement wall could more easily accommodate a future NE 195th Street culvert replacement which will be designed to meet Washington Department of Fish and Wildlife (WDFW) fish passage criteria. WSDOT completed the emergency repairs in October 2016. A copy of the design drawings for the wall repair is included in Appendix K in Volume II of this report. WSDOT had obtained emergency permits for the work. During construction, WSDOT setup a temporary stream bypass and performed electrofishing to remove fish from the work area. In doing so, they removed one juvenile coho salmon (Oncorhynchus kisutch) and two cutthroat trout (Oncorhynchus clarkii). Prior to this time, there had been no documentation of confirmed fish habitat use upstream of the NE 195th Street culvert (Herrera 2016).

An additional City project, the proposed North Maintenance Facility (NMF) is relevant to the 25th Avenue NE Flood Reduction project. The City purchased the NMF site (19547 25th Avenue NE, See Figure 1-1) in 2013. Prior to this time, the site was a maintenance facility owned and operated by King County. To date, the City's plan is to potentially redevelop the site as a major maintenance and operations center. Although not provided in this report, the City currently has conceptual site plans for this development (which are preliminary and could be modified if the City moves forward with site development). However, it should be noted that as of the writing of the draft pre-design report. City Council has authorized staff to pause development of the NMF and use the predesign facility programming information to identify alternative properties within the City that could potentially meet the Public Works maintenance facility needs. The goal of this work is to identify a location that meets the Public Works maintenance facility needs at a lower cost than the NMF site or confirm the NMF site is the best location and value. If this site is confirmed to be redeveloped as the NMF, it will likely include two driveways off of 25th Avenue NE, near the north and south property lines.

1.5 Project Objectives

The primary objective of this project is to reduce flood hazards within the study area with the overall best and most cost effective approach. Selecting the best approach will involve several considerations and sub-objectives developed by the City and consultant team. These include:

- **Effective:** Proposed improvements should reduce flood risk to the maximum extent feasible.
- **Affordable:** Proposed improvements should (1) be cost effective, such that the flood reduction benefit received is maximal relative to expenditures; and (2) obtain funding from grants and other sources, if possible.

- **Acceptable:** Project team will converse with a broad collection of all interested stakeholders to gather input and help to identify the best approach. Proposed improvements should be supported by a wide selection of stakeholders.
- **Permitable**: Proposed improvements must be configured so that all required permits and approvals from regulatory stakeholders are obtainable.
- **Beneficial**: Proposed improvements should protect and enhance the environment and provide amenities to the neighborhood to the maximum extent feasible.
- **Coordinated:** 25th Avenue NE and NMF projects must work together for optimal timing and configuration of improvements.
- **Responsible:** Proposed improvements should have little to no impacts to downstream areas and minimal adverse impacts overall. Conveyance improvements to eliminate flooding problems can sometimes result in increased downstream flows (further described in Section 3.1.1).

1.6 Stakeholder Outreach

There are numerous stakeholders that will have input and some degree of influence on project formulation and outcomes, including property owners, jurisdictions, regulatory stakeholders, local interest groups, and environmental regulators. It will be important to coordinate with these stakeholders as a part of the planning process, including gathering data, evaluating and gathering input on preferred alternatives, and follow-up on design and permitting of project improvements to be constructed. Table 1-1 summarizes key project stakeholders as well as a short description of the stakeholder's relevance to the project.

Table 1-1:
Summary of Anticipated Project Stakeholders

Stakeholder	Relevance to Project
City of Shoreline (City) Planning and Community Development Department	The 25th Ave NE project will need to obtain any required local permits and approvals through the City Planning Department (e.g., SEPA, Critical Area Special Use Permit (CASUP)).
City of Shoreline (City) Parks Department	Coordination with the Parks Department will be required for any project-related activities or proposed changes to the areas within Brugger's Bog Park or along 25th Ave NE immediately east of the park (located at the upstream end of the project area) or for any potential project-related activities within the Ballinger Creek Open Space located along Ballinger Creek approximately 300 feet upstream of Brugger's Bog Park.
City of Shoreline North Maintenance Facility (NMF) Project Team	The project improvements and timing need to be coordinated with the site development of the NMF. For example, it would be undesirable to construct improvements for one project and then have those improvements disturbed by the other project. In addition, any daylighting of the creek along 25th Avenue NE fronting the NMF property will affect the site buffer. Understanding the buffer implications and timing associated with the impacts is important (e.g., if daylighting is constructed first, it could increase stream buffer on NMF and complicate development opportunities).
City of Lake Forest Park (LFP)	The City of LFP will have input to the project in a number of areas, including: LFP will provide input to the preferred alternative(s) for the project; LFP will be the lead agency for local permits and approvals within LFP jurisdiction (e.g., SEPA, right-of-way, critical areas); LFP engineering department will provide design review and approval for improvements within LFP. Should there be any new construction easements in LFP, the City of LFP would need to be the lead agency in acquiring the easements (with appropriate support from the City of Shoreline).
State and Federal Environmental Regulatory Stakeholders	In general, proposed improvements affecting wetlands and streams require permits and approvals from the Washington Department of Fish and Wildlife, Washington State Department of Ecology, and US Army Corps of Engineers. In some cases, these regulatory stakeholders may require compensatory mitigation in order to obtain project permits. Compensatory mitigation can be provided on- or off-site, but on-site, in-kind mitigation is generally preferred.
Native American Indian Tribes	Native American Indian Tribes have significant interest in the protection and restoration of fish habitat and species throughout the state. They also have interest in protecting Native American heritage. Two tribes that have expressed interest in the project area are the Muckleshoot Indian Tribe and the Snoqualmie Indian Tribe. Tribes have the opportunity to comment on projects during the public comment period for SEPA analysis associated with local and state permitting (e.g., Hydraulic Project Approval or Critical Areas Permit), in addition to Section 106 of the National Historic Preservation Act consultation required when federal permits (e.g., Nationwide Permit for Clean Water Act Section 404 compliance) are issued. Because Tribes typically provide project input as part of the regulatory process, as a stakeholder group they may sometimes be included in coordination with State and Federal Environmental Regulatory Stakeholders.

Stakeholder	Relevance to Project
Shoreline Public Schools	Shoreline Schools owns a large property immediately east of the 25th Avenue NE right-of-way along a significant portion of its length (2545 NE 200th Street, often referred to as the Alderwood Annex). This property is across the street from both Brugger's Bog Park and the North Maintenance Facility site and could be impacted by improvements, particularly any located on the east side of 25th Avenue NE north of NE 195th Place. While the Aldercrest Annex currently has no buildings and is only lightly used for parking in the northern half and some usage of athletic fields in the southern half, this project should coordinate with Shoreline Schools regarding current and potential future usage of this property. Shoreline Schools also operates an active school site (Aldercrest School site) located nearby at 2800 NE 200th Street, approximately 900 feet northeast of Brugger's Bog Park. Temporary construction impacts will need to be coordinated with consideration of activities related to this school, such as school bus and other traffic.
Private Property Owners and Residents	This stakeholder group includes property owners and residents neighboring project areas, as well as any downstream residents who could potentially be affected by any project improvements. Private properties adjacent to the project area may be currently subjected to flooding and/or could potentially be affected by the project. On-street parking appears to be in high demand along both sides of 25th Avenue NE north of Ballinger Way NE, which the project may impact. It will be important to get neighborhood input on the preferred alternative, and later in the project timeframe coordinate design details and construction activities and timing, etc.
Ballinger Neighborhood Association	It will be important to inform the community of the project, get input on the preferred alternatives, and coordinate construction notifications. The Ballinger Neighborhood Association is a citizen organization representing residents of the Ballinger neighborhood in northeastern Shoreline where the project is located.
General Public	The general public is a broad stakeholder group including City of Shoreline Surface Water Utility ratepayers as well as citizens from other jurisdictions who may pass through the project areas (drivers, bicyclists, pedestrians, and other public right-of-way users), and anyone else with an interest in this project not belonging to one of the other presently-identified stakeholder groups. The project team will seek input from the general public using the project website via the City's homepage, the City's "Currents" monthly newsletter, by open house, informational signage, and possibly by other means.
Lake Forest Park Stewardship Foundation (LFPSF)	The LFPSF is a citizen organization dedicated to the stewardship of natural environment within and around Lake Forest Park, with an interest in wetlands and watersheds for salmon habitat restoration and the overall health of natural systems. As such, it will be important to solicit input from LFPSF on the preferred alternatives.
Washington State Department of Transportation (WSDOT)	The Ballinger Creek NE 195th Street culvert is located in Ballinger Way NE WSDOT (SR104) right-of-way. The existing culvert is owned by the City of Lake Forest Park. However, if it replaced with a larger, fish passage culvert, it will likely exceed the threshold that defines who owns culverts that are in WSDOT right-of-way through a local jurisdiction (i.e. 60-inch-diameter). Thus, the replacement culvert will likely be owned and maintained by WSDOT and they will want to review and approve of the design. There is also a gabion wall along the east side of Ballinger Way NE adjacent to Ballinger Creek that is in poor/failing condition. Potential changes to the creek channel in this area will have to consider protection of the wall. WSDOT manages the signal at the intersection of NE 25th St/NE 195th St/Ballinger Way NE and owns infrastructure related to the signal, and will also be interested in any temporary traffic control affecting Ballinger Way NE during construction.

Stakeholder	Relevance to Project
Seattle Public Utilities (SPU)	Seattle Public Utilities' 66-inch-diameter steel water distribution main (the Tolt Pipeline) crosses directly above the Ballinger Creek culvert crossing of NE 195th Street. It will be important to coordinate the design of any replacement crossing to provide adequate clearance from the water line and get prior approvals from SPU for construction.
King County Flood Control District (KCFCD)	In 2016, the City applied for and was successful in obtaining a KCFCD Flood Reduction Grant to partially fund the pre-design and design development for the 25th Avenue NE Flood Reduction Project. KCFCD is accordingly a project stakeholder and will provide review feedback on project pre-design and design topics. This project is also eligible to reapply for KCFCD Flood Reduction Grant funding for future phases if eligible.
Other Utilities	There are several other utilities within the project corridor that will require coordination, particularly if proposed improvements require relocation of any utilities. Some of the key utilities include North City Water District, Ronald Wastewater District, Puget Sound Energy, Seattle City Light and telephone/cable providers. It will be important to understand requirements and timing for utility relocations, where needed.

Section 2
Investigations and Results

2.1 Survey, Base Mapping, and Existing Utilities

A field survey of the study area was conducted by the project team (Perteet Engineers) that included development of a project base map at 1-foot contour intervals and showing physical features and above ground and underground utilities along the project corridor. A copy of the survey is included in Appendix C. There are public and private utilities utilizing the 25th Avenue NE and NE 195th Street corridors within the project area. These include:

- North City Water District
- Ronald Wastewater District
- Puget Sound Energy
- Seattle City Light
- Telephone/Cable providers (providers known to be in the area include Comcast, CenturyLink, WSDOT – traffic light signals and traffic loops, although there may be others)
- Seattle Public Utilities (SPU)

Two of the more critical utilities that need to be considered during evaluation of alternative improvements are a 66-inch-diameter steel water lined owned by SPU that runs along NE 195th Street and utility poles jointly owned by Seattle City Light and CenturyLink carrying overhead power and telecom lines along the east side of 25th Avenue NE.

To understand the potential for utility conflicts with future conveyance improvements, underground utility potholing was also performed. Potholing was performed by Applied Professional Services (APS). Eleven (11) utility locate potholes were completed and the results are included in Appendix H in Volume II of this report.

Based on the results of the survey and utility potholing, a stream profile of the existing system was developed and is presented on Figure 2-1. This figure shows that the existing NE 195th Street culvert lies directly below the 66-inch-diameter water line.

Utility impacts of various alternatives are discussed in more detail in the Alternative Evaluation section of this report.

2.2 Storm Pipe Condition Assessment

Assessing the conditions of the 25th Avenue NE piped stream conveyance system and NE 195th Street culvert are important to inform the City how to weigh the long-term need to replace these pipes. Like all infrastructure, pipes have a functional lifespans which vary and are dependent upon numerous factors specific to the material, installation, usage, and environment of each pipe. At the end of this functional lifespan, the pipe will become compromised by structural failure(s) and require replacement. Pipes which have failed (common failures include breaks, holes, joint displacements, deformations, and collapses) may still be able to function as a conduit for flows, but with a high risk of a catastrophic event, such as a blockage leading to upstream flooding, or a hole which pipes soils away from above creating a sinkhole, or a hole which undermines a culvert leading to a blowout. Assessment of pipe system condition and planning for timely replacement can anticipate such failures and avert potential catastrophic events.

All of the pipes of interest are made of corrugated metal pipe (CMP) material. CMP typically has a targeted design life of 50 to 100 years, but in some instances may fail and require replacement after as little as 20 years due to corroded holes within the invert (pipe bottom). CMP is "flexible" pipe, meaning that it is dependent on proper pipe bedding materials and depths for full structural strength.

The existing NE 195th Street culvert was installed between 1961 and 1980, based on available plans for adjacent features (the 1961 plan for the 66" diameter SPU water line shows an 18" diameter concrete culvert at this location, while the 1980 plan for WSDOT gabion wall shows this CMP culvert). The existing 25th Avenue NE piped conveyance system was probably installed between 1950 (date of King County Roads yard development) and 1980 (completion of most initial development in this area). So the CMP infrastructure of interest is likely at least almost 40 and possibly over 55 years old, an age at which corrosion may lead to significant structural defects.

The complete 25th Avenue NE piped stream conveyance system was CCTV inspected in the summer of 2014 under the Lyon Creek Basin Plan condition assessment (both low flow and bypass branches, around 950 total linear feet). Appendix O in Volume II of this report contains CCTV summary inspection reports for each pipe reach (between CBs) along with a key map that identified structure locations and names. The CCTV inspection included a qualitative inspection rating following the industry standard National Association of Sewer Service Companies (NASSCO) system of rating.

With a few minor exceptions, overall condition for this system appears to be good; observed defects were mostly limited to a handful of small holes and dents. Two pipes (SP-1973 on the east side of 25th Avenue NE, and SP-2908 on the west side) exhibited a couple larger holes and deformations which may warrant repair if this system is to remain in extended operation. Surface corrosion was consistently present within the inverts of all these pipes, as could be expected for CMP of this age. While the depth and extent of corrosion damage cannot be assessed by visual observations (and the presence of shallow flows partially obscured view of the invert in all pipes), there was no indication at any location that corrosion has caused any structural failure within the pipe invert; no holes were found.

The CCTV inspection videos also provided some information regarding the condition of the structures located along the 25th Avenue NE stream conveyance system. These structures are custom-built with brick and mortar walls and concrete top slabs, likely the same age as the CMP pipe (40 to 60+ years). The apparent condition of these structures is good; in some locations mortar is not visible between bricks, but no major cracks, displacements, or other failures in the structure walls or top slabs were observed.

Due to the generally good but aging/worn conditions observed within the 25th Avenue NE stream conveyance system pipes and structures, it seems likely that this system could continue to function adequately without risk of major failure due to condition for at least 10 to 20 more years if necessary. If the City decides to pursue a course which would leave this system in place for an extended time, it is recommended to (1) make spot repairs to known defects and provide other maintenance as needed to prolong remaining life, and (2) provide comprehensive inspections, including CCTV pipe inspections, on a 5 to 10 year interval to periodically verify condition adequate for continued function. Additionally, given that the pipes within this system have inadequate depth of cover (and hence insufficient structural strength to bear loads) and are located in areas with heavy parking usage (including large trucks), if the City intends to preserve this system for prolonged function it would be advisable to investigate ways to deepen pipe cover and/or block heavy vehicles from parking directly on top of these pipes and structures.

The NE 195th Street culvert was CCTV inspected in October 2016 while the creek was temporarily bypassed around the culvert during the WSDOT emergency repair of the gabion wall at the culvert outlet. Inspection of this culvert is normally not possible due to the permanent backwater condition created by aggradation of the stream channel immediately downstream (pipes which are submerged cannot be reliably CCTV inspected). With the creek bypassing the culvert, the invert was mostly dry, allowing for detailed visual inspection. No major defects – such as large holes or deformations – were found during this inspection; however corrosion in the invert of this culvert has notably advanced to an early stage of failure: clusters of small holes (most less than 1" in diameter) at were found at various locations along the raised corrugations in the invert where the pipe material has corroded through. While these small holes do not immediately threaten the structural integrity of the pipe, they do indicate that serious concern should be given to the limited remaining lifespan for this pipe and potential for failure from large corroded holes in the pipe invert. Because this culvert carries perennial streamflow crossing below both a major roadway and the 66" diameter SPU water pipeline, the consequence would be high if such a failure led to a catastrophic event, such as a culvert blowout.

Because of the conditions observed indicating early stage failure due to invert corrosion holes within the NE 195th Street culvert, it seems unlikely that this culvert can continue to function adequately without risk of major failure due to condition for 10 to 20 more years. If the City of Shoreline opts not to replace this culvert within the next few years as part of the 25th Avenue NE Flood Reduction Project, further coordination will be needed with the City of Lake Forest Park, as the owner of this culvert, regarding the condition and future plans to replace this culvert.

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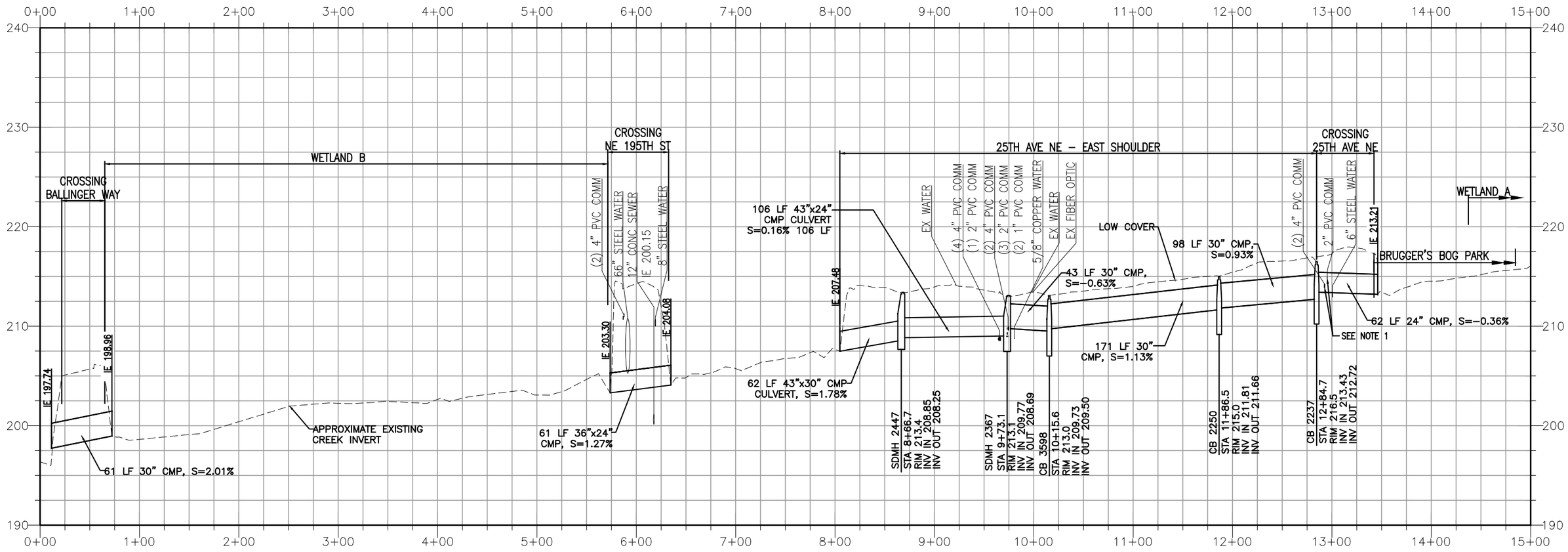

NOTES

1. APPROXIMATE DEPTHS OF UNDERGROUND UTILITIES SHOWN ARE BASED ON POTHOLING. WHERE A UTILITY IS SHOWN GOING THROUGH A PIPE, IT LIKELY WAS INSTALLED EITHER ABOVE OR BELOW STORM DRAIN AROUND ITS IMMEDIATE PROXIMITY.

SCALE
H: 1"=100'
V: 1"=10'

1"=100' 100 50 0 100 200 Scale Feet

1"=10' 10 5 0 10 20 Scale Feet

Figure 2-1
Existing Ballinger Creek Profile

25th Ave. NE Flood Reduction Project
City of Shoreline

Louis Berger

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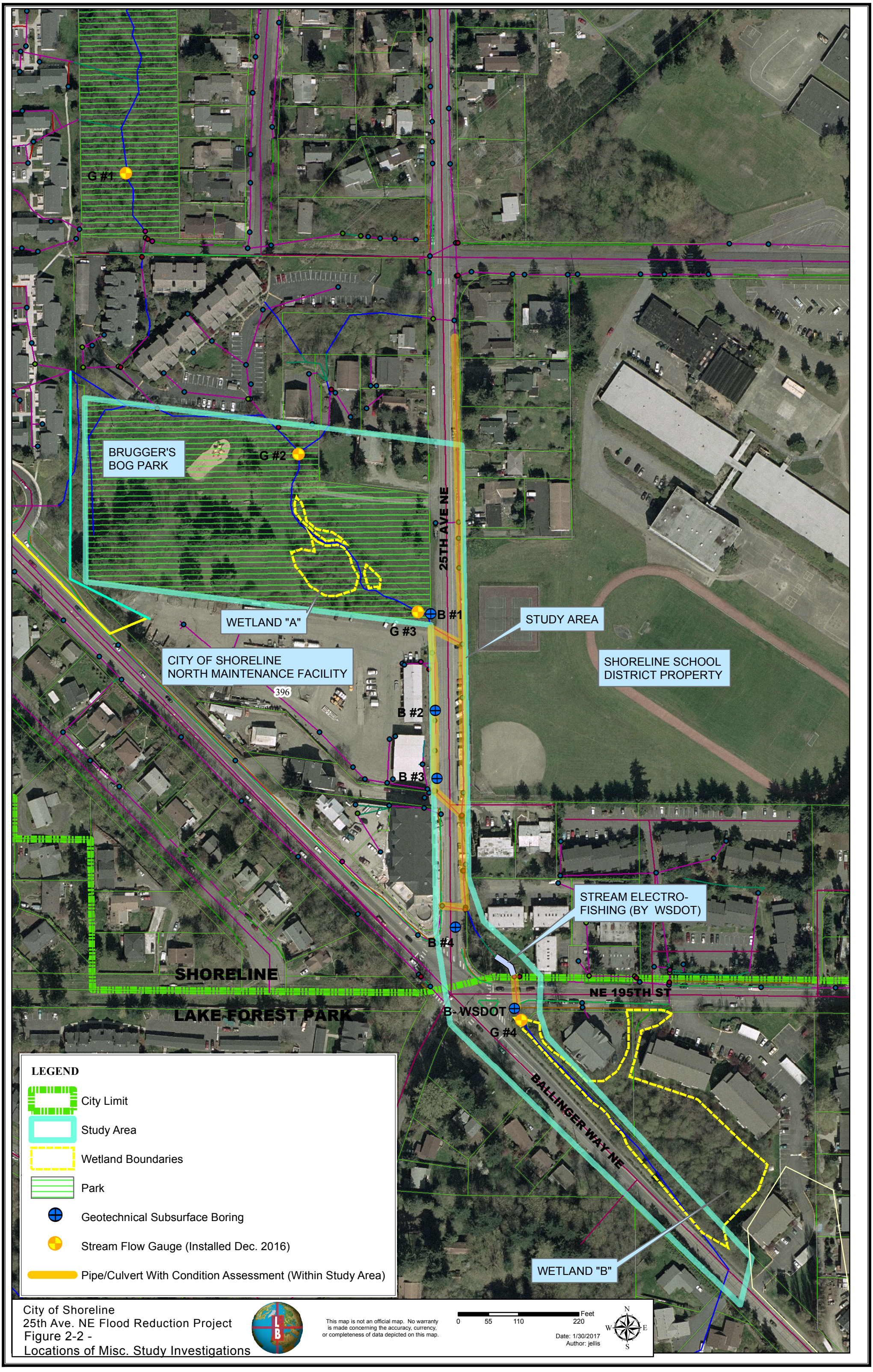
2.3 Geotechnical Investigations

A preliminary geotechnical investigation was conducted by the project team (Terracon) and is included in Appendix I of Volume II of this report. The purpose of the preliminary geotechnical investigation was to review available data in the area and conduct subsurface explorations in order to evaluate geotechnical conditions in the area that may affect the project and provide preliminary geotechnical recommendations concerning the alternatives under consideration for proposed stormwater improvements.

Terracon conducted geotechnical explorations which consisted of four borings, three of which included installation of groundwater monitoring wells, and review of other existing subsurface information available. Based on this information, construction of typical conveyance (culverts and large diameter pipe) and stream channel improvements in the proposed project alternatives appears to be geotechnically feasible. The following geotechnical considerations were identified:

- Underlying soil conditions typically consist of transitional beds of medium dense to very dense sand and gravel with varying fines (silt and clay) content. Soil interpreted to be alluvium consisting of very loose silty sand extends to a depth of up to about 13 feet below ground surface (bgs) in most of the borings. Fill overlies the alluvium or transitional beds and typically consists of very loose to medium dense silty sand with gravel. The fill typically extended to a depth of about 3.5 to 5 feet bgs.
- Oil and diesel range hydrocarbons were detected between three and 3.25 feet in one of the borings (boring B-4, see Figure 2-2) located near the intersection of 25th Avenue NE and Ballinger Way NE. While the sample tested was below Washington State Model Toxics Control Act (MTCA) cleanup levels, excavation could uncover areas with higher concentration. It is also noted that in some of the explorations completed within the NMF site had similar findings.
- Groundwater was observed within 2 feet bgs in most of the explorations with depth to groundwater being near 7 feet bgs at higher ground elevations near NE 195th Street. Shallow groundwater will likely require the need for significant dewatering measures related to excavation for culvert installation and for daylighting stream sections.
- Stream channel regrading to lower elevations, as needed for any replacement culvert at NE 195th Street to pass below the existing 66-inch-diameter water main, may present some geotechnical challenges. South of NE 195th Street, the creek is at the toe of the existing gabion basket wall along the Ballinger Way NE embankment that is currently in very poor condition. Lowering the grade of the creek at the toe of the gabion wall could undermine the existing wall exacerbating the ongoing failure of the gabion wall base, and possibly destabilizing the slopes above. Moving the deepened stream alignment away from the toe of slope to avoid cutting at the toe of these slopes would be strongly preferable; otherwise installing robust structural reinforcement of the existing wall will be necessary.

- The existing rockery near the outfall of the 25th Avenue NE pipe system is oversteepened and it was noted that a few rocks had been apparently dislodged from the slope, indicating possible instability of this feature. Consideration should be given to replacing a portion of the rockery with a concrete wall where it is oversteepened and adjacent to the creek.
- Open channel stream bank slopes should be sloped no steeper than 2 horizontal to 1 vertical (H:1V) and will require protection from erosion.


G #1
BRUGGER'S
BOG PARK
G #2
25TH AVE NE
WETLAND "A"
B #1
G #3
STUDY AREA
CITY OF SHORELINE
NORTH MAINTENANCE FACILITY
SHORELINE SCHOOL
DISTRICT PROPERTY
396
B #2
B #3
B #4
STREAM ELECTRO-
FISHING (BY WSDOT)
SHORELINE
LAKE FOREST PARK
NE 195TH ST
B- WSDOT
G #4
BALLINGER WAY NE
WETLAND "B"
LEGEND
City Limit
Study Area
Wetland Boundaries
Park
Geotechnical Subsurface Boring
Stream Flow Gauge (Installed Dec. 2016)
Pipe/Culvert With Condition Assessment (Within Study Area)
City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 2-2 -
Locations of Misc. Study Investigations
This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.
0 55 110 220 Feet
Date: 1/30/2017
Author: jellis
N
W
E
S

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2.4 Environmental Investigations

A critical areas report/sensitive areas study (report) was prepared by the project team (Herrera Environmental Consultants; Herrera 2016). The report addresses critical areas including wetlands and fish and wildlife habitat conservation areas (e.g., streams) and was conducted in accordance with current federal, state, and local regulations and guidance. The report contains information about the applicable federal, state, and local regulations associated with impacts to wetlands and streams. The following paragraphs provide a summary of the findings. Additional information about the methods and findings can be found in Appendix J of Volume II of this report.

Federal laws regulating wetlands and streams include Sections 404 and 401 of the Clean Water Act (United States Code, Title 33, Chapter 1344 [33 USC 1344]). Washington State laws and programs designed to control the loss of wetland acreage include the State Environmental Policy Act (SEPA) and Section 401 of the Clean Water Act (administered by the Washington State Department of Ecology (Ecology), as mandated by the Washington State Water Pollution Control Act).

Project areas span both sides of the city limits of Shoreline and Lake Forest Park. Therefore the project areas within different jurisdictions are respectively subject to either the Shoreline Municipal Code (SMC) or Lake Forest Park Municipal Code (LFPMC), which specify wetland categories/classes, stream types/classes, required buffer widths, development standards, and mitigation requirements for critical or environmentally sensitive areas within each jurisdiction.

The Watershed Company (Watershed 2016) previously delineated one wetland within Brugger's Bog Park, Wetland A (working in support of the NMF project located immediately to the south). In 2016, Herrera biologists working on this project delineated one additional wetland in the downstream portion of the study area, Wetland B (Table 2-1) within Lake Forest Park. Wetland delineations were conducted in accordance with the Regional Supplement to the US Army Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (Environmental Laboratory 2010) and Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). An AutoCAD file of the Watershed Company's delineation of Wetland A was obtained and added to the project basemap. Perteet Engineering surveyed the delineated flags for Wetland B which were subsequently added to the project basemap. These wetlands are shown on Figure 2-2 (as well as Figure 3 in Appendix J). Wetland A is a riparian wetland located along Ballinger Creek within Brugger's Bog Park in the City of Shoreline. Wetland B is a riverine and depressional wetland located south of NE 195th Street along Ballinger Creek in the City of Lake Forest Park. Table 2-1 presents a summary of the wetlands size, classification, wetland rating, and buffer requirements, applying the City of Shoreline's regulations for Wetland A and Lake Forest Park's for Wetland B.

Table 2-1:
Wetlands Delineated in the Study Area
for the 25th Avenue NE Flood Reduction Project

Wetland ID	Size of Wetland (square feet/acre)	USFWS Clas.[a]	Hydro-geomorphic Clas.[b]	Wetland Rating Category	Standard Buffer Width (feet)	Min. Buffer Width (feet)	Local Juris.
A	10,197/0.23	PFO	Riverine	II [c, d]	165[f]	n/a[f]	Shoreline
B	54,808/1.26	PSS/PFO	Riverine, Depressional	II[c]/II[e]	100[g]	70[g]	Lake Forest Park

a) US Fish and Wildlife Service classification is based on Cowardin et al. (1979): palustrine forested (PFO) and palustrine scrub-shrub (PSS).
b) Hydrogeomorphic classification is based on Brinson (1993).
c) Wetland Category is based on the Washington State Department of Ecology (Ecology) wetland rating system (Hruby 2014).
d) The City of Shoreline requires the use of Ecology's 2014 rating system.
e) Wetland Category is based on the criteria outlined in Lake Forest Park Municipal Code (LFPMC) 16.16.040.AA. The City of Lake Forest Park does not require the Ecology rating system.
f) Wetland buffer widths are based on the Ecology wetland rating and habitat score, per Shoreline Municipal Code (SMC) 20.80.330.
g) Standard buffer widths assume the incorporation of mitigation measures outlined in SMC Table 20.80.330(A)(2). If an applicant chooses not to apply the mitigation measures, then a 33 percent increase in the width of all buffers is required.
h) Wetland buffer widths are based on LFPMC 16.16.320.A. The City of Lake Forest Park allows for a minimum buffer width in accordance with the criteria outlined in LFPMC 16.16.320.E.

Additional information regarding the functions and values of the wetlands can be found in Appendix J.

The ordinary high water marks (OHWMs) of streams within the study area were delineated using the definition provided in WAC 222-16-010, which has been adopted by both Shoreline and Lake Forest Park. In addition, methods in the publication Determining the Ordinary High Water Mark on Streams in Washington State (Olson and Stockdale 2010) were applied. The Watershed Company (Watershed 2016) previously delineated the OHWM of Ballinger Creek within Brugger's Bog Park. The AutoCAD file of the delineations was obtained and added to the project base map. Herrera biologists flagged the OHWM of two segments of Ballinger Creek within the study area, downstream of 25th Avenue NE. Perteet Engineers surveyed the OHWM flags, which were subsequently added to the project base map.

Within the City of Shoreline, Ballinger Creek is a Type F-anadromous stream, is regulated as a critical area (fish and wildlife conservation area), and is afforded a 115-foot standard buffer (SMC 20.80.280). Type F streams and waterbodies are those known to be used by fish, or meet the physical criteria to be potentially used by fish.

Within the City of Lake Forest Park, Ballinger Creek is a Category I stream, is regulated as an environmentally sensitive area (stream), and is afforded a 115-foot standard buffer or 70-foot minimum buffer (LFPMC 16.16.350). Type I streams are those that are used at least seasonally by fish for spawning, rearing, or migration; streams that are fish passable from Lake Washington; and streams or parts thereof that are waters of the state (WAC 222-16-031).

The 2016 Herrera report indicates that there is no documented fish habitat use in Ballinger Creek within the study area; however, new information on fish presence within the project area has come to light since this report was created. As part of WSDOT's emergency repair to the failed gabion wall at the Ballinger Creek culvert crossing of NE 195th Street, electrofishing done on October 9, 2016, collected two (2) cutthroat trout (approximately 7 cm and 11 cm long) and one (1) coho salmon (approximately 7 cm long) from Ballinger Creek at the upstream end of the NE 195th St culvert (see Appendix K.3 Electrofishing Report in Volume II). Both species are documented as present downstream of the project area within Ballinger and Lyon Creeks. WDFW's SalmonScape database identifies the culvert under 25th Avenue NE as a total fish passage barrier and the culvert under NE 195th Street is identified as a partial barrier.

Ballinger Creek's general channel conditions were assessed in the field by Herrera on June 10, 2016. Given that the creek channel upstream of NE 195th Street is fragmented by roads and developed areas, and due to the presence of thick concentrations of Himalayan blackberry (Rubus armeniacus), field observations were not continuous, and were only performed at the following locations:

- Within the open channel segment between NE 195th Street and the downstream outlet of the culvert under 25th Avenue NE.
- Within Brugger's Bog Park, except for the channel segments along the northern and western boundaries of the park.
- Immediately upstream from NE 200th Street, and at the downstream outlet of the culvert beneath NE 203rd Street (the channel segment in between these two roads, which flows through Ballinger Creek Open Space, was not assessed).
- At the downstream outlet of the culvert beneath 205th Street NE (the channel segment between NE 203rd Street and 205th Street NE was not assessed).
- Upstream of 205th Street NE, along the southern end of 54th Avenue W (within the City of Mountlake Terrace).

Between the culvert inlet at the southeast corner of Brugger's Bog Park and 205th Street NE, the bankfull width ranges from 3.8 feet (at the upstream boundary of Brugger's Bog Park) to 8.9 feet, half way into Brugger's Bog Park near Wetland A. Immediately upstream from NE 195th Street, the channel width is 5.8 feet. Because some of these areas are under wetland or backwater influence, an average bankfull width of 6 feet was assumed as most representative of the Ballinger Creek channel.

Riparian vegetation exists in a narrow corridor along the open channel segments of Ballinger Creek within Brugger's Bog Park and between 25th Avenue NE and NE 195th Street. Within both segments, riparian habitat includes a forested canopy of mostly deciduous trees with a shrub and herbaceous understory. Himalayan blackberry is present along a portion of the riparian area within the Park, immediately upstream of the 25th Avenue NE culvert. Japanese knotweed, a King County noxious weed (King County 2016), is present at two locations along Ballinger Creek: between the creek and 25th Avenue NE along the open channel north of NE 195th Street, and at the southern end of the Ballinger Creek Open Space just north of NE 200th Street. Downstream of

the NE 195th Street culvert, the riparian habitat is similar to that within the Park, but it includes Wetland B.

Woody debris capable of forming instream habitat features was only observed within the channel segment within Brugger's Bog Park, where the only pools were observed.

Sediment sources were not determined during the site visit on June 10, 2016; however, surface and subsurface (down to 1-foot in depth) sediment conditions in the Ballinger Creek channel were assessed. Quarry spalls (averaging 5 inches in size) and poorly sorted, sub-angular gravel dominated the surface substrate (10 to 20 percent embedded in fines) within the open channel segment upstream of NE 195th Street. The quarry spalls were mostly located immediately upstream from the NE 195th Street culvert. Subsurface substrate included coarse sand and sub-round small gravel. Similar substrate characteristics (including the presence of quarry spalls and sub-angular gravel) were observed at the northern boundary of Brugger's Bog Park, near a housing development. Quarry spalls and sub-angular gravel are not suitable substrate for salmonid spawning. More natural surface substrate conditions were observed within Brugger's Bog Park and included small to medium size sub-round to round gravel, 10 to 50 percent embedded in sand in some areas. Subsurface substrate in this area included sand, large gravel, and cobbles in some locations. Organic matter was observed in the subsurface substrate along the creek channel segment located adjacent to Wetland A.

Although cutthroat trout and juvenile coho salmon were observed in the open channel segment upstream from the NE 195th Street culvert, it is unclear whether they can spawn there, given the substrate characteristics. Nonetheless, some gravels were observed along that channel segment. Upstream of the 25th Avenue NE culvert within Brugger's Bog Park adjacent to Wetland A, spawning and rearing habitat are present. The spawning habitat is limited in quantity and quality; however, it is functional (channel bed is not armored) and could potentially support coho salmon and cutthroat trout populations if access was provided through fish passage downstream. There is only instream juvenile rearing habitat, as opposed to off-channel habitat, within the park. While their presence was not specifically assessed, no fish were observed during the site visit; a review of previous assessments of this channel found no earlier confirmed fish sightings. If fish were present in the past, they were likely flushed out of this stream reach during high flood flows due to the lack of off-channel habitat and because of the downstream passage blockages (i.e., culvert under 25th Avenue NE), they have not been able to recolonize Ballinger Creek within the park.

In addition to wetlands and fish and wildlife habitat conservation areas, local jurisdictions also regulate buffers around critical areas. One of the influencing factors on the project is how the buffer requirements would apply to any of daylighting of the current pipe conveyance system. Buffers are discussed in more detail in Section 3.2.7.

It is noted that the City of Lake Forest Park is updating its critical areas regulations. It is likely that by the time permits are submitted for the project that the new regulations will be in effect. This will likely modify the buffer requirements as well as permit process requirements.

2.5 Existing Conditions Hydrologic and Hydraulic Model Updates

Existing conditions hydrologic and hydraulic models prepared previously were updated to incorporate better information and were used to perform due diligence to ensure the models accurately represent conditions at the site.

2.5.1 Hydrology

The Lyon Creek HSPF (USEPA) model was used to model the hydrology at the site. The HSPF model was originally developed and calibrated by Hammond Collier Wade Livingstone (1999) to simulate a future development conditions in the Lyon Creek basin. Subsequently, in 2009, Otak updated the model as part of the Flood Reduction Planning Study, Lyon Creek and McAleer Creek Drainage Basins (Otak, 2009) for the City of Lake Forest Park. Otak's updates included extending the precipitation data through 2007. In 2015, Osborne Consulting Incorporated (OCI) used the model without modifications to study the Ballinger Creek area within the City of Shoreline as part of the City of Shoreline Lyon Creek Basin Plan (AltaTerra, 2015).

As part of this study, Louis Berger updated the HSPF model to better represent the project area. The updates to the model included:

- Updating and extending the precipitation data. The precipitation data used in the previous model was noted as "Everett data extended using the Alderwood gauge in Lynnwood". Upon reviewing the data, it did not appear to coincide well with recent gauged precipitation within the City of Shoreline. As a result, the data between 10/1/1991 to 8/15/2016 was replaced and extended with precipitation data from King County Brugger's Bog rain gauge 35u, which is located within the project area at the NMF site. The King County gauge is located much closer to the study area than the Alderwood gauge and better represents the precipitation at the site.
- Subdividing the basin areas tributary to the study site. The previous model only included a single subbasin representing the entire catchment tributary to the study area. This subbasin was subdivided in order to more accurately represent the flow through and downstream of the study area, thus allowing the change in flow through the study area for existing conditions and potential alternatives to be assessed. The updated subbasins are shown in Figure 2-3.
- Updating the stage-storage-discharge (FTABLEs) tables. FTABLEs were created for each of the subdivided subbasins to better define their stage-storage-discharge relationship. HEC-RAS was used to create the FTABLEs for the subbasins along Ballinger Creek (390, 393, 394 and 395). FTABLEs define a relationship between reach depth, surface area, volume, and flow rate for each stream reach FTABLEs for subbasins that are tributary to the creek (i.e., tributary to reach 390, 393, 394, or 395) were estimated based on the approximate average size and length of its major conveyance system.

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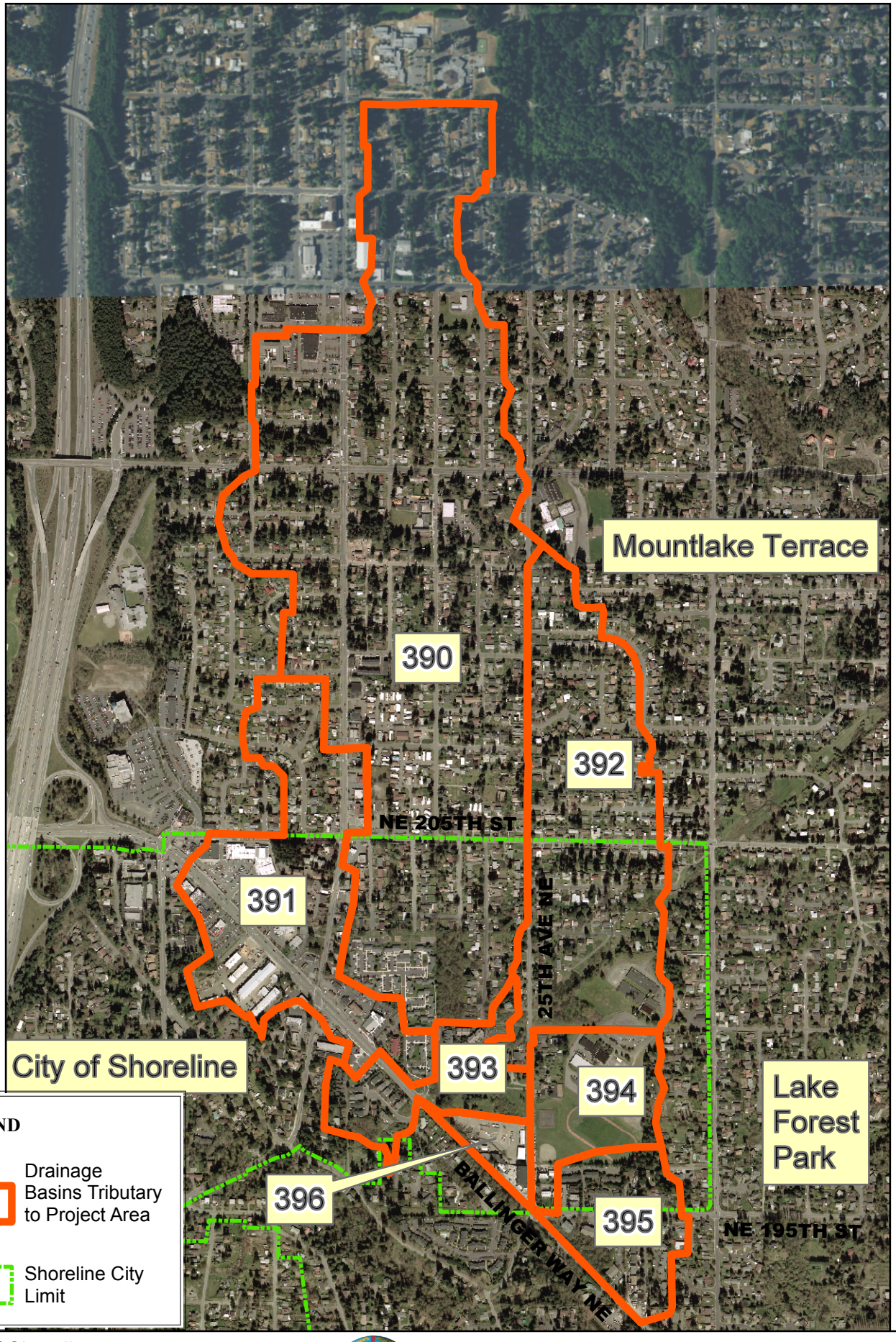

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 2-3 -
Ballinger Creek Subbasin Definition

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

0 385 770 1,540 Feet

N W E S

Date: 1/30/2017
Author: jellis
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- Updating the impervious area coverage based on existing conditions. The impervious area coverage for the tributary areas was updated using 2006 land coverage available from the Washington State Department of Ecology Land Cover website. Effective impervious fractions were applied to the impervious area based on land use to determine the effective impervious area to be used in the model.

  Return period flow for the 2, 10, 25 and 100-year storm event were developed using the HSPF peak annual flow and the Log-Pearson Type III distribution. The resulting peak flows are presented in Table 2-2. Note that there is a minor reduction in flow between NE 195th Street and Ballinger Way NE due to the attenuation in Wetland B upstream of Ballinger Way NE and the backwater from the undersized culvert under Ballinger Way NE.

  In addition, the high and low fish passage flows were developed. The high fish passage flow assumed to be the 10 percent exceedance rate based on daily mean flows for September, October, and November. The low fish passage flow is the 95 percent exceedance rate based on daily mean flows for the whole year. The fish passage flow analysis considers upstream passage for adult cutthroat trout (6-inch) and coho salmon, salmon juvenile rearing and downstream fish passage. It does not consider upstream passage of juvenile salmon. The approach used for the development of these fish passage flows is consistent with the Water Crossings Design Guidelines (WDFW 2013) and the hydraulic code (220-110-070 WAC) criteria, for both low flow and high flow. It acknowledges that passage criteria must be met for all flows up to the fish-passage design flow. These criteria are for culverts, but for planning purposes, they were also considered herein for future application on open channel design.

  To support future design of fish passage improvements, the City installed in December 2016 streamflow monitoring gages at four (4) locations along Ballinger Creek (for locations see Figure 2-2). These data will be helpful to confirm system low flows and the relative ratio of base flows, including groundwater inputs, versus storm flows. This information would help increase certainty of low flow regimes to inform future channel, off-channel, and habitat feature design as well is planting strategies. The resulting flow data will be analyzed in the future. Although data collected to date has not been thoroughly review, it suggest that the system response is quite flashy (i.e., significant stream flow increases can occur within 30 minutes of heavy precipitation).

Table 2-2:
Existing Flows

Location	Subbasin ID	2-Year	10-Year	25-Year	100-Year
Ballinger Way NE culvert	395	35.42 cfs	59.42 cfs	77.99 cfs	116.81 cfs
NE 195th Street culvert	394	40.96 cfs	71.92 cfs	94.46 cfs	139.45 cfs
25th Avenue NE (existing pipe inlet)	393	39.36 cfs	71.45 cfs	93.25 cfs	134.32 cfs
Low Fish Passage	0.19 cfs				
High Fish Passage	2.2 cfs				

2.5.2 Hydraulics

HEC-RAS (US Army Corps of Engineers, Version 4.1.0) was used to simulate the Ballinger Creek water surface profiles through the project study area for the 2, 10, 25 and 100-year storm event. OCI developed a HEC-RAS model of Ballinger Creek within the City of Shoreline for the City of Shoreline Lyon Creek Basin Plan (October 2015). The model extended from the downstream side of the NE 195th Street culvert north to about the north city limits. For this project, the OCI model was extended to the downstream end of the Ballinger Way NE crossing in order to provide a more accurate tailwater elevation for the project and better assess potential impacts from alternatives. In addition, the survey data within the study area was used to develop new cross sections and culvert data for the model from the downstream end to the upstream side of Brugger's Bog Park. The modeled cross sections are presented in Figure 2-4. The cross sections and culvert information previously developed by OCI were used upstream of Brugger's Bog Park. For the level of alternative analysis discussed in this document, a geomorphic assessment was not performed to analyze potential responses associated with the modeled hydraulic conditions. Such geomorphic assessment will be performed on the preferred alternative to help inform its design.

The resulting Ballinger Creek water surface elevations show that Ballinger Way NE and NE 195th Street overtop in the 10-year storm event (likely at a low point along NE 195th Street east of the creek crossing). Refer to Table 2-3. In addition, 25th Avenue NE overtops in the 2-year storm event at the pipe system entrance at the southeast corner of Brugger's Bog Park. Modeling results generally confirm reported flooding history within the project area.

Table 2-3:
Existing Simulated Water Surface Elevations (feet)

Overtopping Elevation	2-year	10-year	25-year	100-year	Estimated Flooding Recurrence
204.02	202.95	***205.29***	***205.39***	***205.52***	Between 2-year and 10-year
210.27	208.79	***210.57***	***210.68***	***210.84***	Between 2-year and 10-year
216.87	***217.37***	***217.84***	***217.97***	***218.07***	2-year

Water surface elevations which exceed overtopping are shown in bold italics.

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XS 3833.85

XS 3364.13

Ballinger Creek

XS 2483

XS 1793.86

XS 1444.11

City of Shoreline

XS 790.39

XS 647.77

XS 556.47

XS 251.15

XS 79.36

City of Lake Forest Park

LEGEND

- Culverts
- OCI Cross Sections (See Note 1)
- New Cross Sections
- HEC-RAS Alignment
- Park
- City Limit

NOTES:

1. WITHIN PROJECT STUDY AREA (I.E., NEW TOPOGRAPHIC SURVEY AREA) NEW CROSS SECTIONS WERE USED INSTEAD OF OCI CROSS SECTIONS TO MAKE USE OF BETTER INFORMATION

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 2-4 -
HEC-RAS Model Cross Sections

0 85 170 340 Feet

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Author: James Ellis
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Section 3
Alternative Identification and Evaluation

3.1 Screening of Potential Alternatives

3.1.1 Project Challenges

Improving the conveyance system to reduce flood hazards through the project area will need to address several project challenges. Some of the key challenges are described in the following paragraphs and are in no particular order.

- High Cost. The existing Ballinger Creek piped stream conveyance system is significantly undersized for a length of over 600 feet (including the 25th Avenue NE system and NE 195th Street culvert). A replacement system of this length with significantly more capacity would require a substantial cost to the City.

- Fish Passage. Federal and state regulations require that fish passage be provided on all streams that have fish presence or have stream habitat conditions that would support fish use. Given the recent finding of fish presence in the project area as well as the presence of fish habitat immediately upstream of the NE 195th Street culvert and within Brugger's Bog Park, regulatory stakeholders, including WDFW and USACE, will require that the conveyance improvements be design to provide fish passage. *Water Crossings Design Guidelines,* (WDFW 2013) provides guidelines for designing culverts to meet fish passage. These criteria include providing minimum flow depths and maximum stream velocities for certain flow regimes, as well as maximum lengths of culverts. The existing 25th Avenue NE pipe system is 545 feet long and is well over any allowable culvert length to provide fish passage. Therefore, at least portions of the system will likely need to be replaced with an open stream channel (a process commonly known as "daylighting"). The existing 25th Avenue NE public right-of-way is the only currently available location for improvements to this system; however this right-of-way must also accommodate roadway traffic, sidewalk, utility, and other uses. Accordingly, it will be spatially challenging to include a fish passable open stream channel within this narrow corridor.

- Fish Habitat Complexity. Given the right-of-way constraints, the open channel segments could have limited cross-sectional space to accommodate multiple flow stages or integrate instream habitat features such as large woody debris and vegetated bars. Space for floodplain and riparian areas is also likely to be limited, and may not provide opportunity to create a floodplain vegetated with herbaceous, shrub, and trees cover. Consequently, there may be some constraints in creating open channel segments along 25th Avenue NE that provide functional rearing habitat for juvenile salmonids, unless the opportunity exists to move the channel

alignment toward some adjacent areas. Similar limitations may apply to the creation of spawning habitat along 25th Avenue NE.

- Permitting Complexity (beyond fish passage and habitat). Numerous permits and approvals from federal, state, and local regulatory stakeholders will be required for the project as it proposed to work within environmentally critical areas (e.g., streams and wetlands) and their buffers. In addition to providing a fish passable solution for conveyance improvements, the project design must incorporate the requirements of federal, state, and local regulatory stakeholders. In particular, the project should be designed to meet the specifications and impact thresholds to qualify for a Nationwide Permit with USACE to comply with Clean Water Act Section 404. If a Nationwide Permit is not applicable to the project design, then an Individual Permit and subsequent evaluation under the National Environmental Policy Act (NEPA) would be necessary, increasing permitting complexity and timeframe for permit acquisition.

- Prevent Increases in Downstream Flows. Existing conveyance restrictions cause flooding north of NE 195th Street and along the 25th Avenue NE corridor. The creek backs up creating volumes of stored floodwaters that help attenuate downstream flows. Conveyance improvements which reduce flood storage could result in increased downstream flows which could exacerbate existing capacity issues or create new flooding. As such, a project goal is to consider options that prevent an increase in downstream flows from occurring and to assess it using the hydrologic/hydraulic models updated for this study.

- Crossing Under SPU's 66-inch-diameter Water Line. As noted previously, the existing NE 195th Street culvert crosses directly underneath the 66-inch-diameter waterline. The project team conducted some initial coordination with SPU regarding the project and SPU indicated that the new culvert must have a minimum clearance of 0.5 feet between the bottom of the 66-inch pipeline and the top of the new culvert. With this added clearance (where there is no clearance under current conditions) and the thickness of a concrete box culvert (roughly one foot compared to thin CMP pipe), the soffit of the new culvert will be approximately 1.5 feet lower than the top of existing culvert. To maintain an adequate vertical opening of the culvert (at least to match existing of 2-feet), the stream channel invert will also need to be lowered 1.5 feet. This will require regrading of the upstream and downstream channel for transitions and increase project costs. It could also affect the existing WSDOT gabion wall as described below.

- WSDOT Gabion Wall and other Stream Grade Issues Downstream of NE 195th Street. Lowering the culvert depth at NE 195th Street as described above could result in additional major challenges because the channel immediately downstream of the culvert has an aggraded (raised) creek bed, and also because the downstream channel runs alongside the failing WSDOT Ballinger Way NE

(SR 104) gabion basket wall for a significant length. As described previously, the wire fabric of the lower gabion baskets in the flow line of the creek has corroded away completely and some of the rocks from within the baskets have spilled out into the creek. This condition exists along most of the visible gabion wall toe. Lowering the creek near the gabion wall will require coordinating with WSDOT. Consideration should be given to either protecting the wall, moving the stream away from the wall (which may require an easement and stream buffer relocation) or both. Lowering or relocating the channel would also impact Wetland B.

- Number of Stakeholder Groups. As noted in Table 1-1, there are a large number stakeholder groups for coordination. These groups will have varying needs, interests in, and influences upon this project – possibly sometimes contrary to other stakeholder interests or general project needs. The City recognizes this and has developed a stakeholder coordination plan to proactively seek out feedback and input early and often in hopes of avoiding major shifts in project direction.

3.1.2 Range of Potential Options to Reduce Flood Hazards

After conducting the investigations described in Section 2, City staff and the consulting team worked together to develop a wide array of potential solutions to increase the protection against flooding. The range of solutions was organized based on the following categories:

- Upper 25th Avenue NE Conveyance Improvement Options (the section of 25th Avenue NE between Brugger's Bog Park and NE 195th Place)
- Lower 25th Avenue NE Conveyance Improvement Options (the section of 25th Avenue NE between NE 195th Place and NE 195th Street)
- Full Length 25th Avenue NE Conveyance Improvement Options (the full length of 25th Avenue NE between Brugger's Bog Park and NE 195th Street)
- NE 195th Street Conveyance Improvement Options
- Regional Detention Storage Options (detain and lower peak flows through the system to reduce flooding as an alternative or in combination with conveyance improvements to reduce flooding)
- Other Basin Wide Strategies
- Minor Improvements (e.g., smaller-scale options intended to help improve the level of flood protection without implementing a larger-scale system improvement solution)

The goal of this exercise was to consider a wide range of options and screen the options to a narrower set of alternatives more likely to be implementable and effective for further analysis. Appendix L in Volume II of this report contains a detailed summary table evaluating these options, including qualitative assessment of the following:

- Flood Reduction Potential
- Property Acquisition/Easements
- Permitting (i.e. permitting feasibility)
- Utility Conflicts
- Fish/Habitat Benefit
- Street Parking Impact
- Need for Increase Maintenance
- Other Considerations

Table 3-1 summarizes these alternatives and provides a brief rationale for advancing an alternative or removing it from further consideration. It is noted that while the summary table in Appendix L contains more detailed qualitative comparison between alternatives, Table 3-1 was prepared subsequent to Appendix L and contains some new information.

Table 3-1
Summary of Options

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
Upper 25th Avenue NE Conveyance Improvement Options (the section of 25th Avenue NE between Brugger's Bog Park and NE 195th Place)		
1 - WEST SIDE of 25th Ave NE (north of NE 195th Pl); General: Avoids major utility impacts on east side		
1A - West side - Daylighted within ROW within ex shoulder Includes: 60 LF culvert across NMF driveway, 260 LF open channel, 75 LF culvert (fish passable culverts)	May not be enough room for stable side slopes for the daylighted creek. Might need to use walls. Not ideal for fish passage and habitat. North Maintenance Facility plan shows planned parking in the ROW on the west side.	YES – As part of Alternatives 1 and 2
1B - West side - Daylighted within ROW within shoulder widened by shifting roadway to the east Includes: 60 LF culvert across NMF driveway, 260 LF open channel, 75 LF culvert (fish passable culverts)	Likely loss or major reduction of on-street parking on both sides: west side dedicated to daylighted creek and east side park may be lost to shifted roadway. Would increase width (possibly up to 8') for the channel cross section but may not be enough to eliminate the need for a wall.	NO – Option 1A is preferable for advancement as less impactful with similar level of benefits
1C - West side - Daylighted beyond ROW (onto NMF property) Includes: 60 LF culvert across NMF driveway, 260+ LF meandering open channel, 75 LF culvert (fish passable culverts)	All of property likely needed for future NMF. However, alternative sites for NMF are currently being investigated. If the City chooses a different location for the NMF, portions of this site may be available for a natural channel cross section for the daylighted creek. Lower utility conflicts than other east side options due to alignment being outside of right-of-way. No easement or property acquisition necessary. Possible issues due to uncertainty of potentially contaminated soils.	YES – As Alternative 3. However this option is infeasible if City pursues current plans for NMF site redevelopment because all of site would be needed for facility improvements. That said, there is currently a chance that selection of an alternative approach for the NMF project could make some portion of the site available for daylighting
1D - West side - Continuous box culvert below existing shoulder Includes: 60 LF culvert across NMF driveway, 260 LF culvert parallel to 25th Ave NE, 75 LF culvert (fish passable culverts)	WDFW discourages pipe lengths greater than 10XBankfull Width. WDFW requires that the width be increased further to accommodate geomorphological features, increasing the hydraulic radius by increasing the width by 30% over the typical fish passage width or using a bridge. This will increase the cost of this option.	NO – Option 1A is preferable for advancement as have fewer permitting issues with better benefits and a similar level of costs. Option 6A as a non-fish passable approach is a more reasonable variation upon closed conveyance.
2 - EAST SIDE of 25th Ave NE (north of NE 195th Pl); General: major utility conflicts		
2A - East side - Daylighted within ROW within ex shoulder Includes: 75 LF culvert across 25th Ave NE, 300 LF open channel, 50 LF culvert across NE 195th Pl (fish passable culverts)	May not be enough room for stable side slopes for the daylighted creek. Might need to use walls. Not ideal for fish passage and habitat. Loss of parking on east side of 25th Ave NE, mostly used by commercial truckers, some use by others. Likely major utility conflicts with water, communications, and utility poles.	NO – Option 1A is preferable for advancement as having significantly fewer utility conflicts with similar level of benefits
2B - East side - Daylighted within ROW within shoulder widened by shifting roadway alignment to west Includes: 75 LF culvert across 25th Ave NE, 300 LF open channel, 50 LF culvert across NE 195th Pl (fish passable culverts)	Likely loss of major reduction of on-street parking on both sides: east side dedicated to daylighted creek and west side parking may be lost to shifted roadway. Would increase width (possibly up to 8') for the channel cross section but may not be enough to eliminate the need for a wall. Likely major utility conflicts with water, communications, and utility poles.	NO – Option 1A is preferable for advancement as having significantly fewer utility conflicts and other impacts with similar level of benefits
2C - East side - Daylighted beyond ROW (onto Alderwood Annex property) Includes: 75 LF culvert across 25th Ave NE, 325 LF meandering open channel, 50 LF culvert across NE 195th Pl (fish passable culverts)	Best option to provide a natural channel cross section for the daylighted creek. Lower level of utility conflicts than other east side options due to alignment being outside of right-of-way. Depends entirely upon coordination with Shoreline Schools to allow easement or other form of access or approval of property use	MAYBE – As a potential variant of Alternative 3. Preliminary discussion with Shoreline Schools indicates usage of the Aldercrest Annex for this project is unlikely, though not necessarily impossible. Alternative 3 can serve as an analog (i.e. similar comparison) for potential improvements at this site in the event that future usage is allowed.

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
2D - East side - Continuous box culvert below existing shoulder Includes: 75 LF culvert across 25th Ave NE, 350 LF culvert running down east side of 25th and across NE 195th Pl	WDFW discourages pipe lengths greater than 10XBankfull Width. WDFW requires that the width be increased further to accommodate geomorphological features, increasing the hydraulic radius by increasing the width by 30% over the typical fish passage width or using a bridge. This will increase the cost of this option. Likely major utility conflicts.	NO – Option 1A is preferable for advancement as have fewer utility conflicts and permitting issues with better benefits and a similar level of costs. Option 6A as a non-fish passable approach is a more reasonable variation upon closed conveyance.
Lower 25th Avenue NE (Between NE 195th Place and NE 195th Street) **Note: Lower 25th Ave NE options need to be combined with an Upper 25th Ave NE option**		
3 - WEST SIDE of 25th Ave NE (south of NE 195th Pl); General: Avoids major utility conflicts on east side, possible reduction in parking impacts		
3A- West side - Daylighted within ROW Includes: 200 LF open channel, 60 LF culvert crossing 25th Ave NE to existing open channel	May not be enough room for stable side slopes for the daylighted creek. Likely need to use walls. Not ideal for fish passage and habitat. Would likely need to eliminate 5' amenity strip and shift road center to east. Tight construction with proximity to existing large "25th Place" condo building at 19500 Ballinger Way NE (built with an approximate 0' setback from 25th Ave NE ROW boundary).	YES – As part of Alternatives 1 (and 3)
3B - West side - Daylighted beyond ROW	Conflict with large "25th Place" condo building at 19500 Ballinger Way NE (built with an approximate 0' setback from 25th Ave NE ROW boundary).	NO - this option would require very costly purchase and removal of large building; other options are preferred.
3C – West side – Continuous box culvert Includes: 200 LF culvert parallel to 25th Ave NE, 60 LF culvert crossing 25th Ave NE to existing open channel	Work would requirement removal and replacement of newer sidewalk and excavation work close to foundation of newer large "25th Place" condo building at 19500 Ballinger Way NE (built with an approximate 0' setback from 25th Ave NE ROW boundary). WDFW discourages pipe lengths greater than 10Xbankfull Width. WDFW requires that the width be increased further to accommodate geomorphological features, increasing the hydraulic radius by increasing the width by 30% over the typical fish passage width or using a bridge. This will increase the cost of this option.	YES – As part of Alternative 4
4 - EAST SIDE of 25th Ave NE (south of NE 195th Pl); **General: Follows existing stream conveyance alignment, avoids potential complications of excavating near the foundation of 19500 Ballinger Way NE**		
4A - East side - Daylighted within ROW Includes: 115 LF open channel parallel to 25th Ave NE, 60 LF culvert crossing driveway for 2518 complex	May not be enough room for stable side slopes for the daylighted creek. Likely need to use walls. Not ideal for fish passage and habitat. Significant loss of parking on east side of 25th Ave NE, currently used by residents. Likely major utility conflicts with water, communications, and utility poles.	YES – As part of Alternatives 2 (and 3)
4B - East side - Daylighted beyond ROW Includes: 115+ LF open channel meandering parallel to 25th Ave NE, 60 LF culvert crossing 2518 complex driveway or parking	Best option to provide a natural channel cross section for the daylighted creek; could also provide floodplain storage potential due to need to acquire whole parcel. Lower level of utility conflicts than other east side options due to alignment being outside of right-of-way. Depends entirely upon property acquisition of 2500 NE 195th Pl fourplex (>$700k cost)	NO - this option would require costly purchase and removal of fourplex building; other options are preferred.
4C - East side - Continuous box culvert Includes: 175 LF culvert parallel to 25th Ave NE, below parking area and crossing driveway for 2518 complex	WDFW discourages pipe lengths greater than 10XBankfull Width. WDFW requires that the width be increased further to accommodate geomorphological features, increasing the hydraulic radius by increasing the width by 30% over the typical fish passage width or using a bridge. This will increase the cost of this option. Likely major utility conflicts with water, communications, and utility poles.	NO – Option 3C is similar and preferable for advancement due to presence of east side utility conflicts.
25th Avenue NE - Full Length Options (Between Brugger's Bog Park and NE 195th Street) **Note: All 25th Ave NE full length options would be done in lieu of any of the Upper and Lower 25th Ave NE options**		

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
5 - Install high-flow bypass (likely along west side of 25th Ave NE to minimize utility impacts); existing system to remain	WDFW could require a fish screen for highflow bypass. Fish screens can be prohibitively expensive. Fish screens require fine mesh to exclude fish which results in a very large structure. It would be difficult to fit a large fish screen into a site. Fish screens can get clogged with debris easily and become a maintenance issue or render the highflow bypass blocked during big events. Could use a self-cleaning screen like used in irrigation. Need to consult with WDFW to determine if the fish screen requirement might be waived if above OHW, or waived if significant off-site habitat mitigation is provided. Even if approved, this option may be technically challenging because the existing system is so shallow.	YES – As Alternative 5
6A - Upsize existing pipes with non-fish passable pipe sizes sized only for conveyance and seek permit approvals using significant off-site habitat mitigation. This could also include other elements to increase the flooding level of protection (such as Interim Solutions below).	May not eliminate as much storage as replacing the culverts with fish-passable culverts and therefore may not need to add as much flood storage to compensate. Need to consult with WDFW to determine if this option would be permitable, and if so the extent of mitigation that could be required.	YES – As part of Alternative 4
6B – Trenchless installation of pipe repair liner in existing 25th Ave NE pipes to lengthen pipe lifespan and slightly increase capacity due to increased smoothness. This could also include other elements to increase the flooding level of protection (such as Interim Solutions below).	May not eliminate as much storage as replacing the culverts with fish-passable culverts and therefore may not need to add as much flood storage to compensate. Need to consult with WDFW to determine if this option would be permitable. Permit approval may require off-site habitat mitigation	NO – for the main 25th Ave NE stream conveyance system, likely not permitable. YES – as part of Alternative 7 for the existing high flow bypass pipe system, assuming (1) it is allowable by permitting, and (2) implementation of other improvements would be sufficient to help reduce flooding
7 - Do Nothing (No Change to Existing Conditions for 25th Ave NE Ballinger Creek conveyance system)	Flooding would continue along 25th Ave NE. In future, whenever stream conveyance system needs to be replaced due to failing condition, the City would be presented with the same costly requirements for providing fish passage at that time. This recurring flooding problem has been confirmed as caused by undersized infrastructure and is one of the most serious flooding problems in the City. Continued flooding could adversely affect access to and operations at the future NMF site, in addition to continued impacts to nearby properties and public ROW.	NO - One of the City's Surface Water Utility's core functions is to reduce flooding. The Utility has a responsibility to plan and implement the most appropriate solution (or array of solutions) to address this issue.
Conveyance Options NE 195th Street		
8 - Replace with fish passable culvert	Good for fish passage and therefore easily permitable. Costly and complicated due to presence of 66" diameter SPU water distribution pipe and downstream WSDOT gabion wall issues. Potential jurisdictional complications due to culvert location outside of City of Shoreline (within LFP and WSDOT ROW).	YES – As part of Alternatives 1, 2, 3, and 4
9 - Buy-out flooding property	Flooding within the project area has most frequently affected only a small number of private properties. While this option would eliminate the threat to selected frequently-flooded private property through buyout, by itself it would not alleviate flooding upstream along 25th Ave NE and would not address aging infrastructure along 25th Ave NE. Additional improvements would be needed. Could require re-locating residents for those properties that are purchased.	YES – As Alternative 6

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
10 - Trenchless installation of pipe repair liner in existing NE 195th St culvert to lengthen pipe lifespan and slightly increase capacity due to increased smoothness. This could also include other elements to increase the flooding level of protection (such as Interim Solutions below).	May not eliminate as much storage as replacing the culverts with fish-passable culverts and therefore may not need to add as much flood storage to mitigate for increased downstream flows. High water levels upstream of NE 195th Street impact flooding at 25th Avenue NE. It is not clear at this point how much flood reduction benefit this option would have on 25th Avenue NE. Existing culvert is set below the downstream grade. Cleaning out and lining the culvert would improve the capacity, but it is likely that it would fill up with sediment again and be a maintenance issue.	NO – not permitable.
11 - Flood proofing structures (such as raising buildings); no NE 195th culvert replacement	High water levels upstream of NE 195th Street impact flooding at 25th Avenue NE. This option would not help alleviate flooding upstream along 25th Ave NE. Flooding of parking areas (including parked cars) would remain. Ultimately in future when culvert is replaced due to failure (in this case by LFP), the cost spent on flood proofing would have not been needed. Would not need a HPA	NO - because this approach is one of the least cost-effective options with regard to reduction of flood risk. It would also represent a significant investment of public funds on private property largely for the limited benefit of a very small number of private property owners.
12 - Install a NE 195th St culvert high flow bypass (configured above OHW)	WDFW requires a fish screen for high flow bypass. Fish screens can be prohibitively expensive and large with fine mesh. Typically hard to fit a large fish screen into a site. Tend to get clogged with debris and become a maintenance issue or render the high flow bypass blocked during big events. High flow bypass would need to cross SPU 66" diameter water main. Inlet to bypass located above OHW would require new bypass pipe to cross on top of SPU 66" diameter pipe; would need to check for spatial constraints due to this utility arrangement. Need to consult with WDFW to determine if the fish screen requirement might be waived if above OHW, or waived if significant off-site habitat mitigation is provided	YES – As part of Alternative 5
13 - Do Nothing (No Change to Existing Conditions for NE 195th St Ballinger Creek culvert)	Flooding conditions would continue along 25th Ave NE. This recurring flooding problem has been confirmed as caused by undersized infrastructure and is one of the most serious flooding problems in the City. Continued flooding could adversely affect access to and operations at the future NMF site, in addition to continued impacts to private properties and public ROW.	NO - One of the City's Surface Water Utility's core functions is to reduce flooding. The Utility has a responsibility to plan and implement the most appropriate solution (or array of solutions) to address this issue. HOWEVER, because the NE 195th St culvert does not belong to the City of Shoreline, the Utility has no long-term obligation to replace or maintain this culvert. If an appropriate solution can be found which does not require improvements to the NE 195th St culvert/system, it would be acceptable for the City of Shoreline to not undertake unnecessary work within other jurisdictions.
Storage Options		

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
14A - Brugger's Bog Park Southeast Floodplain Storage (FPS) (using southeast portion of park)	Site is sloped so it may be difficult for potential FPS site to have sufficient volume fully mitigate the loss of flood storage. Would need to work around Wetland A or provide mitigation for any impacts. Need to coordinate any FPS site with potential future park improvements/uses. Some potential efficiency for siting FPS improvements close to channel modifications required by upgrading 25th Ave NE stream conveyance.	NO – as a standalone solution; storage provided by a smaller FPS site will not be sufficient to improve flooding conditions alone. YES – Potentially in addition to other improvements, assuming effectiveness, need, permitability, and cost.
14B - Brugger's Bog Park Northwest Floodplain Storage (using northwest portion of park)	Site is sloped so it may be difficult for potential FPS site to have sufficient volume fully mitigate the loss of flood storage. Need to coordinate any FPS site with potential future park improvements/uses. A portion of this location is within the Seattle City Light (SCL) transmission corridor and easement, so potential FPS improvements within the easement would need to be closely coordinated with SCL. Typical SCL requirements include minimum required setbacks from and access to towers and poles and no standing water within the easement.	NO – as a standalone solution; storage provided by a smaller FPS site will not be sufficient to improve flooding conditions alone. YES – Potentially in addition to other improvements, assuming criteria can be met for effectiveness, need, permitability, and cost.
15- North Maintenance Facility Floodplain storage (open natural floodplain with habitat features/planting)	All of property likely needed for future NMF. However, alternative sites for NMF are currently being investigated. If the City chooses a different location for the NMF and this site may be available for floodplain storage alongside the daylighted creek. Possible issues due to uncertainty of potentially contaminated soils	YES – As part of Alternative 3. However this option is infeasible if City pursues current plans for NMF site redevelopment because all of site needed for facility improvements; however, there is currently a chance that selection of an alternative approach for the NMF project could make some portion of the site available for FPS.
16 – Aldercrest Annex (Shoreline Public Schools Property)	General: These options (#16A & B)) are feasible only on the condition that access to school property is allowed (See Option 2A). Preliminary discussion with Shoreline Schools indicates usage of the Aldercrest Annex for this project is unlikely, though not necessarily impossible.	
16A - Floodplain storage (open natural floodplain with habitat features/planting)	Baseball field adjacent to where the daylighted creek would be is less sloped than other flood storage sites.	YES – Potentially in combination with Option 2A, which is considered as a potential variant of Alternative 3.
16B - Underground vault (allowing for above use such as playfield)	Expensive and less environmentally desirable than using floodplain storage. Allows improvements, such as recreational fields or paved parking, to be constructed above the vault.	NO – unlikely that there would be a set of circumstances under which this approach would be optimal. If Shoreline Schools allows access to property for improvements it would likely be for daylighting + floodplain storage, not vault.
17 - Ballinger Open Space Area	General: 2.6 acre City-owned property; no easement/acquisition required.	
17A - Site excavation and regrading and add floodwall along NE 200th St to increase storage. 17B - Site excavation and regrading and raise NE 200th to increase storage	Site is steeply sloped. May not be enough area to fully mitigate the loss of flood storage. Adding a flood wall will help increase storage volume. South portion of site is likely wetland. An optional configuration could be to focus on the north portion of site. Site is steeply sloped. May not be enough area to fully mitigate the loss of flood storage. Raising NE 200th will help increase storage volume.	NO – Options 14 and 15 are preferable as potential floodplain storage sites with similar potential benefits and fewer complications. NO – Options 14 and 15 are preferable as potential floodplain storage sites with similar potential benefits and fewer complications.

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
18 - Half-Time III LLC property (just u/s of Ballinger Way at 2609 NE 195TH ST 98155)	May not be enough area to fully mitigate the loss of flood storage. Site may contain wetland, which may make permitting more complicated. Requires easement/property acquisition. Note this would be in Lake Forest Park.	NO – not viable based on H/H modeling which shows that this area already provides significant storage and is subject to flooding. Also, in future when downstream culvert is replaced, likely needs to be fish passable.
Basin-wide Options		
19 - Apply green streets to the tributary basin	A significant portion of the basin would need to be converted to green streets to have a significant impact on the site. A large portion of the basin is within Mountlake Terrace. Would need to obtain an agreement with Mountlake Terrace to convert to green streets.	NO - Likely not feasible as a primary solution because much of the basin is in Mountlake Terrace and a fairly large portion of the remaining area in Shoreline is very highly developed. This is a good long-range option for regionally reducing flooding conditions, but not feasible for near-term project-specific needed improvements.
20 - Retrofit tributary basin with UIC (underground injection to infiltration wells/trenches)	Need to consult with a geotech to determine if UIC is a realistic option in this basin. All infiltrated stormwater would need pre-treatment using Ecology standards. This would likely be prohibitively expense for retrofit situations.	NO - Not considered a viable option due to unknown benefit and likely cost prohibitive pre-treatment required.
21 - Upstream diversion with regional detention at Shoreline School District Property	Need further study to determine if this would provide enough relief to mitigate for the flooding. Requires easement/property acquisition.	NO – unlikely that there would be a set of circumstances under which this approach would be optimal. If Shoreline Schools allows access to property for improvements it would likely be for daylighting + floodplain storage, not regional detention.
22- Buyouts and provide storage in upper piped portion of basin (avoiding significant permitting) (such as trailer park at NW corner of 54th Ave W and NE 205th St).	Property within Mountlake Terrace. Would require cooperation of MLT to proceed. Would require relocating residents. Not clear whether this would provide enough detention to mitigate the flooding at the project site.	NO - Not considered as further option due to uncertainty of benefits and difficulty of potential execution due to location being outside of City and County jurisdiction. Potential for coordination with MLT on future projects.
23 - Downstream culvert replacement (to avoid flood storage mitigation)	Would need to assess downstream flow impacts in Lake Forest Park. There are six culverts on Ballinger Creek and if the increase in downstream flow continues into Lyon Creek, there are an additional nine culvert crossings. Upsizing one (if the increase in flow causes flooding) has the potential to further increase downstream flows/flooding which may result in a domino effect. Also, increased downstream flows may adversely impact the stream channel. The Lake Forest Park Flood Reduction Study (Otak) notes reaches with stability problems on Lyon Creek downstream of the project. However, the study did not study Ballinger Creek.	NO – Not necessary assuming that post-project downstream flows are not increased as a result of project improvements. This would be analyzed using hydrologic and hydraulic modeling. Preventing downstream flow increases would minimize downstream impacts.

Option ID and Description	General Notes	Candidate for Further Consideration at Present Time?
24 - Regional detention in the northwest corner of Brugger's Bog Park.	A large commercial basin enters Ballinger Creek at this location (about 55 acres). This would be a good location to detain and treat flow entering the creek. Need to coordinate any regional detention site with potential future park improvements/uses. A portion of this location is within the Seattle City Light transmission corridor and easement, so potential improvements within the easement would need to be closely coordinated with SCL. Typical SCL requirements include minimum required setbacks from and access to towers and poles and no standing water within the easement.	NO - Not considered as further option due to uncertainty of benefits. Flood Storage Option Alt #15 is likely a more preferable similar approach at this location.
25 - High flow bypass for Ballinger Way storm system	This would convey a large (25%) portion of the basin impervious area to a location downstream of NE 195th Street An issue would be potential increases in downstream flows, which would likely require mitigation storage. Another consideration is that if the City has to replace the 25th system in the future due to failure, the City would still need to meet the costly fish passage. Thus, this may not be considered viable, unless WDFW/agencies agree to not requiring fish passage in future replacement.	NO - not considered viable at this time. Increased downstream peak flows would require storage mitigation. Fish passage conveyance will likely be required for replacement of future conveyance system. Other options would probably address issues more effectively, more directly, and for longer-term.
26 - High flow bypass and storage at North Maintenance Facility	The North Maintenance Facility project is already pressed for finding enough space for its own needs. No significant area remaining for flood storage in pond arrangement. However, there may potential for underground storage in vault and serving the west portion of the basin if combined with a high flow pipe system extension (e.g. from Ballinger Way just west of 22nd Ave NE an existing 24-inch pipe system could be extended to the NMF and detained in a vault in the west portion of the site prior to discharge to the existing system. In this location the vault could be deep. One additional consideration is that the storage may be able to function as mitigation for storm water detention, in lieu of detaining runoff from the site itself.	MAYBE - This option is viable for consideration only if NMF design can accommodate such a facility. Given that the NMF is already committed to provide on-site stormwater management facilities (likely including vaults), it may be possible to work with the NMF team to configure these vaults in a manner which optimizes benefit to Ballinger Creek without a large cost increase to the NMF project.
Minor Improvements		
27 - Clean out culvert at 195th and channel downstream	The culvert appears to be set lower than the downstream channel. Cleaning out the culvert would improve capacity, but it is likely that it would just get filled in again and continue to be a maintenance issue. Not clear if cleaning the culvert would reduce flooding sufficiently. The Basin Plan model includes a culvert that is completely open at this location and is still showing flooding.	YES – Included as part of Alternative 7. This work would likely need to be performed by Lake Forest Park as system maintenance. Culvert was cleaned in October 2016 during WSDOT Emergency Gabion Repair Project and sediment removed from downstream culvert end.
28 - Raise 25th Avenue NE	Raising 25th Avenue NE may help to limit the depth and extents from floodwaters and help contain flooding to within the channel. However, raising the grade of the road would be costly and would not be not a good investment considering that the 25th Ave NE stream conveyance system will need to be replaced in the future due to pipe conditions. A fish passable culvert would be required and it is likely that a fish passable culvert would lower the upstream water level such that the extra roadway elevation would not be needed to prevent flooding of the roadway.	NO - not considered viable at this time. Other options would probably address issues more effectively, more directly, and for longer-term.
29 - Construction a short wall/berm at 25th Avenue NE	This would be similar to raising 25th Avenue but the investment would be smaller. May need to use a wall rather than a berm due to the lack of space available.	YES – Included as part of Alternative 7.
30 - Construction driveway berms and other raised features along the east side of 25th Ave NE to keep flood flows contained in ROW.	Potentially could increase LOP for structures. May make flood depths along 25th Ave NE slightly higher.	YES – Included as part of Alternative 7.

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3.1.3 Preliminary Alternatives for Evaluation

After review of the high level summary of potential options (as shown in Table 3-1) and eliminating those options that appeared -- from a permitting perspective, cost, or technical reason – to be likely infeasible or ineffective, the list of potential alternative for preliminary evaluation was reduced to seven (7) main alternatives by the project team. The intent was that these seven alternatives could be evaluated in more depth than the alternative screening, but still at a high level that did not involve development of detailed conceptual plans and profiles, detailed modeling, or cost analysis. The rational for this approach is that some of the alternatives were thought to be possibly problematic from a key stakeholder perspective. Rather than putting in significant effort to fully evaluate all seven alternatives, this process was used to consider further elimination of any alternatives thought to be unrealistic to advance. The seven alternatives are briefly described below. Preliminary "hand-drawn" sketches and summary comparisons, including cost estimates, and alternative comparison are presented in Appendix D.

For the comparison of the seven alternatives, broad criteria were considered including; order of magnitude costs, property acquisition needs, fish/habitat benefit, potential mitigation, utility conflicts, street parking impacts, and maintenance need/risk. The alternatives are described as follows:

- Alternatives 1 and 2: Daylighting the creek within the 25th Avenue NE right-of-way and replacing the NE 195th Street Culvert. Alternative 1 kept most of the improvements on the west side of the right-of-way to minimize loss of roadside parking and reduce major utility conflicts (with both parking and major utilities concentrated on the east side). It also included one long culvert from approximately NE 195th Place to the existing open channel to reduce costs and minimize construction impacts. Alternative 2 was focused on keeping the open channel on the west side of the ROW along the NMF property and transitioning to the east side of the right-of-way at NE 195th Place to have shorter culverts (benefiting fish passage) and avoid having construction activities adjacent to the existing "25th Place" building at 19500 Ballinger Way NE (the eastern foundation of which was constructed with no setback from the 25th Ave NE right-of-way).

- Alternative 3: Daylight the creek on the NMF property and transition to either Alternative 1 or Alternative 2 alignment south of NMF property. This alternative would only be feasible if the NMF site development does not move forward as currently envisioned and that the City develops a future maintenance facility at an alternative location. If this were to be the case, the City owned site could be used for storm drainage and park uses, and possibly mitigation for other City projects. It was assumed that this alternative would include floodplain storage and also fish habitat enhancements. Alternative 3 was also conceived as a concept analogous to what the daylighting configuration could potentially look like if the creek was daylighted on the east side of 25th Avenue NE within the for the Shoreline School Aldercrest Annex property, in the event that such usage of the property was allowed.

- Alternative 4: Replace the 25th Avenue NE pipe system with a larger closed conveyance system from Brugger's Bog Park to the existing pipe outfall location, and replace the NE 195th Street culvert with a fish passable culvert. In recognition that a daylighted channel confined within the right-of-way presents many challenges, this alternative was identified as an alternate option to daylighting, assuming that in order to get regulatory permits and approvals significant on-site and off-site environmental mitigation would be required. In other words, given the limited habitat available upstream of 25th Avenue NE, this alternative considers whether investing in environmental mitigation on-site and/or off-site combined with a more simplified "conveyance-only" improvements may be acceptable to the regulatory stakeholders.

- Alternative 5: Extend and enlarge the existing high flow bypass for the 25th Avenue NE system to eliminate flooding and replace the NE 195th Street culvert with a fish passable culvert. This alternative was identified to resolve flooding along 25th Avenue NE by installing a bypass system for peak flows while avoiding costs and complications associated with replacing it with a daylighted stream conveyance system. It is likely that to obtain regulatory permits and approvals for this alternative on-site and/or off-site mitigation would be required.

- Alternative 6: This alternative considers a "Buy Out" option where the City would acquire private properties that are subject to frequent flooding as a way of eliminating a portion of the problem without having to improve the drainage systems along 25th Avenue NE or the NE 195th culvert crossing. Properties to be considered for buyout would include frequently-flooded residential parcels on the east side of 25th Ave NE at 2518 NE 195th St and 2500 NE 195th Pl (shown on the figure in Appendix D). The project could include restoring the purchased properties with a stormwater facility providing flood storage. It is noted that under this alternative, upstream flooding conditions would continue along 25th Avenue NE because the existing 25th Avenue NE stream conveyance system would not be improved. This alternative includes some berming that could provide additional flood protection for the properties east of the properties considered for the buy-out.

- Alternative 7: This alternative, referred to as the flood proofing alternative, seeks to reduce the frequency and magnitude of flooding incrementally by implementing an array of lower-cost improvements without full system replacement. It includes more limited types of improvements that seek to either increase the capacity of the system or provide berms that help protect frequently flooded areas. Note that based on modeling, the current system has a level of protection up to about a 2-year storm (i.e. there is a one in two chance in any given year). Under this alternative, the level of protection against flooding may be increased to about a 4-year storm (i.e. there is a one in four chance in any given year). The elements considered for the flood proofing alternative are shown on a

sketch in Appendix D. It is also noted that under this alternative, very limited improvements would be made within the OHWM of Ballinger Creek, or within Wetlands A or B, so the effort to obtain permits would be significantly less than other alternatives. Under this alternative roadway and property flooding would continue for storms larger than about the 4-year event.

Although not presented as a standalone alternative to reduce flooding, Appendix D also includes preliminary assessment of potential improvements to Brugger's Bog Park. This was initially considered as a means to provide flood plain storage to reduce downstream flows if necessary (due to the loss of storage from conveyance improvements). As the project team completed the analysis it became evident that this improvement was likely not needed and was dropped from further consideration.

3.1.4 Early Stakeholder Outreach

The above alternatives – or slight variations of them – were presented in September and October 2016 to a series of key stakeholders for early feedback on viability, feasibility, or other major concerns which could affect the details of further development for each alternative.

3.1.4.1 Meeting with City of Shoreline Public Works Managers

On September 22, 2016, members of the project team met with selected key managers from the City of Shoreline's Public Works Department to provide an update on project status and solicit feedback on preliminary alternatives and an early stakeholder outreach plan. The public works managers generally approved of the alternatives and early stakeholder outreach plan as presented, with a few comments to refine details of those approaches.

3.1.4.2 Permit Pre-Application Meeting with City of Shoreline Planning and Community Development Department

On September 27, 2016, members of the project team met with representatives of the City's Planning and Community Development (PCD) Department to discuss potential City permitting requirements, especially concerning the potential buffer requirements for daylighted stream segments. Based on a review of the Shoreline Municipal Code, minimum required buffer widths for newly-daylighted stream combined with other spatial constraints posed by specific topography and property boundaries and ownership at this site, all alternatives featuring daylighting would create new buffer crossing onto private properties. SMC 20.80.276(D.6.c) specifically requires written agreement from any neighboring property owner with a new buffer extending onto their property, and there would be reasonable financial justification for a property owner to not accept such a buffer. These code requirements could potentially pose major restrictions on the locations and extents of any proposed daylighted channel. The project team applied for this pre-application meeting as recommended by PCD in order to formally discuss these questions.

PCD provided feedback on the permit application process, which for this project will likely include a Critical Areas Special Use Permit (CASUP). Because the project is a volunteer daylighting project, a critical area buffer reduction can be requested through the CASUP. The buffer reduction amount would be a negotiation by which the applicant requests a reduction (providing justification) and PCD will respond with a counter reduction width or accept the request. Buffer reduction requests could incorporate limiting buffers to front yard setbacks and areas where there is existing vegetation, so as to not impact neighboring properties appreciably, presuming the applicant can make a case that there is a functional isolation in areas where there is 8 feet or more break in vegetation in the buffer (SMC 20.80.200.D.7). Doing so may eliminate the need to request permission from private property owners to allow a critical area buffer on their property. Voluntary daylighting is self-mitigating (SMC 20.30.333) because the proposed project is leaving the stream in the same or better condition after implementation of the project. No mitigation for buffer reduction would be necessary. That said, the PCD representatives were not able to specifically confirm that the stream buffer widths could be sufficiently reduced to eliminate any potential conflicts with adjacent private property owners, as this outcome could only be obtained through the CASUP process. A summary of the meeting minutes is included in Appendix F.

3.1.4.3 Lake Forest Park Review of Preliminary Alternatives

On October 13, 2016, the project team met with representatives from the Planning and Building, Public Works, and Engineering departments of the City of Lake Forest Park to review the preliminary project alternatives to be presented to the regulatory stakeholders. Summary meeting minutes for the meeting are included in Appendix F.4. In general there were no major comments on the project alternatives and Lake Forest Park was supportive of the City of Shoreline's efforts. It was noted that the City of Lake Forest Park is in the process of updating their critical area regulations which will affect the buffers for Ballinger Creek and Wetland B in addition to the permit process for the project. It was also noted that should new drainage easements be needed for project areas within Lake Forest Park, it would likely be Lake Forest Park to obtain the easement and pass along the applicable costs to the City of Shoreline. In terms of construction, the City of Lake Forest Park indicated that it would likely be acceptable to temporarily close NE 195th Street to traffic for the culvert replacement.

3.1.4.4 Regulatory Stakeholder Review of Preliminary Alternatives

As noted above, the project team concluded that it would be important to solicit early feedback from regulatory stakeholders because their input can often drive or determine what improvements will ultimately be acceptable and permitable. The following regulatory stakeholders were invited to attend a discussion at Shoreline City Hall on October 18, 2016, followed by a visit to the study area:

- U.S. Army Corps of Engineers (USACE) – two representatives attended

- Washington Department of Fish and Wildlife (WDFW) – one representative attended
- Washington Department of Ecology (Ecology) – one representative attended discussion portion by phone, but was unable to participate in site visit
- Muckleshoot Indian Tribe Fisheries Division (MITFD) – invited but unable to attend

For this meeting, the alternatives discussed included only Alternative 1, 2, 4, and 5 (presented using a slightly different numbering system at the time). Alternative 3 was not formally presented because the ability to use the NMF site at the time was too uncertain for it to be considered a viable option compared with other alternatives; however it should be noted that the regulatory stakeholders expressed interest in any potential opportunities to daylight the Ballinger Creek outside of the 25th Avenue NE right-of-way.

Alternatives 6 and 7 were not presented because, with much smaller environmental impacts, permitting processes with these regulatory stakeholders would presumably be much easier. For this early meeting the project team wanted to solicit specific input on those alternatives where the permitting could significantly affect the alternative configuration and whether alternatives would be permitable.

A copy of the meeting minutes and information packet that was provided to the regulatory stakeholders is included as Appendix F.1. One of the most important pieces of feedback received in this meeting was regarding upcoming regulatory changes that will affect permitting for this project. The USACE Nationwide Permits (NWPs) and Regional General Conditions (RGCs) will be updated in 2017 (currently planned effective date of March 19, 2017). The new RGC regulations will stipulate that culverts must provide fish passage and meet the stream simulation methodology – consistent with WDFW's HPA requirements – and require effectively no perennial stream loss.

The main conclusions drawn by the project team following this meeting included the following:

Alternative 1 – the long culvert proposed in Alternative 1 would not meet the fish passage criteria and would need to be reconfigured in such a way as to use shorter culverts meeting the fish passage requirements.

Alternative 4 – It would be unlikely to obtain necessary permits for this alternative. The option of providing environmental mitigation was discussed, but the regulatory stakeholders tend to consider acceptance of mitigation combined with non-fish passage stream conveyance improvements as a very last resort, for rare situations where fish passable stream conveyance improvements can be exhaustively proven to be infeasible.

Alternative 5 – It would be unlikely to obtain necessary permits for this alternative. The option of providing environmental mitigation was discussed, but as with Alternative 4, the regulatory stakeholders would not allow a non-fish passable bypass when there are clearly less impacting alternatives available.

Other findings and input from the regulatory stakeholders meeting can be reviewed in Appendix F.1.

3.1.5 Results of Alternative Screening

In addition to the outreach meetings described above involving Shoreline Public Works, Shoreline Planning and Community Development, City of Lake Forest Park, and the regulatory stakeholder, two additional brief coordination efforts were made with City of Shoreline Parks and Shoreline Public Schools. Based on the findings of the project investigations and feedback for the early stakeholder outreach, the project team further narrowed the list of alternatives as well as refined some of the elements within the alternatives.

Alternatives 4 and 5 were considered infeasible primarily based on regulatory stakeholder feedback, and were eliminated from further serious consideration at this time.

3.2 Alternative Analysis of Selected Alternatives

3.2.1 General

An alternative analysis was performed on the remaining alternatives after the screening described in Section 3.1. The remaining alternatives include 1, 2, 3, 6, and 7. Figure 3-1 presents a simplified overlay of these five alternatives. Note that Figure 3-1 does include some modifications to some of the alternatives from those shown in Appendix D, where alternative locations or extents were subsequently changed during the planning process. This section describes the remaining alternatives, as well as hydrologic and hydraulic analyses and a comparative evaluation of the alternatives.

3.2.2 Alternative 1

Alternative 1 includes daylighting Ballinger Creek on the west side of 25th Avenue NE before crossing 25th Avenue NE to enter the existing creek channel downstream of NE 195th Place. Refer to Figures 3-2, 3-3 and 3-4, which show a plan view, sections and profiles, respectively.

Alternative 1 was modified from the original concept described in Section 3.1 and shown in Appendix D. The main change from the earlier description was to eliminate the long culvert crossing from the west to east side of 25th Avenue NE because it would not meet the fish passage criteria and therefore not be permitable.

BRUGGER'S BOG PARK

WETLAND "A"

25TH AVE NE

SHORELINE SCHOOL DISTRICT PROPERTY

19533 25TH AVE. NE

19500 BALLINGER WAY NE

2500 NE 195TH PL

2518 NE 195TH ST

NE 195TH ST

2525 NE 195TH ST.

WETLAND "B"

2609 NE 195TH ST.

BALLINGER WAY NE

BALLINGER WAY CULVERT

~~LEGEND~~

COLOR CODE

- Alternative 1 — *Daylighting Creek within 25th Ave. NE ROW (West side) and replace NE 195th Culvert*
- Alternative 2 — *Daylighting Creek within 25th Ave NE ROW (west and east side) and Replace NE 195th Culvert*
- Alternative 3 — *Daylight Creek in NFM and Transition to Alt 1 or Alt 2 (Alt 1 shown in graphic)*
- Alternative 6 — *Buy Out Alternative*
- Alternative 7 — *Flood Proofing Alternative*
- Shoreline City Limit

LINE TYPE

- Open Channel
- Closed Pipe
- Line Existing Pipe with Smooth Interior
- Berming/Raising Height of Driveway "Speed Bumps"
- Improving Conveyance of Existing Roadway Shoulder and Pipe System
- Limits of Buy-Out Property Acquisition
- Limits of Floodplain Storage

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-1 -
Alternatives Overview

Feet
0 37.5 75 150

N W E S

Date: 2/2/2017
Author: James Ellis
Path: P:\PROJECTS\City of Shoreline\25th Ave NE\Data Analytical\GIS\Figures\Figure 3-1 - Alternatives Overview.mxd

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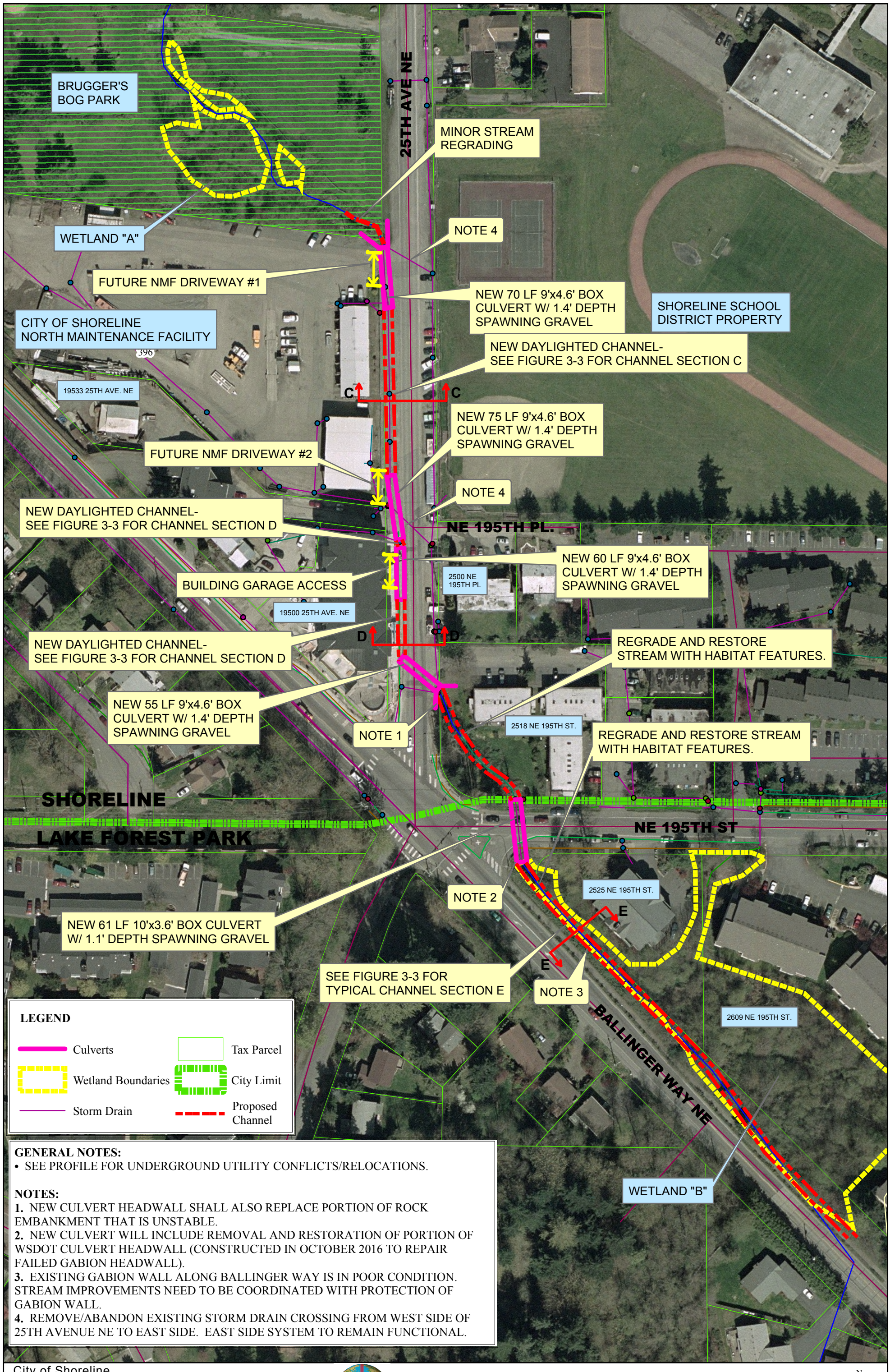

GENERAL NOTES:

- SEE PROFILE FOR UNDERGROUND UTILITY CONFLICTS/RELOCATIONS.

NOTES:

1. NEW CULVERT HEADWALL SHALL ALSO REPLACE PORTION OF ROCK EMBANKMENT THAT IS UNSTABLE.

2. NEW CULVERT WILL INCLUDE REMOVAL AND RESTORATION OF PORTION OF WSDOT CULVERT HEADWALL (CONSTRUCTED IN OCTOBER 2016 TO REPAIR FAILED GABION HEADWALL).

3. EXISTING GABION WALL ALONG BALLINGER WAY IS IN POOR CONDITION. STREAM IMPROVEMENTS NEED TO BE COORDINATED WITH PROTECTION OF GABION WALL.

4. REMOVE/ABANDON EXISTING STORM DRAIN CROSSING FROM WEST SIDE OF 25TH AVENUE NE TO EAST SIDE. EAST SIDE SYSTEM TO REMAIN FUNCTIONAL.

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-2 -
Alt 1 Plan View

Feet
0 37.5 75 150

Date: 1/30/2017
Author: James Ellis
Path: P:\PROJECTS\City of Shoreline\25th Ave NE\Data Analytical\GIS\Figures\Figure 3-2 - Alt 1 Plan.mxd

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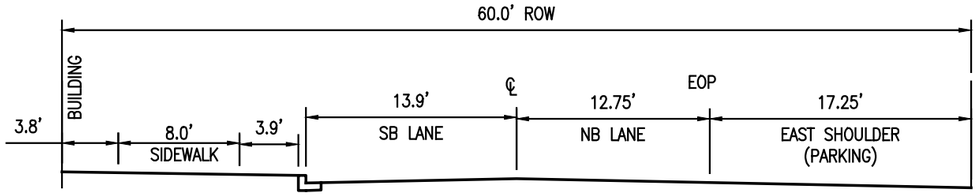
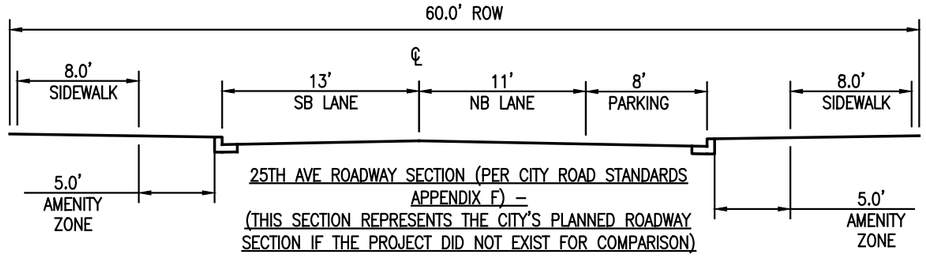


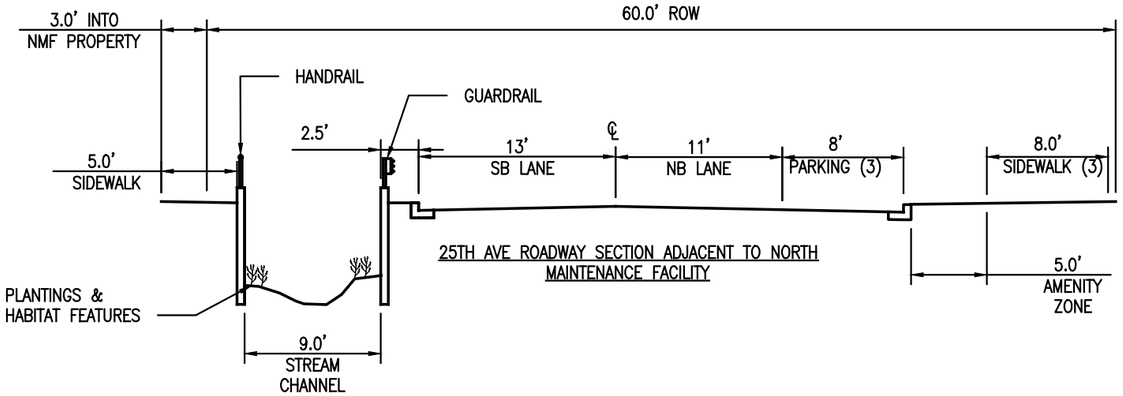
EXISTING 25TH AVE NE ROADWAY SECTION (CONDITIONS AT 19500 25TH AVE NE) (LOOKING NORTH)

SECTION A

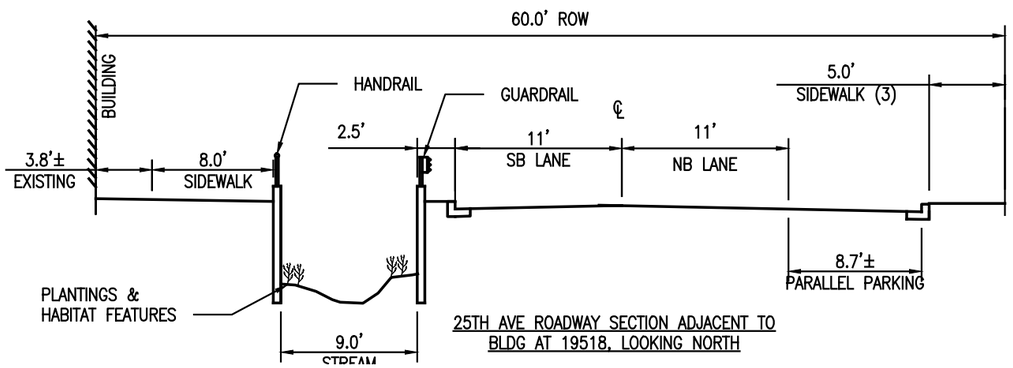


25TH AVE ROADWAY SECTION (PER CITY ROAD STANDARDS APPENDIX F) – (THIS SECTION REPRESENTS THE CITY'S PLANNED ROADWAY SECTION IF THE PROJECT DID NOT EXIST FOR COMPARISON)

SECTION B

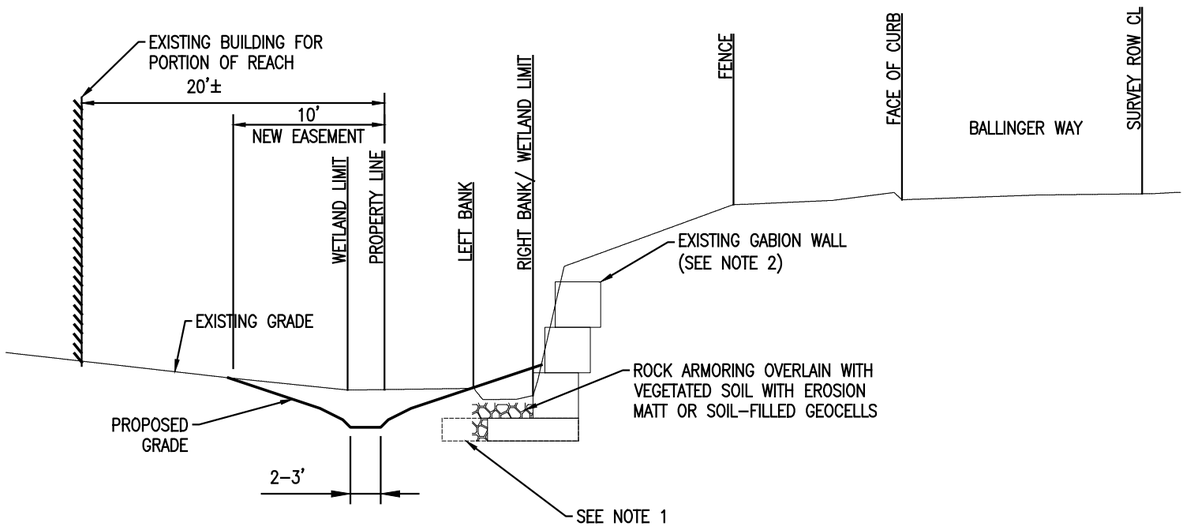


SECTION C



25TH AVE ROADWAY SECTION ADJACENT TO BLDG AT 19518, LOOKING NORTH

SECTION D



BALLINGER CREEK (APPROX 80FT DOWNSTREAM OF NE 195TH ST)(LOOKING SOUTH)

SECTION E

NOTES:
1. ONE ADDITIONAL GABION BASKET (DASHED) EXTENDS INTO CHANNEL EVERY 30'–60' (ASSUMED FOR TOE PROTECTION FROM CREEK). NEW CHANNEL TO MEANDER EAST AROUND BASKETS WHERE REQUIRED.
2. GABION BASKET WALL FAILING AT TOE (SEE TEXT). TOE WILL NEED TO BE PROTECTED BY BURIED ROCK ARMORING.
3. THIS COMPONENT OF STREET IMPROVEMENT MAY BE FUTURE WORK AND NOT PART OF THE FLOOD PREVENTION PROJECT.

1"=10' 10 5 0 10 20
Scale Feet

Figure 3-3
25th Ave. NE - Existing and Alt 1 Sections

25th Ave. NE Flood Reduction Project
City of Shoreline

Louis Berger

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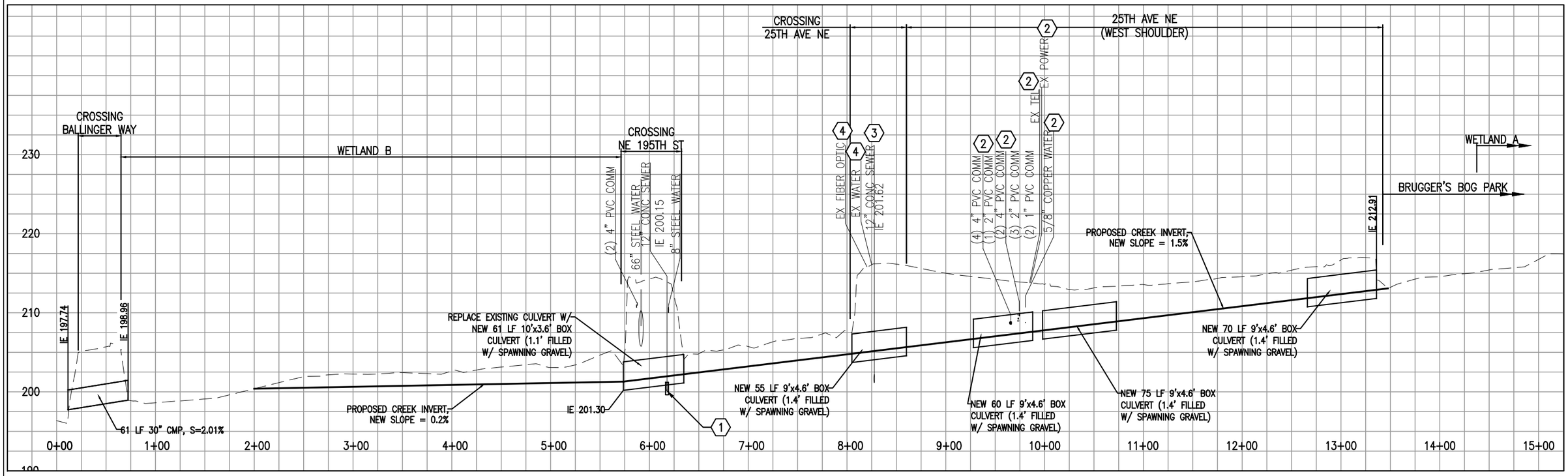

KEYED NOTES

1. CULVERT TO BE EQUIPPED WITH APPROXIMATELY 6 LF OF SPECIALLY DESIGNED PRECAST SECTION THAT PROVIDES A SUMP FOR EXISTING SEWER CROSSING. EXISTING SEWER TO BE PLACED IN PROTECTIVE STEEL CASING SPANNING THROUGH CULVERT WITHIN SPAWNING GRAVEL LAYER.
2. UTILITY MAY NEED TO BE RELOCATED ABOVE OR BELOW NEW CULVERT.
3. PUT EXISTING 12" SEWER IN CASING PIPE BELOW NEW CULVERT OR ENCASE IN CONCRETE.
4. PROTECT AND SUPPORT UTILITY CROSSING DURING EXCAVATION.

GENERAL NOTES

1. SMALLER INDIVIDUAL UTILITY SERVICE CONNECTIONS TO ADJACENT PARCELS NOT SHOWN ON PROFILE.

SCALE
H: 1"=100'
V: 1"=10'

1"=100' 100 50 0 100 200 Scale Feet

1"=10' 10 5 0 10 20 Scale Feet

Figure 3-4
Ballinger Creek Alt 1 Profile

25th Ave. NE Flood Reduction Project
City of Shoreline

Louis Berger

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Alternative 1 includes the following elements:

- **Four new box culverts along 25th Avenue NE (approximately 260 LF).** The four new culverts would allow the creek to pass under (1) the driveway to the north side of the NMF, (2) the combined south driveway to the NMF and the access road to the apartments at 19533 25th Avenue NE, (3) the garage access to 19500 Ballinger Way NE as well as (4) 25th Avenue NE. These culverts would be 9-foot-wide by 4.6-foot-high box culverts. The inverts of the all the culverts would be buried to create a natural channel bottom within the culverts. The culverts were sized to meet WDFW's stream simulation option.

- **A replacement 10-foot-wide by 3.6-foot-high box culvert under NE 195th Street.** This culvert would be shorter than the other culverts in order to pass underneath the 66-inch-diamter SPU water supply pipeline that is aligned along NE 195th Street. The culvert invert would be buried to create a natural channel bottom. The culvert was sized to meet WDFW's stream simulation option and WSDOT hydraulic criteria which specifies that the 25-year flow depth not exceed 1.25 times the height of the culvert (2015 WSDOT Hydraulics Manual, Section 3-3.2.2). Based on input from SPU, a vertical clearance between the existing 66-inch-diameter pipe and the new box culvert should be a minimum of 0.5-feet. With this added clearance (where there is no clearance under current conditions) and the thickness of a concrete box culvert (roughly one foot), the soffit (or top) of the new culvert will be approximately 1.5-feet lower than the top of existing culvert. To meet WSDOT's hydraulic criteria requires the culvert height has to be 0.6-feet taller than the existing 2-foot tall culvert. Thus the culvert replacement will require the creek invert be lowered approximately 2-feet below the existing culvert invert. This requires that the creek invert to be similarly lowered (as described below).

- **New open channel sections on the west side of 25th Avenue NE (approximately 255 LF).** The new open channel segments would extend from Brugger's Bog Park south adjacent to the NMF and to the building at 19500 Ballinger Way NE to where the creek would cross 25th Avenue NE. It would include some minor regrading of the existing stream channel in Brugger's Bog Park. Due to the competing needs for use of the 25th Avenue NE public right-of-way along this alignment (sidewalks, parking, travel lanes, amenity zone, etc.), the daylighted channel width is limited to 9-feet, calculated as the minimum width necessary for acceptable stream design. Accordingly, vertical walls are required on both sides of the creek to maximize capacity for this minimum width (i.e., 9-foot width wall to wall). With this configuration as the minimum space needed to daylight the channel within the right-of-way, the project team has assumed that an additional 3 foot width projecting into the NMF property would be needed to accommodate a 5-foot wide sidewalk to the west of the channel, which is narrower than the 8-foot wide sidewalk called for in the City's Engineering Design Manual (EDM). Figure 3-3 shows the widths for sidewalk, travel lanes and parking within the 25th Avenue NE right-of-way assumed by the project team and generally attempting to comply with the future roadway section as called for in the City's EDM. Further advancement of this alternative or others featuring a daylighted

channel within the 25th Avenue NE right-of-way would need to further consider the impact of the daylighted channel width on other potential uses for the right-of-way width, coordinate with the NMF team regarding any impacts to that property, and gain approval for the proposed approach by means of an Engineering Deviation application.

For the sake of visualizing what this daylighted channel could look like, a recent project in the City of Bothell, the Horse Creek Drainage Improvements Project (designed by project team member BergerABAM) used concrete walls to create an open channel similar to what is being considered on this project (see Photo 1 below). The photograph shows how a traffic barrier and pedestrian fence/railing are used to protect the traveling public and how an open stream section can be daylighted in a dense urban environment.

Photo 1. Example of 3-Sided Open Channel with Concrete Walls

- **Channel excavation between 2518 NE 195th Street to about 130 feet upstream of the Ballinger Way NE culvert crossing (approximately 160 LF).** In order to install the replacement culvert below the 66-inch diameter SPU water supply pipe line in NE 195th Street, the invert of Ballinger Creek needs to be lowered by about 2 feet at the downstream side of NE 195th Street. A constant channel slope was assumed between Brugger's Bog Park and the downstream side of NE 195th Street. A flatter slope was used between NE 195th Street and Ballinger Way NE because the culvert invert at Ballinger Way NE cannot be adjusted. As shown on Figure 3-4, much of the existing stream channel between the driveway to 2518 NE 195th Street and several hundred feet downstream of NE 195th Street would need to be lowered by approximately 2-3 feet, and as much as 4 feet immediately downstream of NE 195th Street where the channel as aggraded (raised).

Some thought was initially given to having the portion of the stream channel along 25th Avenue NE be flatter and more shallow (to save on construction costs). However, it would require that the section of existing open channel between the driveway to 2518 and NE 195th Street be much steeper, which would be undesirable for fish passage considerations. Therefore constant slope is proposed.

3.2.3 Alternative 2

Alternative 2 is similar to Alternative 1 except that a portion of the newly daylighted channel would be located on the east and the west side of 25th Avenue NE. Refer to Figures 3-5, 3-6, and 3-7, which show a plan view, sections and profile, respectively. This alternative includes:

- **Four new box culverts along 25th Avenue NE (approximately 227 LF).** These new culverts would allow the creek to pass under (1) the access road on the north side of the NMF, (2) 25th Avenue NE, (3) NE 195th Place, and (4) the driveway to 2518 NE 195 Street. Similar to Alternative 1, these culverts would be 9-foot-wide by 4.6-foot-high box culverts. The inverts of the all the culverts would be buried to create a natural channel bottom within the culverts. The culverts were sized to meet WDFW's stream simulation option.

- **A replacement 10-foot-wide by 3.6-foot-high box culvert under NE 195th Street.** This culvert would be the same as under Alternative 1.

- **New open channel sections partly on the west and partly on the east side of 25th Avenue NE (approximately 290 LF).** The northern portion of this new open channel would be the same as Alternative 1 with the daylighted channel on the west side of 25th Avenue NE adjacent to the NMF. It too, would have minor regrading of a short section of stream channel within Brugger's Bog Park. The main change from Alternative 1 is that the creek would cross under 25th Avenue NE beginning just upstream of the southern NMF driveway and outlet just upstream of NE 195th Place. From NE 195th Place southward, the new open channel will be located on the east side of 25th Avenue NE. This alternative would have the same complications as Alternative 1 due to limited space within the right-of-way available for daylighting the channel. The proposed new daylighted channel would be the same size as Alternative 1, would require wall on either side to minimize its footprint, and is assumed to need an additional 3 foot width of property along the NMF.

- **Channel excavation between driveway to 2518 NE 195th Street to about 130 feet upstream of the Ballinger Way NE culvert crossing (approximately 160 LF).** Similar to Alternative 1, Alternative 2 requires regrading of the existing channel in order to pass the creek under the SPU's water supply pipe line in NE 195th Street.

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BRUGGER'S BOG PARK

25TH AVE NE

MINOR STREAM REGRADING

WETLAND "A"

NOTE 4

FUTURE NMF DRIVEWAY #1

NEW 70 LF 9'x4.6' BOX CULVERT W/ 1.4' DEPTH SPAWNING GRAVEL

SHORELINE SCHOOL DISTRICT PROPERTY

CITY OF SHORELINE NORTH MAINTENANCE FACILITY

396

NEW DAYLIGHTED CHANNEL- SEE FIGURE 3-6 FOR CHANNEL SECTION C

19533 25TH AVE. NE

C

C

NEW 75 LF 9'x4.6' BOX CULVERT W/ 1.4' DEPTH SPAWNING GRAVEL

FUTURE NMF DRIVEWAY #2

NEW DAYLIGHTED CHANNEL- SEE FIGURE 3-6 FOR CHANNEL SECTION D

NOTE 5

NE 195TH PL

NOTE 4

NEW 30LF 9'x4.6' BOX CULVERT W/ 1.4' DEPTH SPAWNING GRAVEL

2500 NE 195TH PL

BUILDING GARAGE ACCESS

D

D

19500 25TH AVE. NE

NOTE 5

NEW DAYLIGHTED CHANNEL- SEE FIGURE 3-6 FOR CHANNEL SECTION D

REGRADE AND RESTORE STREAM WITH HABITAT FEATURES.

NEW 52 LF 9'x4.6' BOX CULVERT W/ 1.4' DEPTH SPAWNING GRAVEL

NOTE 1

2518 NE 195TH ST.

REGRADE AND RESTORE STREAM WITH HABITAT FEATURES.

NEW 61 LF 10'x3.6' BOX CULVERT W/ 1.1' DEPTH SPAWNING GRAVEL

SHORELINE

LAKE FOREST PARK

NE 195TH ST

NOTE 2

2525 NE 195TH ST.

E

SEE FIGURE 3-6 FOR TYPICAL CHANNEL SECTION E

E

NOTE 3

BALLINGER WAY NE

2609 NE 195TH ST.

WETLAND "B"

LEGEND

- Wetland Boundaries
- Tax Parcel
- Alt 2 Culverts
- City Limit
- Storm Drain
- Proposed Channel

GENERAL NOTES:

- SEE PROFILE FOR UNDERGROUND UTILITY CONFLICTS/RELOCATIONS.

NOTES:

1. NEW CULVERT HEADWALL SHALL ALSO REPLACE PORTION OF ROCK EMBANKMENT THAT IS UNSTABLE.

2. NEW CULVERT WILL INCLUDE REMOVAL AND RESTORATION OF PORTION OF WSDOT CULVERT HEADWALL (CONSTRUCTED IN OCTOBER 2016 TO REPAIR FAILED GABION HEADWALL).

3. EXISTING GABION WALL ALONG BALLINGER WAY IS IN POOR CONDITION. STREAM IMPROVEMENTS NEED TO BE COORDINATED WITH REPAIR PROTECTION OF GABION WALL.

4. REMOVE/ABANDON EXISTING STORM DRAIN CROSSING FROM WEST SIDE OF 25TH AVENUE NE TO EAST SIDE. EAST SIDE SYSTEM TO REMAIN FUNCTIONAL.

5. EXISTING POLE WITH OVERHEAD POWER AND COMM LINES TO BE RELOCATED (TWO LOCATIONS).

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-5 -
Alt 2 Plan View

0 37.5 75 150 Feet

N W E S

Date: 1/30/2017
Author: James Ellis
Path: P:\PROJECTS\City of Shoreline\25th Ave NE\Data Analytical\GIS\Figures\Figure 3-5 - Alt 2 Plan.mxd

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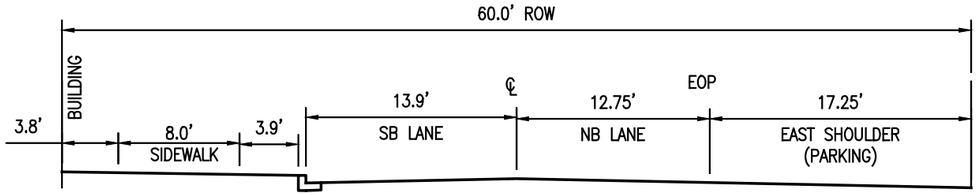
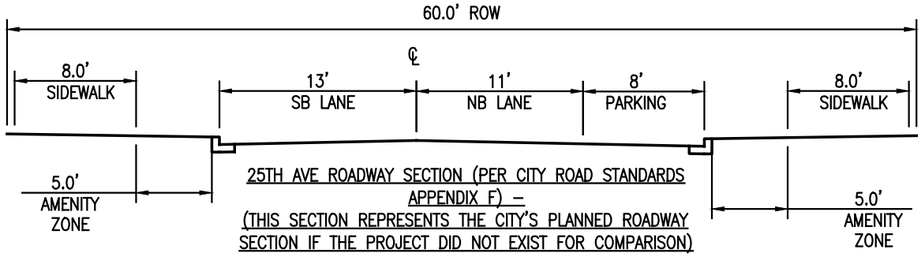


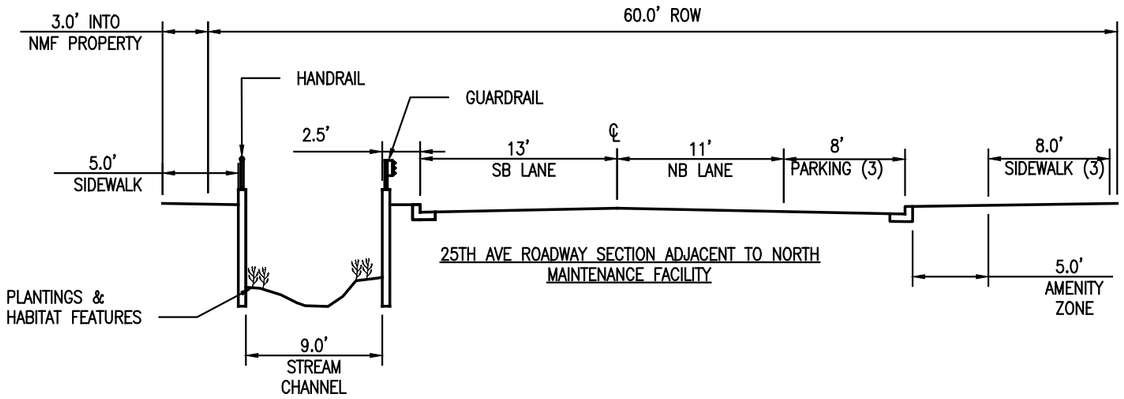
EXISTING 25TH AVE NE ROADWAY SECTION (CONDITIONS AT 19500 25TH AVE NE) (LOOKING NORTH)

SECTION A



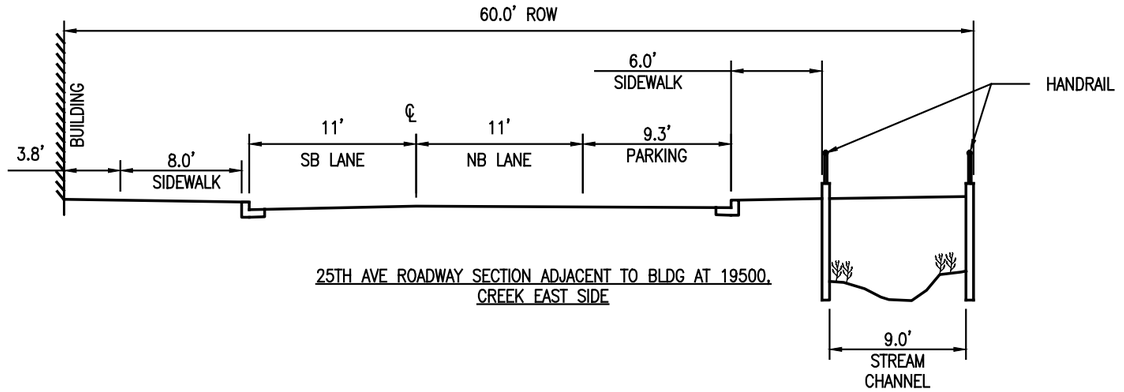
25TH AVE ROADWAY SECTION (PER CITY ROAD STANDARDS APPENDIX F) –
(THIS SECTION REPRESENTS THE CITY'S PLANNED ROADWAY SECTION IF THE PROJECT DID NOT EXIST FOR COMPARISON)

SECTION B



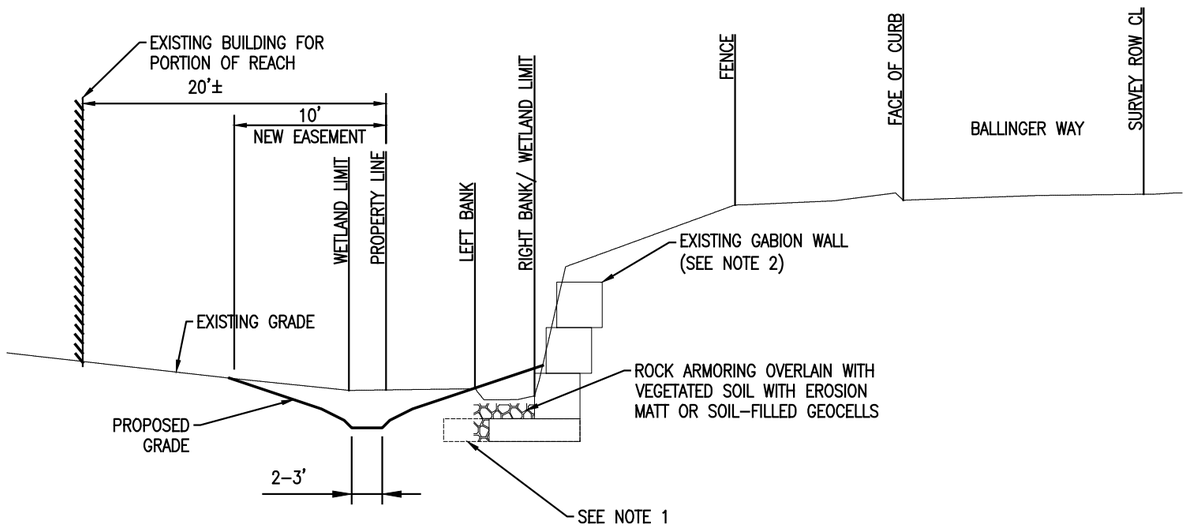
25TH AVE ROADWAY SECTION ADJACENT TO NORTH MAINTENANCE FACILITY

SECTION C



25TH AVE ROADWAY SECTION ADJACENT TO BLDG AT 19500, CREEK EAST SIDE

SECTION D



BALLINGER CREEK (APPROX 80FT DOWNSTREAM OF NE 195TH ST)(LOOKING SOUTH)

SECTION E

NOTES:
1. ONE ADDITIONAL GABION BASKET (DASHED) EXTENDS INTO CHANNEL EVERY 30'–60' (ASSUMED FOR TOE PROTECTION FROM CREEK). NEW CHANNEL TO MEANDER EAST AROUND BASKETS WHERE REQUIRED.
2. GABION BASKET WALL FAILING AT TOE (SEE TEXT). TOE WILL NEED TO BE PROTECTED BY BURIED ROCK ARMORING.
3. THIS COMPONENT OF STREET IMPROVEMENT MAY BE FUTURE WORK AND NOT PART OF THE FLOOD PREVENTION PROJECT.

1"=10' Scale: 10 5 0 10 20 Feet

Figure 3-6
25th Ave. NE - Existing and Alt 2 Sections

25th Ave. Flood Reduction
City of Shoreline

Louis Berger

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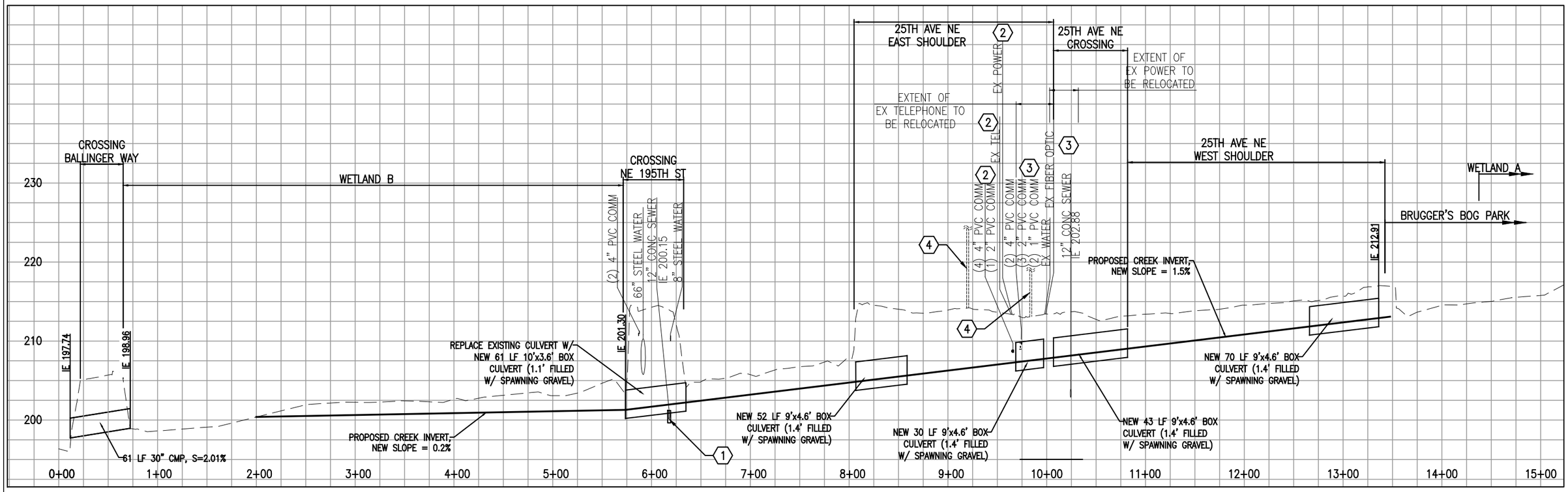

KEYED NOTES

1. CULVERT TO BE EQUIPPED WITH APPROXIMATELY 6 LF OF SPECIALLY DESIGNED PRECAST SECTION THAT PROVIDES A SUMP FOR EXISTING SEWER CROSSING. EXISTING SEWER TO BE PLACED IN PROTECTIVE STEEL CASING SPANNING THROUGH CULVERT WITHIN SPAWNING GRAVEL LAYER.
2. UTILITY MAY NEED TO BE RELOCATED EITHER BELOW THE STREAM CHANNEL OR TO NEARBY CULVERT CROSSING.
3. UTILITY MAY NEED TO BE RELOCATED EITHER ABOVE OR BELOW NEW CULVERT.
4. SEATTLE CITY LIGHT POLE TO BE RELOCATED.

GENERAL NOTES

1. SMALLER INDIVIDUAL UTILITY SERVICE CONNECTIONS TO ADJACENT PARCELS NOT SHOWN ON PROFILE.

SCALE
H: 1"=100'
V: 1"=10'

1"=100' 100 50 0 100 200 Scale Feet

1"=10' 10 5 0 10 20 Scale Feet

Figure 3-7
Ballinger Creek Alt 2 Profile

25th Ave. NE Flood Reduction Project
City of Shoreline

Louis Berger

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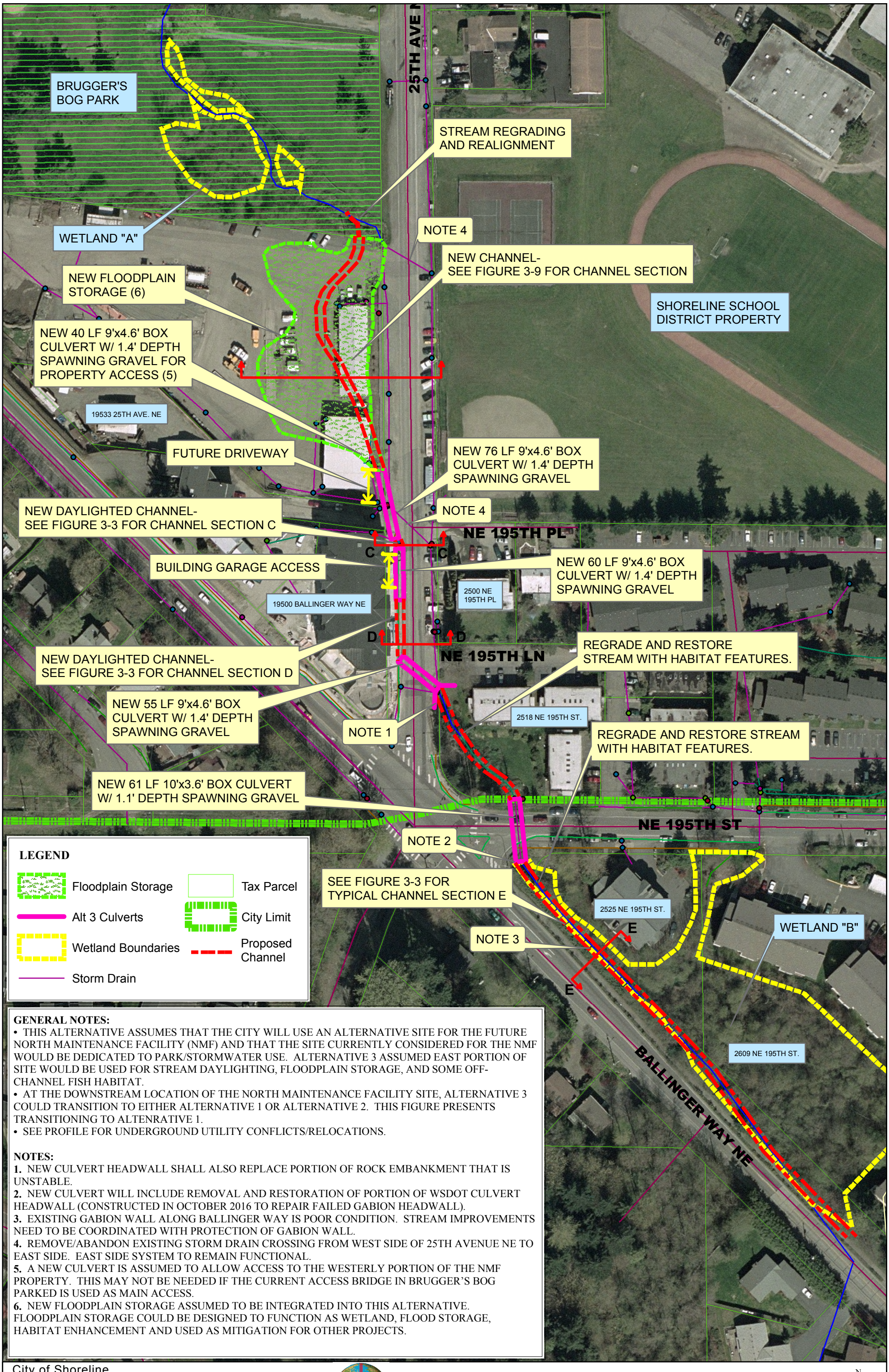
3.2.4 Alternative 3

The principal distinguishing feature of Alternative 3 involves daylighting the creek within the NMF property, then transitioning to either Alternative 1 or Alternative 2 alignment south of the NMF property. As noted previously, this alternative is feasible only on the condition that NMF site development does not move forward as currently envisioned and that the City develops a future maintenance facility at an alternative location. If this were to be the case, a portion of the City-owned site along 25th Avenue NE could be potentially re-purposed for surface water (uses for the remaining portions of the NMF property would be "to be determined" but could include conversion to park land, mitigation for other City projects, and/or some limited uses in support of City operations). Refer to Figures 3-8, 3-9, and 3-10, which show the plan view, sections, and profile, respectively.

For Alternative 3, the following project elements were assumed.

- **New Daylighted Channel through NMF.** A new daylighted channel would be created through the eastern side of the NMF property. Due to additional space available, the daylighted channel at this location could include wider stream buffers and floodplain storage which would help reduce downstream flows. A short section, approximately 30-50 feet of the existing creek in Brugger's Bog Park, downstream of Wetland A could be relocated and regraded to align to the new daylighted channel to increase the buffer width offset from 25th Avenue NE hard surfaces. The floodplain storage could also be configured to provide wetland habitat, off channel flood refuge, and rearing habitat for juvenile fish and include habitat features, such as rootwads, snags, and island hummocks.
- N**ew Culvert for NMF**. For the Alternative 3 configuration shown, it was assumed that there would need to be a new culvert at the south end of the NMF site to preserve access to the westerly portion of the property. Depending on the future intended uses for this portion of the property, the existing bridge across Ballinger Creek within Brugger's Bog Park could potentially service as an alternative access path to this area; which would reduce cost by eliminating the added length to serve the NFM and also maximize the length of daylighted channel. A culvert at the north end of the property (where the existing driveway is located) was assumed to be unnecessary in this scenario.
- T**ransition to Either Alternative 1 or Alternative 2 Alignment.** Downstream of the NMF facility, the alignment of stream conveyance improvements would transition to the downstream alignment of either Alternative 1 or Alternative 2. Figure 3-8 shows how Alternative 3 could transition to Alternative 1. For the transition to Alternative 1, the new culvert for NMF (in bullet described above) would actually connect to and be part of a longer culvert that also serves 19533 25th Avenue NE. Further advancement of this alternative would need to further analyze which downstream alignment to use.

- As previously noted, Alternative 3 is roughly analogous to what the daylighting configuration could potentially look like if the daylighted channel was located within the Shoreline School Aldercrest Annex property on the east side of 25th Avenue NE, in the event that such usage of the property was allowed. Notable exceptions include the culvert crossing 25th Ave NE which would be needed immediately downstream of Brugger's Bog Park, and transition to the Alternative 2 alignment at the southern end of the Aldercrest Annex property (i.e., the Alternative 1 alignment would not make sense under this scenario). Due to the current unlikeliness of this project being allowed to use the Aldercrest Annex property, this configuration was not chosen for representation among the narrowed selection of alternatives. If future usage of the Aldercrest Annex is allowed for this project and considered for further advancement, the Alternative 3 concepts as presented would need to be reconfigured to account for conditions specific to the Aldercrest Annex property.



GENERAL NOTES:

- THIS ALTERNATIVE ASSUMES THAT THE CITY WILL USE AN ALTERNATIVE SITE FOR THE FUTURE NORTH MAINTENANCE FACILITY (NMF) AND THAT THE SITE CURRENTLY CONSIDERED FOR THE NMF WOULD BE DEDICATED TO PARK/STORMWATER USE. ALTERNATIVE 3 ASSUMED EAST PORTION OF SITE WOULD BE USED FOR STREAM DAYLIGHTING, FLOODPLAIN STORAGE, AND SOME OFF-CHANNEL FISH HABITAT.
- AT THE DOWNSTREAM LOCATION OF THE NORTH MAINTENANCE FACILITY SITE, ALTERNATIVE 3 COULD TRANSITION TO EITHER ALTERNATIVE 1 OR ALTERNATIVE 2. THIS FIGURE PRESENTS TRANSITIONING TO ALTENRATIVE 1.
- SEE PROFILE FOR UNDERGROUND UTILITY CONFLICTS/RELOCATIONS.

NOTES:

1. NEW CULVERT HEADWALL SHALL ALSO REPLACE PORTION OF ROCK EMBANKMENT THAT IS UNSTABLE.
2. NEW CULVERT WILL INCLUDE REMOVAL AND RESTORATION OF PORTION OF WSDOT CULVERT HEADWALL (CONSTRUCTED IN OCTOBER 2016 TO REPAIR FAILED GABION HEADWALL).
3. EXISTING GABION WALL ALONG BALLINGER WAY IS POOR CONDITION. STREAM IMPROVEMENTS NEED TO BE COORDINATED WITH PROTECTION OF GABION WALL.
4. REMOVE/ABANDON EXISTING STORM DRAIN CROSSING FROM WEST SIDE OF 25TH AVENUE NE TO EAST SIDE. EAST SIDE SYSTEM TO REMAIN FUNCTIONAL.
5. A NEW CULVERT IS ASSUMED TO ALLOW ACCESS TO THE WESTERLY PORTION OF THE NMF PROPERTY. THIS MAY NOT BE NEEDED IF THE CURRENT ACCESS BRIDGE IN BRUGGER'S BOG PARKED IS USED AS MAIN ACCESS.
6. NEW FLOODPLAIN STORAGE ASSUMED TO BE INTEGRATED INTO THIS ALTERNATIVE. FLOODPLAIN STORAGE COULD BE DESIGNED TO FUNCTION AS WETLAND, FLOOD STORAGE, HABITAT ENHANCEMENT AND USED AS MITIGATION FOR OTHER PROJECTS.

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-8 -
Alt 3 Plan View

0 37.5 75 150 Feet

Date: 2/1/2017
Author: James Ellis
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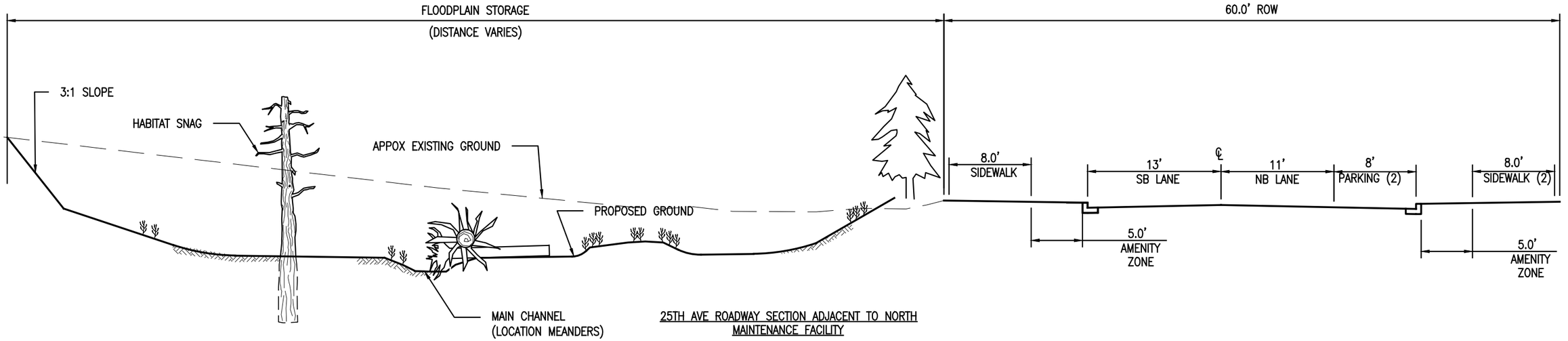

1"=10'

10 5 0 10 20

Scale Feet

NOTES:
1. CROSS SECTIONS DOWNSTREAM OF THE NORTH MAINTENANCE FACILITY SITE WILL EITHER CONFORM TO THE CROSS SECTIONS FOR ALTERNATIVE 1 OR ALTERNATIVE 2. SEE FIGURES 3-3 AND 3-6.

2. THIS COMPONENT OF STREET IMPROVEMENT MAY BE FUTURE WORK AND NOT PART OF THE FLOOD PREVENTION PROJECT.

Figure 3-9
25th Ave. NE - Alternative 3 Sections

25th Ave. Flood Reduction
City of Shoreline

Louis Berger

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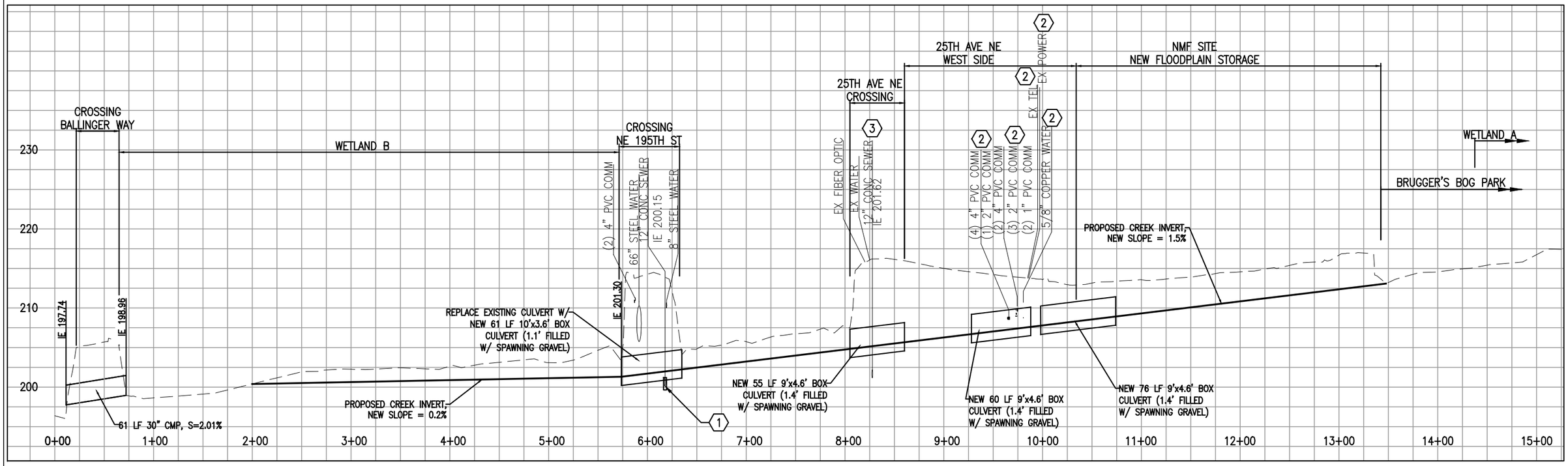

KEYED NOTES

1. CULVERT TO BE EQUIPPED WITH APPROXIMATELY 6 LF OF SPECIALLY DESIGNED PRECAST SECTION THAT PROVIDES A SUMP FOR EXISTING SEWER CROSSING. EXISTING SEWER TO BE PLACED IN PROTECTIVE STEEL CASING SPANNING THROUGH CULVERT WITHIN SPAWNING GRAVEL LAYER.
2. UTILITY MAY NEED TO BE RELOCATED ABOVE OR BELOW NEW CULVERT.
3. PUT EXISTING 12" SEWER IN CASING PIPE BELOW NEW CULVERT OR ENCASE IN CONCRETE.

GENERAL NOTES

1. SMALLER INDIVIDUAL UTILITY SERVICE CONNECTIONS TO ADJACENT PARCELS NOT SHOWN ON PROFILE.
2. THIS PROFILE REFLECTS ALTERNATIVE 3 TRANSITION TO ALTERNATIVE 1 DOWNSTREAM OF NMF. IT COULD ALSO TRANSITION TO ALTERNATIVE 2, SEE FIGURE 3-6 FOR PROFILE DOWNSTREAM OF NMF.

SCALE
H: 1"=100'
V: 1"=10'

1"=100' 100 50 0 100 200 Scale Feet

1"=10' 10 5 0 10 20 Scale Feet

Figure 3-10
Ballinger Creek Alt 3 Profile

25th Ave. NE Flood Reduction Project
City of Shoreline

Louis Berger

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3.2.5 Alternative 6

Alternative 6 (sometimes referred to as the "Buy Out" alternative) considers an approach whereby the City would acquire key portions of private properties that are subject to the worst and most frequent flooding as a way of eliminating a portion of the problem without having to improve the drainage systems along 25th Avenue NE and the NE 195th culvert crossing. The key portions of properties are shown on Figure 3-11, which was modified from the initial concept of this alternative discussed in Section 3.1.3 and presented in Appendix D.

Previously, the initial properties considered for acquisition were 2518 NE 195th Street and 2500 NE 195th Place. After subsequent discussions with the project team, an effort was made to modify the extent of acquisitions to reduce the cost of this alternative. The parcel at 2500 NE 195th Place was eliminated in part because it not considered to flood as frequent as 2518 NE 195th Street and that some additional protection of this alternative may be provided by adding berms and raising a portion of NE 195th Place in an attempt to better contain flood flows in the 25th Avenue NE right of way. It was also decided to only consider acquiring one of the three existing buildings at 2518 NE 195th Street. This was to reduce the alternative cost and because some added flood protection of the buildings to remain could be achieved through the installation of a new berm between the acquired portion of the property and the existing buildings. Figure 3-11 presents the updated Alternative 6 elements.

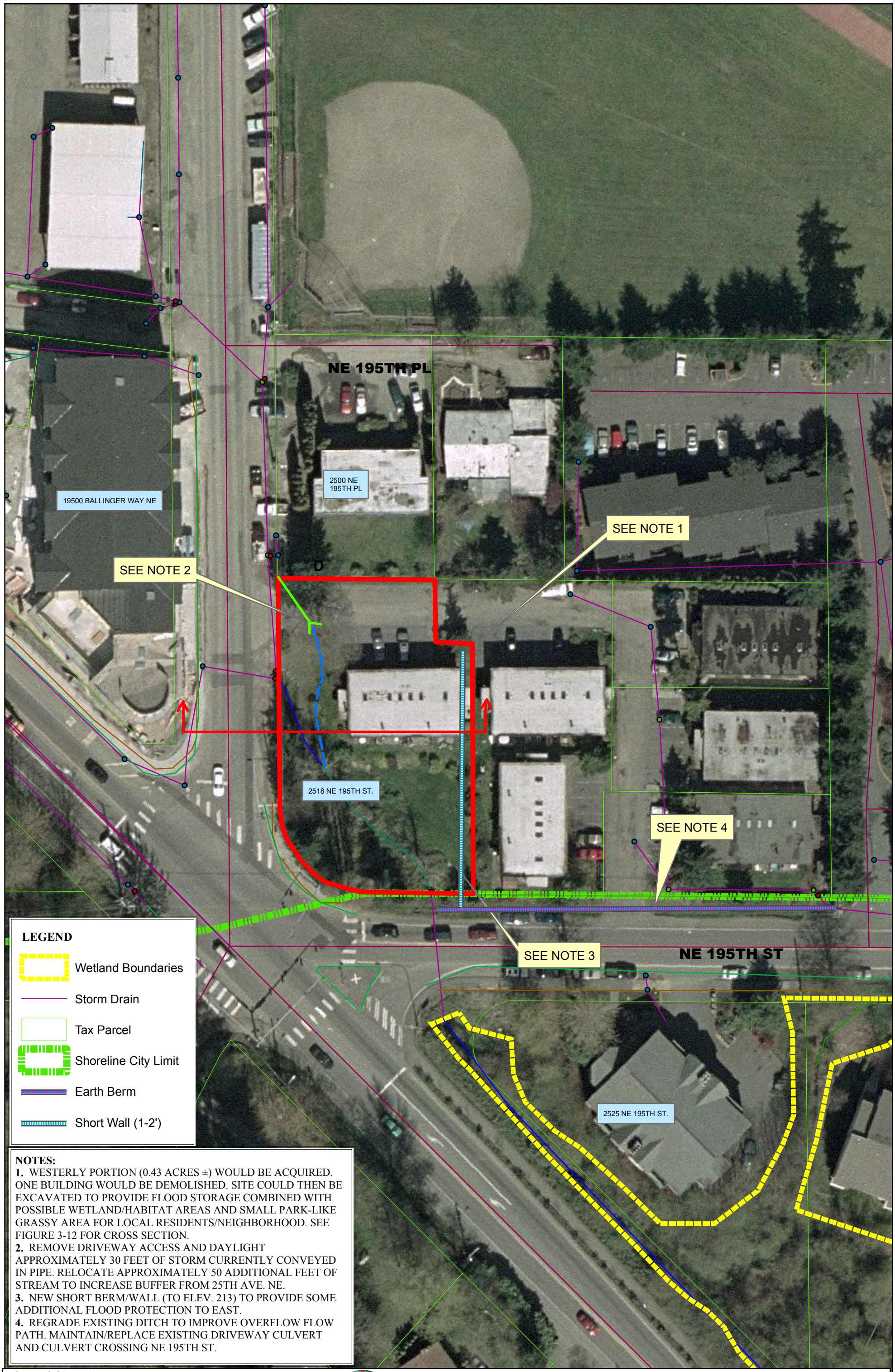
Overall, Alternative 6 was assumed to include the following elements described below:

- **Property Acquisition**. The westerly portion of 2518 NE 195th Street would be acquired by the City and one building would be demolished and removed. Providing relocation assistance of existing residents may be a requirement of the project depending on project funding (i.e., certain funding sources like federal programs mandate relocation assistance when municipalities acquire residential housing).
- **Site Improvements**. The existing driveway to 2518 NE 195th Street off of 25th Avenue could be removed, allowing an approximate 30 feet of Ballinger Creek to be daylighted. A new storm drain would need to be installed to connect the existing system along 25th Avenue NE to the new daylighted channel. Figure 3-11 shows that a portion of this driveway could remain private and be used for parking. The exact portion of the parking area to remain would need to be negotiated. In addition to daylighting a small segment of stream, the newly acquired property could be improved for other benefits. The site could be excavated to provide flood storage combined with possible wetland/habitat areas and a small park-line grassy area for local residents/neighborhood. Figure 3-12 presents a potential cross sections of these improvements.

  Along the eastern portion of the newly acquired property, a berm and/or wall could be constructed (e.g. to elevation 213) to provide some additional flood protection to those properties to the east. While these properties would still likely flood during a major event, the berm/wall would help contain low and moderate

flows within the stream channel. The berm/wall could be constructed with a designated overflow weir to direct flood overflows along the NE 195th Street right-of way corridor. A short wall (1'-3' in height), as opposed to earthen berm, is assumed to be needed at the south and south east portion of the acquired property because of the steep grades near the culvert entrance.

It is noted that under this alternative, upstream flooding conditions would continue along 25th Avenue NE because the existing 25th Avenue NE stream conveyance system would not be improved.



NOTES:

1. WESTERLY PORTION (0.43 ACRES ±) WOULD BE ACQUIRED. ONE BUILDING WOULD BE DEMOLISHED. SITE COULD THEN BE EXCAVATED TO PROVIDE FLOOD STORAGE COMBINED WITH POSSIBLE WETLAND/HABITAT AREAS AND SMALL PARK-LIKE GRASSY AREA FOR LOCAL RESIDENTS/NEIGHBORHOOD. SEE FIGURE 3-12 FOR CROSS SECTION.

2. REMOVE DRIVEWAY ACCESS AND DAYLIGHT APPROXIMATELY 30 FEET OF STORM CURRENTLY CONVEYED IN PIPE. RELOCATE APPROXIMATELY 50 ADDITIONAL FEET OF STREAM TO INCREASE BUFFER FROM 25TH AVE. NE.

3. NEW SHORT BERM/WALL (TO ELEV. 213) TO PROVIDE SOME ADDITIONAL FLOOD PROTECTION TO EAST.

4. REGRADE EXISTING DITCH TO IMPROVE OVERFLOW FLOW PATH. MAINTAIN/REPLACE EXISTING DRIVEWAY CULVERT AND CULVERT CROSSING NE 195TH ST.

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-11 -
Alt 6 Plan View

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

0 15 30 60 Feet

Date: 2/1/2017
Author: James Ellis
Path: P:\PROJECTS\City of Shoreline\25th Ave NE\Data Analytical\GIS\Figures\Figure 3-11 - Alt 6 Plan.mxd

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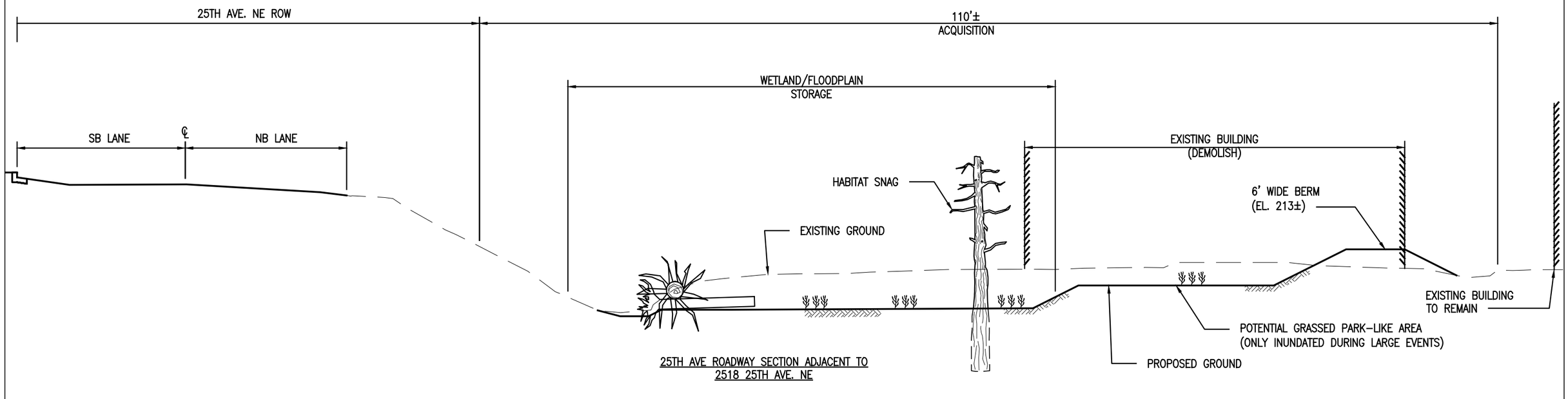

25TH AVE ROADWAY SECTION ADJACENT TO
2518 25TH AVE. NE

NOTES:
1. BERM COULD ALSO ACT AS PEDESTRIAN TRAIL.

1"=10' Scale: 10 5 0 10 20 Feet

Figure 3-12
25th Ave. NE - Alternative 6 Sections

25th Ave. Flood Reduction
City of Shoreline

Louis Berger

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3.2.6 Alternative 7

Alternative 7, referred to as the flood proofing alternative, was identified with the intent to reduce the frequency and magnitude of flooding incrementally by implementing an array of lower-cost improvements without full system replacement. It includes more limited types of improvements that seek to either increase the capacity of the system or provide berms that help increase protection of frequently flooded areas. It can also be viewed as potential interim improvements that may help reduce flooding until either system conditions necessitate replacement at a larger scale, or the City secures funding for one of the long-term alternative solutions.

The element of this alternative are presented in Figure 3-13. The main elements of the alternative a described in the following paragraphs:

- **Pipe Repair by Means of Lining the Existing High Flow Bypass.** The existing high flow bypass consists of approximately 225 feet of 24-inch-diameter CMP pipe and approximately 135 feet of 24-inch high x 36-inch wide CMP arch pipe. Remaining lifespan and capacity (by means of smoothing interior walls) of this high flow bypass system can be increased by installing pipe lining. Potential lining processes to be used include slip lining (which involves mechanically "slipping" a new HDPE plastic pipe snugly inside the existing pipe), or Cured-In-Place Pipe (CIPP) lining (which inserts a soft composite resin-impregnated felt-liner into the existing pipe, then cures the resin with heat and pressure (typically using steam) into a hard finished liner which conforms to the shape of the existing pipe interior and has a texture and durability similar to plastic). As a high flow bypass, this system is believed to be above the Ballinger Creek Ordinary High Water delineation (OHW), exempting it from the in-water work permits which would typically be required from USACE and WDFW. If this system is, in fact, deemed to be below OHW, it is likely that these permitting processes would not allow lining repair of these pipes. Thus, determination of OHW extents relative to the existing bypass system is a critical requirement for this work.

- **Extend Existing High Flow Bypass.** The existing Ballinger Creek piped conveyance system along 25th Avenue NE has an overall length of 570 feet. However, the existing bypass system conveys separated peak flows (while picking up a handful of side drainage connections) for only a 385 foot length before combining with the main conveyance system for Ballinger Creek on the east side of 25th Avenue NE at NE 195th Place. These combined flows continue south along the east side of 25th Avenue NE for approximately 180 feet; this combining of main flows and bypassed flows can exacerbate capacity issues for this length of pipe. This measure would extend the bypass system by installing approximately 250 feet of new pipe and any necessary structures to discharge to the open channel section of the creek at 2518 NE 195th Street. The new bypass extension would need to discharge to the existing creek-side riprap rockery at a location above the stream OHW. Keeping all components of this measure above the OHW is a requirement for feasibility.

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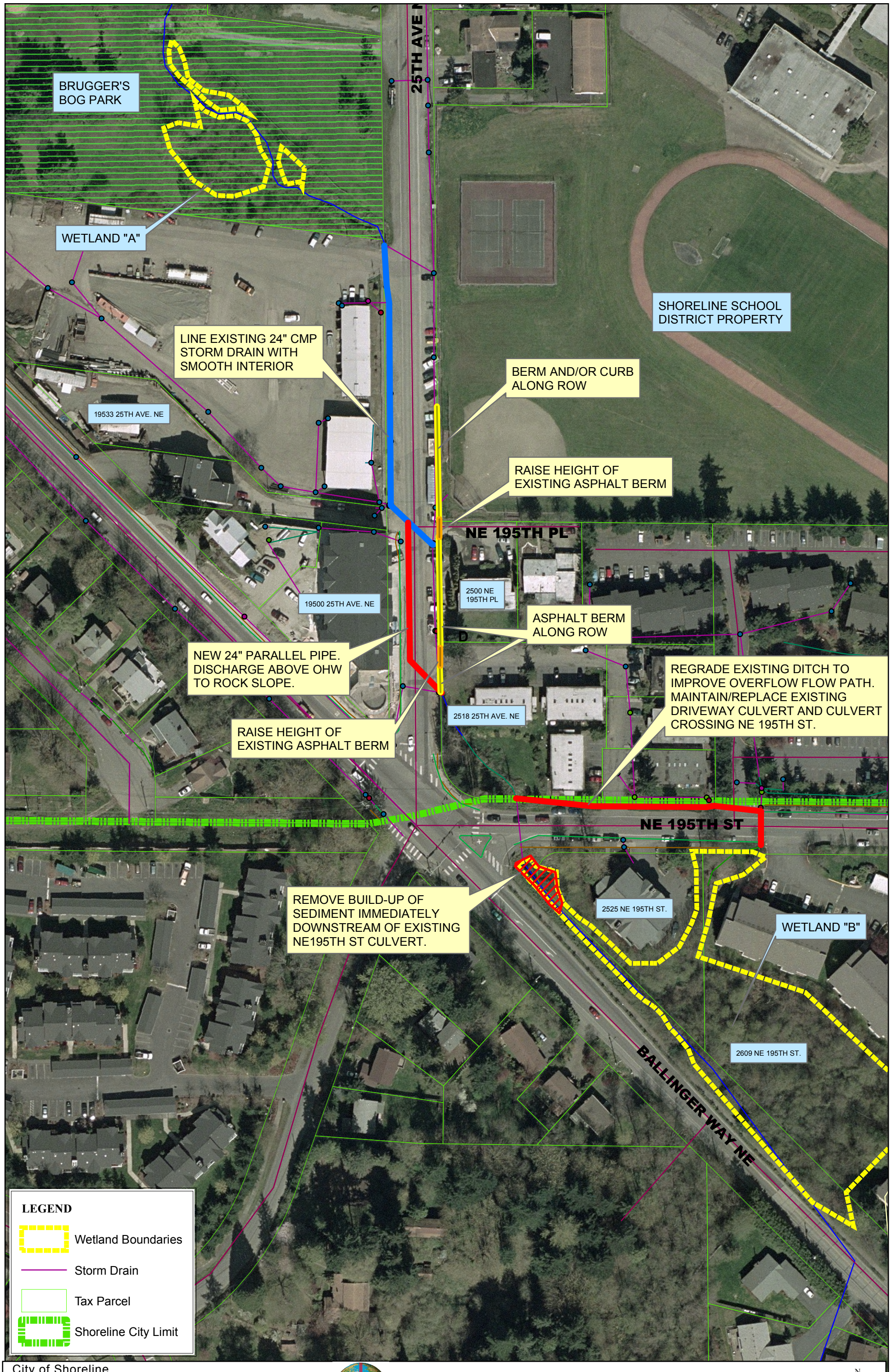

City of Shoreline
25th Ave. NE Flood Reduction Project
Figure 3-13 -
Alt 7 Plan View

This map is not an official map. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

Feet
0 37.5 75 150

Date: 1/31/2017
Author: James Ellis
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- **Improve Drainage Overflow Path along NE 195th Street**. Work done under this measure would include light grading and ditch maintenance along the north side of NE 195th Street between Ballinger Creek and an existing small pipe crossing NE 195th Street located approximately 200 feet to the east of the creek (at the low point of NE 195th Street). This measure would also include maintenance and/or replacement of the driveway culvert at 2526 NE 195th Street as well as maintenance of the existing 12-inch to 18-inch pipe that crosses NE 195th Street. The overall objective of these improvements would be to improve and formalize an overflow path for Ballinger Creek floodwaters on the north side of NE 195th Street. All of this work would take place within the city limits of Lake Forest Park and coordination with LFP and affected properties would be necessary.

- **Improve Existing Driveway Berms and Other Small Berms Along the East Side of 25th Avenue NE**. Asphalt driveway berms (which resemble small speed bumps) were previously installed as flood prevention measures along the driveways on the east side of 25th Avenue NE serving NE 195th Place and 2518 NE 195th Street. These berms were presumably installed around the same time as the 2005 channel improvements at 2518 NE 195th Street, and changes in reported flooding patterns since that time would appear to indicate that these berms have been fairly successful in redirecting any surcharges (surface flows) from the 25th Avenue NE Ballinger Creek conveyance system away from the low elevation portions of properties to the east and into the open channel to the south. However, it is likely that the effectiveness of these berms could be improved upon by installing an improved (newer, higher, more robust) and more complete (longer, better connected) array of engineered berms. A consideration would be to extend the berms beyond the existing driveways north and south along the east side of 25th Avenue NE to try and further contain any surface flows. Minor re-grading of the east shoulder of 25th Avenue NE south of NE 195th Place would help to direct floodwaters to the south and keep them within the public right-of-way.

- **In-Channel Sediment Maintenance/Removal Downstream of NE 195th Street.** The intent of this measure would be to perform minor stream channel excavation to remove deposited sediments where the channel has aggraded (filled in) downstream of the NE 195th Street culvert. As previously noted, the grade of the downstream channel is above the invert of the culvert which creates backwater conditions within the culvert, reducing its capacity and increasing the likelihood of flooding. This measure assumes that this work would be limited in extent to fall under the City's programmatic 2016-2012 HPA that allows the City to perform maintenance of stream channels/culverts where clogged by accumulated sediment, woody debris and trash. The permit limits the extent of maintenance to within 25-feet of the culvert. In addition, by keeping the extent of the activity limited, the City would qualify for a relatively simple USACE Nationwide Permit (#19 – minor dredging) as well as JARPA. More extensive channel excavation would require more significant permitting (HPA, 404, 401, and local critical areas permits), and likely exceeds the benefit from this measure. This work would be in the City of

Lake Forest Park and coordination with LFP and any affected properties would be necessary.

One measure previously discussed during the preliminary alternative screening (and shown on a figure in Appendix D) was installation of a short floodwall or berm around the inlet to the 25th Avenue NE system to provide improved flood protection to the existing driveway at the north end of the NMF site and contain any Ballinger Creek floodwaters at that location within the southeast corner of Brugger's Bog Park. However, upon further analysis it was concluded that construction of such a floodwall would allow hydraulic head to build up on the downstream pipe system and cause downstream catch basins grates to surcharge, potentially creating new flooding issues or exacerbating existing issues at these downstream locations. This measure could be further analyzed to assess if raising of downstream catch basin grates (and some minor regrading around those grades) could help mitigate the risk of surcharge enough to allow a viable version of such a floodwall. However, this more detailed analysis was beyond the scope of this study.

3.2.7 Hydrologic/Hydraulic Analyses of Alternatives

The hydrology and hydraulics models for existing conditions were updated to assess the impacts or changes between existing conditions and Alternatives 1 and 6. Alternatives 2 and 3 were not modeled at this time. The difference between Alternative 1 and 2 is primarily a change in alignment which is not anticipated to affect the hydraulics and hydrology of the stream system. The difference between Alternative 1 and 3 is the inclusion of floodplain storage at the NMF property. Alternative 3 was not modeled because the initial analysis of Alternative 1 did not show increases in downstream flow at Ballinger Way NE. The addition of floodplain storage in Alternative 3 would tend to further attenuate peak flows which would further reduce downstream flows. Because this criterion was already met without floodplain storage, it was determined unnecessary to model this alternative. Alternative 7 was modeled in a simplified fashion in order to provide some qualitative assessment of the increase in level of flood protection. It was not modeled in HSPF/HEC-RAS because there was no substantive change if flood storage.

The modeling of Alternative 1 assumes that the 2.6 foot open height of the culvert at NE 195th Street is acceptable to WSDOT. This proposed sizing was based on both providing fish passage and meeting WSDOT hydraulic criteria, which specifies that the 25-year flow depth not exceed 1.25 times the height of the culvert (2015 WSDOT Hydraulics Manual, Section 3-3.2.2). During preliminary coordination with WSDOT, they indicated that there may be a preference to providing greater freeboard (see coordination in Appendix K.4 in Volume II) at this culvert. Therefore, additional coordination is needed to address this issue. That said, WSDOT will need to understand that due to the backwater from the downstream Ballinger Way NE culvert, it is unlikely that any more improvements in conveyance at NE 195th Street (i.e., creating greater freeboard) would have a significant benefit on upstream water surface elevations and freeboard.

The modeling of Alternative 6 assumes the creation of approximately 1 acre-feet of new floodplain storage within the property to be acquired at 2518 NE 195th Street. In addition, it assumes that a new berm/wall is constructed along the east portion of this site (at top elevation 213.0) to help increase the level of flood protection for the properties to the east. No other changes to the existing system models were made for Alternative 6.

For Alternative 7 a simplified XPSWMM model was developed to represent the parallel pipe system along 25th Avenue NE to assess the potential for the Alternative 7 improvements to increase the level of flood protection provided. The HSPF/HEC-RAS was not used because the proposed improvements would be unlikely to affect system storage and consequently peak flows. In addition, XPSWM does a more accurate job of assessing parallel pipe systems than HEC-RAS. Of the Alternative 7 improvement elements, only the pipe lining of the existing high flow bypass (to make smooth interior) and the high flow bypass system extension along the west side of 25th Avenue NE were included in the model. The other elements of the alternative were not included because, while they could help contain flooding/overflows, they would not have much effect on lowering water levels. The bypass system extension on the west side was assumed to discharge to the creek above ordinary high water and therefore would not require an HPA to construct.

The XPSWMM model showed that the limiting factor affecting capacity of the system is the low lying catch basins on the west side of the street. The model showed that CB 2185 would overflow prior to the creek overtopping the roadway at the inlet. Therefore, it was assumed that the rim of this catch basin would be sealed (i.e., installing a solid locking lid that neither let water escape the system or allow surface flows to enter the system) as part of the improvement. In addition, the model showed that adding a berm at the inlet such that the headwater elevation could be increased at the inlet caused additional the catch basins farther south to overtop. These catch basins to the south tended to pick up more road and side runoff and were considered less likely to be sealed and have a functioning system. Therefore adding a berm was removed from consideration as part of this alternative. The improvements resulted in an increase in conveyance capacity of the 25th Avenue NE conveyance system from about 33 cfs to 54 cfs or about a 20 cfs improvement. While this appears to be a significant increase in capacity, it only has modest increase in level of protection; improving the level of protection from about a 2-year event to about a 4-year event. This improvement would be specific to the 25th Avenue NE system. The increase of level of flood protection to the properties east of 25th Avenue NE was not estimated, but likely at about the same level.

Hydrologic Results of Alternatives

The resulting Alternative 1 and Alternative 6 peak flows for different return periods is presented on Table 3-2. The results for Alternative 1 show a general increase in the peak flows at NE 195th Street when compared to existing conditions. This is as anticipated because the conveyance improvements associated with Alternative 1 would tend to eliminate some flood storage volume impounded in flooded areas that would otherwise help to attenuate peak flows. Downstream from the culvert crossing at Ballinger Way

NE downstream from NE 195th Street, there is a slight decrease in peak flows for 2-year, 25-year, and 100-year events, and slight increase in peak flow for the 10-year event. The Ballinger Way NE results are somewhat counterintuitive, because it was expected that an increase in Alternative 1 flows would occur at this location (similar to the results for NE 195th Street), albeit reduced because of the large volume of flood storage in Wetland B that would attenuate flows.

Table 3-2: Comparison of Return Period Peak Flows Existing vs Alternative 1 and Alternative 6 Conditions at Various Locations

Location	Existing Peak flows (cfs)				Alternative 1 Peak flows (cfs)				Alternative 6 Peak flows (cfs)			
	2-year	10-year	25-year	100-year	2-year	10-year	25-year	100-year	2-year	10-year	25-year	100-year
Ballinger Way (Upstream)	35.42	59.42	77.99	116.81	35.32	59.56	75.14	116.7	34.09	56.37	74.89	115.88
NE 195th Street (Upstream)	40.96	71.92	94.46	139.45	44.64	80.48	105.09	151.92	38.33	62.96	80.57	114.97
25th Avenue NE (existing pipe inlet)	39.36	71.45	93.25	134.32	39.6	71.94	93.69	134.36	39.29	71.2	92.94	134.03

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Due to the somewhat unexpected results, the hydrology was further examined to identify factors that contribute to the slight reduction in major event peak flows for Alternative 1 over existing conditions at the Ballinger Way NE culvert. This is further examined below.

The results for Alternative 6 show a general decrease in peak flows throughout the system, albeit the flow decreases at the 25th Avenue NE pipe inlet is negligible. This is consistent with what would be expected as flood storage is added to the system (by converting the buy-out property to flood storage), and not making any other changes to the conveyance system. The added storage at the buy-out location is created through a combination of excavation and berming.

As noted above, the results for Alternative 1 are somewhat unexpected because of the peak flow reductions at Ballinger Way NE and therefore further examined. Alternative 1 includes channel re-grading and excavation between NE 195th Street and Ballinger Way NE in order to have a constant positive slope from the lowered culvert at NE 195th Street. This excavation would provide a net increase in flood storage volume of about 0.2 acre-feet in the stream reach between Ballinger Way NE and NE 195th Street. This added channel storage helps offset potential increases in downstream flows.

Annual peak flows for Water Year 1949 through 2015 further support these results. Annual peak flows were extracted from the HSPF model to present a comparison at Ballinger Way under current conditions and Alternative 1 conditions. The results are shown in Table 3-3.

Table 3-3: Comparison of Annual Peak Flows Existing vs Alternative 1 Conditions Downstream of Ballinger Way

Year	Peak Annual Flow Existing Conditions (cfs)	Peak Annual Flow Alt 1 Conditions (cfs)	Change from Existing (cfs)	Year	Peak Annual Flow Existing Conditions (cfs)	Peak Annual Flow Alt 1 Conditions (cfs)	Change from Existing (cfs)
1949	29.37	29.47	0.11	**1983**	34.63	34.61	-0.02
1950	48.10	47.02	-1.08	**1984**	32.45	32.25	-0.20
1951	34.70	34.41	-0.29	**1985**	41.54	42.11	0.57
1952	32.82	32.53	-0.29	**1986**	46.43	46.37	-0.06
1953	37.83	37.21	-0.62	**1987**	36.62	35.67	-0.95
1954	42.05	40.45	-1.61	**1988**	33.75	32.48	-1.27
1955	49.58	51.49	1.92	**1989**	38.93	37.54	-1.39
1956	25.09	24.83	-0.26	**1990**	25.44	25.21	-0.23
1957	40.29	40.63	0.33	**1991**	35.27	35.15	-0.12
1958	61.92	63.63	1.71	**1992**	30.58	29.92	-0.65
1959	31.28	32.02	0.74	**1993**	43.60	44.63	1.03
1960	28.44	28.19	-0.24	**1994**	31.69	31.45	-0.24
1961	71.37	74.13	2.75	**1995**	27.38	26.84	-0.54
1962	35.52	34.38	-1.14	**1996**	48.14	48.26	0.12
1963	51.12	50.21	-0.91	**1997**	147.72	140.20	-7.52
1964	30.86	30.66	-0.20	**1998**	30.52	31.22	0.70
1965	21.62	21.42	-0.20	**1999**	37.65	37.86	0.21
1966	22.09	21.87	-0.22	**2000**	25.08	24.94	-0.14
1967	60.85	59.31	-1.54	**2001**	35.58	35.42	-0.17
1968	38.85	37.78	-1.08	**2002**	32.34	32.14	-0.20
1969	43.04	41.51	-1.53	**2003**	24.30	23.98	-0.32
1970	27.14	26.77	-0.36	**2004**	55.01	53.29	-1.73
1971	39.72	40.71	0.99	**2005**	50.14	51.60	1.46
1972	57.69	58.75	1.06	**2006**	33.25	32.79	-0.46
1973	37.14	36.58	-0.56	**2007**	40.96	42.38	1.42
1974	38.35	37.55	-0.80	**2008**	58.32	57.49	-0.83
1975	38.37	38.87	0.50	**2009**	32.25	31.98	-0.27
1976	34.32	34.16	-0.16	**2010**	28.75	29.09	0.34
1977	28.07	27.63	-0.44	**2011**	102.23	108.72	6.49
1978	25.50	25.31	-0.18	**2012**	23.25	22.72	-0.53
1979	49.59	48.00	-1.58	**2013**	51.33	53.48	2.15
1980	25.51	25.27	-0.25	**2014**	43.52	43.47	-0.05
1981	27.57	27.04	-0.52	**2015**	31.71	32.25	0.53
1982	29.28	28.88	-0.40				
						Average	**-0.14**
						Median	**-0.24**

As can be seen in Table 3-3, the change in flow downstream of Ballinger Way NE between existing and Alternative 1 conditions varies with each storm, sometimes increasing and sometimes decreasing. This is likely due to the timing of the peak and the nature of each particular storm (high rainfall volume event versus high rainfall intensity event) which affects the shape of the hydrograph. However, when looked at overall on an average basis, Alternative 1 actually decreases the peak annual flow at Ballinger Way NE.

Note that this analysis is based on the existing drainage system downstream of the project improvements including the existing culvert crossing of Ballinger Way NE. It does not consider what impacts downstream improvements may have on the system such as the replacement of the Ballinger Way NE culvert. This effort is beyond the scope of this study and would require significantly more survey, hydrologic/hydraulic modeling, and making assumptions about replacement sizes and configurations, and other assumptions. The Ballinger Creek culvert crossing at Ballinger Way NE is currently owned by the City of Lake Forest Park within WSDOT right-of-way. There are no current plans to replace the culvert and it would be the responsibility of those jurisdictions to assess flow impacts from replacement at that future time.

In conclusion the results for Alternative 1 appear reasonable.

The hydrology was also reviewed to determine the impact the Alternatives 1 and 6 have on Wetland B. Ecology has two criteria which need to be met in order to show that the project does not adversely impact the wetland. These criteria include:

- The total volume of water into the wetland during a single precipitation event should not be more than 20 percent higher or lower than pre-project conditions.
- The total volume of water into a wetland on a monthly basis should not be more than 15 percent higher or lower than the pre-project volumes.

In order to show this project would meet both criteria, mean daily existing (pre-project) conditions were compared to mean daily post-project for Alternatives 1 and 6. The results in Table 3-4 show that the project meets both of these criteria.

Table 3-4: Change in Mean Daily Flows to Wetland B - Existing vs Alternative 1 and 6 Conditions

	Change from Existing Conditions	
	Alternative 1	**Alternative 6**
Minimum	-4.7 percent	-2.7 percent
Maximum	2.7 percent	3.0 percent

Hydraulics

The water surface elevation results for Alternatives 1 and 6 compared with existing conditions are presented in Table 3-5. The results show that under the proposed Alternative 1 improvements, existing flooding conditions at 25th Avenue NE and NE 195th Street no longer flood for the 100-year event; however, Ballinger Way NE continues to flood for the 10-year and greater recurrence events.

The results for Alternative 6 indicate that flooding would continue to the same modeled events as existing system conditions. Along 25th Avenue NE, flooding would continue for the 2-year event. However, for the areas to the east of the acquired property, there would be a modest increase in level of protection created by the added floodplain storage and berm. Based on the overtopping of NE 195th Street for existing conditions and the berm improvements for Alternative 6, the estimated increase in level of protection from existing conditions to Alternative 6 conditions is from about a 3-year return period to about an 8-year return period.

Table 3-5: Alternative 1 and Alternative 6 Water Surface Elevation Results

Location	Overtopping Elevation	Existing Simulated Water Surface Elevations (feet)				Alternative 1 Simulated Water Surface Elevations				Alternative 6 Simulated Water Surface Elevations			
		2-year	10-year	25-year	100-year	2-year	10-year	25-year	100-year	2-year	10-year	25-year	100-year
Ballinger Way (Upstream)	204.02	202.95	***205.29***	***205.39***	***205.52***	202.95	***205.31***	***205.37***	***205.48***	202.83	***205.21***	***205.36***	***205.53***
NE 195th Street (Upstream)	210.27	208.79	***210.57***	***210.68***	***210.84***	203.75	205.8	206.25	207.42	208.29	***213.01***	***213.01***	***213.25***
25th Avenue NE (Alternative 1 -upstream of new crossing at 19500 Ballinger Way NE)	215.7	n/a	n/a	n/a	n/a	207.08	207.49	207.73	209.06	n/a	n/a	n/a	n/a
Garage Access (Alternative 1 - upstream of garage access culvert to 19500 Ballinger Way NE)	213.77	n/a	n/a	n/a	n/a	208.93	209.34	29.58	210.88	n/a	n/a	n/a	n/a
NMF Access - South Access culvert (Upstream) (Alternative 1	213.36	n/a	n/a	n/a	n/a	210.32	210.73	210.97	212.44	n/a	n/a	n/a	n/a
25th Avenue NE (existing and Alternative 6)/NMF Access-North (Alternative 1)	216.87	***217.37***	***217.84***	***217.97***	***218.07***	215.13	215.58	215.84	216.29	***217.37***	***217.88***	***217.99***	***218.09***

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3.2.8 Alternative Analysis and Evaluation

An alternative analysis was prepared to compare the five alternatives. The alternatives were compared considering several criteria that were developed by the City and project team, including:

Criterion #1: Project Cost (Estimated)
Criterion #2: Flood reduction performance
Criterion #3: Downstream impacts
Criterion #4: Fish Passage
Criterion #5: Impacts to Critical Areas
Criterion #6: Permitting Complexity
Criterion #7: Other Environmental Factors including Mitigation
Criterion #8: Constructability
Criterion #9: Property Impacts
Criterion #10: Permanent Parking Impacts
Criterion #11: Community Considerations (pedestrian improvements/ environmental/aesthetic/recreational)
Criterion #12: Property Acquisition Needs
Criterion #13: Maintenance
Criterion #14: Temporary Traffic Impacts
Criterion #15 Opportunities for Grant Funding

Because Alternative 3 would combine with either Alternative 1 or 2 downstream alignments, some of the following discussions consider the comparison of both of these scenarios for a total of 6 options. For example, under project costs there are six cost estimates; Alternative 1, Alternative 2, Alternative 3-1 (combined with Alternative 1), Alternative 3-2 (combined with Alternative 2), Alternative 6, and Alternative 7.

Criterion #1: Project Costs (Estimated). The relative construction cost is an important parameter to compare alternatives. Cost estimates were developed based upon unit costs for various construction items taken from comparable recently-bid projects. Detailed cost estimates are provided in Appendix E. The total estimated costs are presented on Table 3-6, Alternative Summary Comparison. The detailed cost estimates for Alternatives 1, 2, and 3 were divided into two bid schedules: Schedule A includes the work within the "NE 195th Street" project area (from the upstream side of NE 195th Street to the downstream end of the project); Schedule B includes work within the "25th Avenue NE" project area (from the upstream end of NE 195th Street to the upstream end of the project). Division of costs into two schedules was done due to the likelihood that the project improvements will need to be phased (discussed later in the report).

The project costs for Alternative 6 was summed into one project bid schedule. In Appendix E, the project costs for Alternative 7 was separated into the smaller elements of work. Because the Alternative 7 elements were much smaller, some of which could be implemented by City staff, there was some likelihood that the City could want to implement these project elements separately or on potentially separate schedules.

The cost estimates include a 30 percent construction contingency as well as contingencies for administrative costs, design, permitting, construction management and administration, easements, and special testing and inspection. The resulting cost estimates are summarized below:

- Alternative 1: $7.2 million
- Alternative 2: $6.7 million
- Alternative 3 (with Alterative 1 alignment): $6.6 million
- Alternative 3 (with Alternative 2 alignment): at $6.4 million
- Alternative 6: $1.9 million
- Alternative 7: $0.5 million

Criterion #2: Flood Reduction Performance. Flood reduction performance is generally defined as the ability of an alternative to meet the flood reduction criterion defined for this project. The flood reduction criteria for this project are to: (1) eliminate existing flooding issues and create no new flooding issues in the vicinity of 25th Avenue NE and NE 195th Street for up to the 100-year storm event; (2) reduce flooding without increasing flows downstream, in particular at Ballinger Way NE. Improving conveyance to reduce flood potential can often increase downstream flows which may effectively amount to simply moving a flooding problem to another location downstream. In addition, increasing flows can increase the potential for erosion and inhibit upstream fish passage by increasing water velocities.

As discussed above, detailed hydrologic and hydraulic analyses were performed only for Alternatives 1 and 6, and a simplified method for Alternative 7. Alternative 1 met the flood control criteria because it achieves the flood reduction performance goals and does not increase downstream peak flows. Because the difference between Alternative 1 and Alternative 2 is mainly a difference in alignment, the hydrologic and hydraulic responses of the two alternatives are expected to be very similar. Like Alternative 2, Alternative 3 was not explicitly modeled; however, the added flood storage provided within the NMF site would be expected to result in a slight reduction in downstream peak flows and water surface elevations downstream at Ballinger Way NE compared to Alternative 1. Therefore, the flood reduction criterion for Alternative 3 is expected to be met for all of the alternatives.

Alternative 6 and 7 would not meet the ideal flood protection criterion. Both would improve the performance of the system but flooding during major events would continue. Alternative 6 would not increase the level of flood protection along 25th Avenue NE, but was estimated to increase the level of protection for the areas east of the acquired property from about a 3-year event to an 8-year event. The Alternative 7 improvements would increase the level of flood protection from about a 2-year event to a 4-year event within the 25th Avenue NE drainage system. This does not appear to be significant, but the improvements would increase the system capacity from about 33 cfs to 54 cfs (a 64% increase in capacity). The increase in flood protection for the properties east of 25th Avenue NE was not estimated, but providing an improved overflow path would reduce the potential for structural flooding in the area.

Criterion #3: Downstream impacts. As noted above, improving conveyance to reduce flood potential can often increase downstream flows by eliminating some flood storage. However, the hydrologic and hydraulic analyses indicate that neither Alternative 1 nor 6 would increase downstream flows at Ballinger Way NE. Similar to the flood reduction performance discussion above, Alternatives 2 and 3 would have similar results, with Alternative 3 likely reducing downstream flows somewhat because of the added storage. While Alternative 7 was not explicitly modeled, it is concluded that it would have lower downstream flow impact than Alternative 1 because it would eliminate less flood storage (i.e., because is not fully eliminating the flooding problem). The hydrologic and hydraulic analyses also show that impacts to Wetland B for Alternatives 1 and 6 are much less than the threshold Ecology uses to assess impacts to wetlands from development projects (See Table 3-4). Other alternatives would have similar or even lower impacts.

Increased flow conveyance can increase downstream sediment transport, which could help maintain downstream spawning habitat if an adequate source of gravel exists. It could also cause sedimentation impacts, if the sediment transported consists primarily of sand and fines. Consequently, the type and extent of such impacts would vary depending on the sediment type and size being transported. Existing sediment sources are unknown, but would be assessed in support of the preferred alternative. Hence, potential downstream sedimentation impacts were not assessed for this level or alternative analysis, but would likely be similar for Alternatives 1 and 2. Increased sediment transport downstream could have adverse effects on spawning habitats in some locations and beneficial effects in other locations. Adverse effects could include filling of pool habitat downstream of the project area, overly-embedded spawning gravels and salmon redds, and hydraulic and geomorphic responses of bar and other accretionary channel features, which could result in increased bank erosion rates. Beneficial effects could include maintenance of spawning habitat if adequate sources of gravel exist.

Given the floodplain storage element of Alternative 3, potential downstream sedimentation impacts would likely be less pronounced, as the floodplain storage area would retain more sediment, assuming main sediment sources are located upstream. Because Alternatives 6 and 7 would not significantly modify the creek system compared to the other alternatives, their sedimentation impacts would likely be less pronounced.

Criterion #4: Fish Passage. Generally speaking, Alternatives, 1, 2, and 3 would provide similar level of upstream fish passage for adult coho salmon and cutthroat trout. However, all three alternatives have similar potential fish passage risks associated with the open channel and culvert performance, once the project has been completed. For example, channel regrading sites would need to be designed (e.g., include grade control structures) to avoid potential headcut development and migration as well as channel incision leading to a fish passage barrier upstream. Alternative 2 is the alternative most likely to develop upstream fish passage issues over time, which could develop at the 25th Avenue NE crossing given the oblique angle of the crossing followed downstream by the short open channel segment between this culvert and the new 30-foot long culvert immediately downstream. Alternative 6 may provide additional fish habitat and passage between NE 195th Street and 25th Avenue NE; however, without replacing the existing

conveyance system, limited upstream fish passage is gained. Alternative 7 does not provide any additional fish passage.

Alternative 3 may provide the best overall condition for upstream fish passage, as the new floodplain storage area would allow for a larger channel length, thus reducing the relative channel slope within this portion of the creek alignment. Adult salmonids migrating upstream to spawn would have greater resting and holding opportunities within the floodplain storage area (assuming it is designed to provide habitat). They would also experience reduced water velocities within this channel segment, under this alternative. Finally, because Alternative 3 includes fewer culverts, there would be less risk of fish passage issues overtime associated with culvert obstructions compared to the other alternatives.

Criterion #5: Impacts to Critical Areas. Critical areas within the project area include Ballinger Creek, Wetlands A and B, wetland and stream buffers within both cities of Shoreline and Lake Forest Park, and significant trees within both cities. Project impacts associated with all alternatives involve impacts to Ballinger Creek, Wetland B, and the buffer of Wetland A. Such impacts include minor stream regrading along open sections of Ballinger Creek, including within Brugger's Bog Park upstream of the inlet to the 25th Avenue NE pipe system, between 25th Avenue NE and NE 195th Street, and downstream of NE 195th Street within Wetland B. In addition to regrading lowering) the creek within Wetland B, the shifting of the creek away from the failing WSDOT gabion wall will impact both Ballinger Creek and Wetland B.

Impacts may occur within the buffers of Ballinger Creek and Wetlands A and B with the implementation of all alternatives. Buffer widths listed below are per interpretation of current respective codes for Shoreline and Lake Forest Park; buffer widths will be subject to confirmation in later project stages. Within the City of Shoreline, Wetland A is afforded a 165-foot buffer (SMC 20.80.330). Within the City of Lake Forest Park, Wetland B is afforded a 100-foot maximum buffer and 70-foot minimum buffer, (LFPMC 16.16.320.A and 16.16.320.E). Within the City of Shoreline, Ballinger Creek is a Type F-anadromous stream and is afforded a 115-foot standard buffer (SMC 20.80.280). Within the City of Lake Forest Park, Ballinger Creek is a Category I stream and is afforded a 115-foot standard buffer or 70-foot minimum buffer (LFPMC 16.16.350). Project activities, such as clearing and grading, within these buffers are considered impacts and will require mitigation.

Within the City of Shoreline, new buffers for any portions of Ballinger Creek daylighted by the project could potentially extend onto neighboring properties and create potential impacts to those properties. This is a concern for all potential daylighted channel locations along 25th Avenue NE. The standard 115-foot buffer can be reduced by up to 50 percent, to a width of 57.7 feet, in accordance with SMC 20.80.056; however, this reduction would still place buffer on neighboring properties and a written agreement from those property owners would be required (SMC 20.80.267.D6c). There would be a reasonable financial justification for a property owner to not accept such a buffer and thus could make daylighting the creek infeasible. However, as the project is a volunteer daylighting project, a critical area buffer reduction can be requested through a Critical Area Special Use Permit (CASUP) with the City of Shoreline Planning and Community Development Department. The buffer reduction amount is a negotiation by which the

applicant requests a reduction and the City will respond with a counter reduction width or accept the request. The buffer reduction request could incorporate limiting buffers to front yard setbacks and areas where there is existing vegetation, so as to not impact neighboring properties. Where applicable, the applicant can make a case that there is a functional isolation in areas where there is an 8-foot or more break in vegetation in the buffer (SMC 20.80.200.D.7). Doing so will eliminate the need to request permission from private property owners to allow a critical area buffer on their property. Alternatives 1, 2, and 3 would require a CASUP and buffer reduction request. Depending on the extent of restoration work completed as part of Alternative 6, this alternative may also require a CASUP and buffer reduction request.

For Alternatives 1 and 2, if the 25th Avenue NE project daylights Ballinger Creek before the NMF is constructed, then the new stream buffer will extend onto the NMF property. When the NMF is developed, the NMF project would then require a CASUP with a request for a buffer reduction to the new open channel of Ballinger Creek. The Public Works department would have to agree to have the creek buffer on the NMF property in accordance with SMC 20.80.267.D.6.c. However, if the NMF constructs before the daylighting of the creek, or not at all as in Alternative 3, then the row of buildings along 25th Avenue NE stops the buffer of the future open creek from extending onto the property. If construction schedules are similar for both projects, then the projects may be able to apply for a joint CASUP. Permitting the two projects would be less complex if the NMF is developed before daylighting Ballinger Creek along 25th Avenue NE. As mentioned previously, all three project alternatives would require a CASUP and buffer reduction request.

Within the City of Lake Forest Park, realigning Ballinger Creek within Wetland B could require property owner approval as the buffer would shift onto areas of adjacent property that currently are not included in the stream buffer. As most of this property is already encumbered by existing wetland and stream buffers, it may be that the buffer impact would be effectively insignificant from shifting the creek by a small amount. All three project alternatives would require an evaluation of a buffer shift.

The City of Lake Forest Park regulates impacts to trees through LFPMC 16.14 and provides guidelines on vegetation removal, specifically significant trees, in their critical areas regulations (LFPMC 16.16.230). Work proposed in Alternatives 1, 2, and 3 adjacent to Ballinger Creek and Wetland B within Lake Forest Park city limits will require an arborist report inclusive of an inventory of significant trees and proposed mitigation for impacts to trees.

For work within the City of Lake Forest Park, work associated with replacing the NE 195th Street culvert and regrading within Ballinger Creek and Wetland B will be permitted through a process that starts with a Public Agency Utility Exception (PAUE). This process includes a public hearing. The project would also require a Major Sensitive Area work permit, which would include the critical areas report/sensitive area study and arborist report addressing significant trees. Any trees to be removed would require a tree removal permit. Alternatives 1, 2, and 3 would require these permits.

Criterion #6: Permitting Complexity. Project activities undertaken for any of the alternatives include clearing and grading and working within critical areas or critical

area buffers, which will require several potential permits from federal and state regulatory stakeholders and the cities of Shoreline and Lake Forest Park. All alternatives, except for Alternative 7, would require, at a minimum, a Clean Water Act Section 404 permit from USACE, a HPA from WDFW, a State Environmental Policy Act (SEPA) threshold determination from both the cities of Shoreline and Lake Forest Park, critical areas permits from both the cities of Shoreline and Lake Forest Park (as discussed above), and onsite restoration of temporary impacts. All of these alternatives would be required to comply with the in-water work window for fish protection, which generally extends from mid- to late summer. Alternative 7 would require substantially less permit effort presuming that the pipe improvements would be outside of the OHW work triggering several permits and that the work at the outlet of the NE 195th Street culvert would be covered under the City's current programmatic stream maintenance HPA and then only require a USACE Nationwide Permit.

While permitting for Alternative 7 would be minimal, several factors make permitting less complex for the other alternatives, including the lack of presence of species listed under the federal Endangered Species Act, an anticipated determination of non-significance (DNS) or mitigated DNS on environmental elements analyzed under SEPA, project design will meet the requirements of nationwide permits (NWPs) for compliance with Clean Water Act Section 404, and design of the daylighted channel and culvert crossings will be fish passable per WDFW guidelines to comply with both a nationwide permit and an HPA.

For compliance with Clean Water Act Section 404, the project should be designed to meet the requirements of the 2017 NWPs, which are currently being developed and will go into effect in March 2017. The updates and new Regional General Conditions (RGCs) are not anticipated to affect the project as currently proposed in any of the alternatives. All alternatives, except Alternative 7, are likely to be permitted through NWP 14, Linear Transportation Projects, but may also utilize NWP 13 (Bank Stabilization) for work around the culverts and gabion wall along Ballinger Way NE; NWP 3 (Maintenance) for culvert replacement; or NWP 27 (Restoration) for daylighting the creek. If the project exceeds the thresholds of the applicable NWPs, then an Individual Permit would be necessary, which initiates review under the National Environmental Policy Act (NEPA) and includes a rigorous alternatives analysis. If an Individual Permit becomes necessary, the complexity of permitting increases, as does the timeframe for acquiring permits. Alternative 7 would likely be covered under the Nationwide Permit #19 (minor dredging).

Criterion #7: Other Environmental Factors including Mitigation. Temporary and permanent impacts to critical areas and their buffers may require mitigation. Temporary impacts may include vegetation clearing for construction access and can be restored on site through restoration. Permanent impacts that are not "self-mitigating" will require compensatory mitigation. As the project proposes to voluntarily daylight Ballinger Creek, the creek will be left in the same or better condition after implementation of the project; there is no net loss of function and the project can generally be assumed to be "self-mitigating". Alternatives 1 through 3 involve similar impacts to critical areas; however, Alternative 3 creates additional habitat and floodplain storage that could be considered mitigation for impacts that occur as part of other elements of the project.

Alternative 6 would have substantively few impacts than these alternative, with its affects limited to the stream reach between 25th Avenue NE and NE 195th where there is only stream habitat and no wetland habitat. Alternative 7 would have negligible impacts. Any proposed mitigation for impacts to critical areas would be proposed in accordance with SMC 20.80.082 and LFPMC 16.16.340 and 16.16.370.

Criterion #8: Constructability. BergerABAM provided the lead role in constructability reviews for several of the alternatives and prepared the memorandum that is provided in Appendix N in Volume II of this report. This section provides a brief summary of key findings along with input from the project team. Reviewing constructability of alternatives is important because it helps identify risks involved in construction which may result in delays or added costs to the City, and it can be used to identify strategies for further analysis or study. Due in part to the timing of the alternative development and because the scope of improvements for Alternatives 6 and 7 were much less than other alternatives, they were not specifically included in BergerABAM's memorandum. Rather, their input on Alternatives 6 and 7, along with the rest of the project team, is provided in this section.

Constructability considerations focused on the following areas:

- Schedule and In-Water Work Constraints
- Existing Drainage System and Creek Bypass
- Dewatering and Control of High Groundwater
- Potentially Contaminated Soil and Groundwater
- Utilities including SPU's 66-inch-Diameter Water Line Crossing
- Local Buildings
- Walls
- Buried Culverts
- Existing Gabion Wall Along Ballinger Way NE

Schedule and In-Water Work Constraints

From a common construction standpoint, it is desirable to perform the work during the drier months of April through mid-October. However, as previously noted any work within the OHWM for all the alternatives would be required to comply with the mid- to late summer in-water work window for fish protection.

Other work can be performed outside of the in-water work timing limitations. For example, for multiple alternatives the construction of much the of open channel and culvert segments along the west side of 25th Avenue NE could be done outside of the in-water work timing limitations assuming this work is not "connected" to the active Ballinger Creek stream or create impacts within the OHWM.

Given the amount of overall contract work for Alternatives 1, 2, and 3 and in water constraints, it is not likely this project could be completed in one season. For these alternatives, this may be a reason to consider phasing the project into two phases. The other alternatives could likely be constructed in one season. Any temporary or

permanent utility relocation could be done ahead of construction to minimize the duration of the channel and roadway work.

Existing Drainage System and Creek Bypass

The existing drainage system was described in Section 1.2. Along 25th Avenue NE, the stream is conveyed through two (parallel) pipe systems, one passes normal flows and the other high flows. Along this corridor, the system picks up side drainage from properties as well as flow from an 18-inch pipe system along 25th Avenue NE from the north. These side drainages will need to be controlled during construction, including bypassing around construction areas.

All of the alternatives, except Alternative 7, will require the creek be bypassed around the site during construction for some portion of the project. Alternatives 1, 2, and 3 will impact significantly more of the creek and require more extensive temporary bypassing. However, along 25th Avenue NE, if the alignment is located completely on the west side, as in Alternative 1 (or Alternative 3 if combined with the west side alignment), the existing piped stream conveyance and storm drain system between Brugger's Bog Park and 195th Place NE could be left untouched and be used unimpeded throughout the construction of that portion of the project. This indicates that the bypass costs for Alternative 1 alignment, or Alternative 3 combined with Alternative 1 downstream, would be somewhat less costly than for Alternative 2. The cost for temporary bypass for Alternative 6 would be much less, and cost for Alternative 7 would be negligible.

Dewatering and Control of High Ground Water

The geotechnical report prepared by Terracon for the project shows that groundwater was observed around 2 feet below surface along 25th Avenue NE to approximately 5 feet to 7 feet below the surface at higher ground near NE 195th Street. The ground water elevations recorded in the report are from the drier months of June and July, so it will be a construction issue regardless of the time of the year the work is performed. The geotechnical report concludes that any excavations deeper than 2 feet below surface will require an intensive dewatering effort.

All of the alternatives will require dewatering to construct, particularly to install the culverts and the head walls. However, the extent of dewatering should be far less for Alternatives 6 and 7. Of the remaining alternatives, the extent of dewatering should be less for Alternative 3 because a portion of the daylighted creek is proposed to be constructed on the NMF site and therefore does not require dewatering for wall construction through this section (no creek-side walls would be installed within the NMF site). In addition, Alternative 3 does not require a culvert at the north end of the NMF which would eliminate the need to dewater this area for this alternative.

Potentially Contaminated Soil and Groundwater

The geotechnical report document investigations conducted on existing site soils and groundwater for potential contamination. Oil and diesel hydrocarbons were detected in bore B-4 (located on 25th Avenue NE approximately 50 feet north of Ballinger), and elevated levels of arsenic were found in the groundwater at two of the groundwater monitoring wells at the north maintenance facility.

At bore B-4 the levels of oil and diesel hydrocarbons were below Model Toxic Cleanup Act (MTCA). The bore log notes state that at 3.3 feet below the surface, the soil had an oily feel and a hydrocarbon odor. The material was tested and it is above detectable limits but below MTCA cleanup levels. However, the report states that during excavation additional area could be encountered that may be above MTCA levels. Given that the material felt oily and was detectable by smell, it is likely that higher levels may be encountered. Any excavation near the intersection of 25th Avenue NE and Ballinger Way NE may encounter areas of contaminated soils and it is recommended that either additional field investigation be performed as the design progresses to establish the probable perimeter of the potentially contaminated area, or the construction documents include provisions for special handling and payment vehicles to remove soils that are above MTCA cleanup levels and to also provide disposal methods for contaminated materials that are below MTCA cleanup levels. This would affect all alternatives except Alternative 6, while possibly affecting Alternative 1 (and Alternative 3 with alignment 1) more as it has more improvements closer to the intersection.

The geotechnical report also discusses sampling of groundwater monitoring wells installed in the north maintenance facility. The total petroleum hydrocarbon (TPH) and volatile organic compounds (VOC) results were below the laboratory method reporting limits (MRLs). Arsenic was detected in both samples; one sample contained 5.7 ug/L, which is slightly above the 5 ug/L MTCA Method A cleanup level that is protective of groundwater as a potable drinking water source. The report states that this is likely due to the background levels of arsenic in the glacially-derived sediment, and does not appear to be an indication of the presence of contaminant released to the environment, based on the lack of other contaminants detected in the sample.

There is somewhat heightened concern for Alternative 3 and daylighting the channel through the NMF related to potential contaminated soils. If daylighted stream channel and/or floodplain storage area were to be constructed within the NMF site and contaminated soils were confirmed as present within the project area, there would likely be increased scrutiny and requirements from Ecology and the other permitting regulatory stakeholders. The direct interface between groundwater, surface water, and the existing soil may require removal of all contaminated soil near the surface water feature and not just the portion that is above cleanup levels. For a recent Pierce County wetland mitigation/stream realignment project that BergerABAM was involved in, contaminated materials were encountered during excavation of the wetland and stream. In consultation with regulatory stakeholders, and in particular the Department of Ecology, it was determined that all contaminated materials—regardless of whether they were below or above MTCA levels—with any potential for exposure to the stream or groundwater needed be removed until no detection of contaminants were obtained. In addition, any materials above MTCA levels, even if not exposed to groundwater, still needed to be removed. The responsibility to ensure all contaminates on the site were removed belonged to the project owner (Pierce County), with oversight from the regulatory agency. This added substantial cost to the project and also added a groundwater monitoring plan for a minimum of one year. These potential impacts would warrant addition

additional soil and groundwater testing be conducted in the area of proposed new channels for contaminants if the City pursues Alternative 3. Risk of potential contaminated soil impacts to Alternatives 1 and 2, with proposed improvements located along the west side of the 25th Avenue NE ROW along the eastern boundary of the NMF site is considered lower as testing did not identify the presence of contaminants.

Risk of potential contaminated soil impacts from Alternatives 6 and 7 are also considered much lower largely in part due to the reduced extent of improvements and associated excavation.

Utilities - Including SPU's 66-inch-Diameter Water Line

Overhead power and communications lines run on the east side of 25th Avenue NE. There are two power poles potentially affected by the project. These power poles are jointly owned by Seattle City Light and CenturyLink and have power, communication, and cable. It is assumed that overhead power and communication lines and/or poles may have to be relocated for Alternative 2, and possibly a portion of Alternative 1, as the elevation and location of the overhead lines may not allow for safe excavation using standard trenching equipment. For alternative 1, it could be possible to temporarily raise the low hanging line or temporarily relocate these lower lines, but this would need to be further researched during the design phase. In general, the Alternative 2 alignment significantly affects these poles more than Alternative 1.

The pole across 25th Avenue NE from the building at 19500 Ballinger Way NE has several risers. These risers take overhead power and communications down the pole into the ground. From there, the conduits run approximately 45 feet to the north then cross west under 25th Avenue NE just south of NE 195th Place and eventually enter the building on the west side. Any of the Alternatives 1, 2, or 3 (and possibly Alternative 7) will require a rerouting or relocation of these conduits since the new channel crosses through them. The portion of Alternative 2 located on the east side of 25th Avenue NE south of NE 195th Place would likely require more extensive relocation of these conduits than Alternative 1 on the west side. Multiple buried communications conduits run along the east shoulder of 25th Avenue NE north of NE 195th Place; none of the currently-proposed alternatives are expected to conflict with these conduits.

The single physically largest and highest-impact utility to be considered during evaluation of alternative improvements is the 66-inch diameter steel waterline owned by SPU that runs east-west along the south side of NE 195th Street. The existing NE 195th Street culvert for Ballinger Creek crosses immediately below this large water pipeline. As previously noted, SPU requires a 0.5 foot vertical clearance between a culvert replacement the existing pipeline. Alternatives 1, 2, and 3 must all contend with the cost and complexities to replace the culvert below the pipeline, while Alternatives 6 and 7 avoid this issue altogether. For example, the construction contractor will need to provide a special temporary shoring and support plan stamped by a professional engineer demonstrating how the large water line can be supported and protected. In addition, SPU will require special bedding and backfill

material around the pipeline. Close coordination with SPU prior to and during construction around the 66-inch diameter line will be required. Coordination to date is included in Appendix F.2.

North City Water District (NCWD) owns several water lines which have been mapped within the 25th Avenue NE right-of-way, including a 12-inch diameter main along the east side of 25th Avenue between Ballinger Way NE and NE 195th Place, which branches into an 8-inch diameter main running to the west across 25th Avenue NE at NE 195th Place, and a 6-inch diameter main continuing north along the east side of 25th Avenue NE. Ten smaller water service lines have been mapped as being connected to the 25th Avenue NE main, including eight (8) which cross 25th Avenue NE to provide service to properties on the west side, and two (2) which run to the east. NCWD also owns an 8-inch diameter main running along the north side of NE 195th Street. Alternative 2 will have the greatest impact regarding the NCWD water system, running parallel to the 12-inch diameter water for approximately 200 feet on the east side of 25th Avenue NE south of NE 195th Place in a close enough proximity to possibly require relocation. For Alternative 1, NCWD impacts will include crossing the 8-inch diameter main at NE 195th Place (west side of 25th Ave NE), crossing the 12-inch diameter main on the east side, and crossing several water services; all of these conflicts could require relocation. The NE 195th Street culvert replacements for Alternatives 1, 2, and 3 will likely be deep enough to avoid needing to relocate the 8-inch diameter water main, although measures will be required to protect and temporarily support this main during construction.

The sanitary sewers in the project area are currently owned by Ronald Wastewater District (RWD) within the City of Shoreline project areas, and by the City of Lake Forest Park within LFP. In November 2017, Ronald Wastewater District will be assumed by the City of Shoreline and all RWD facilities will become the property of (and managed by) the City of Shoreline. Sanitary sewer mains in the project area are typically 12 inch diameter concrete pipe with approximately 10 foot depth of cover. The sanitary sewer system within the project area flows from north to south along 25th Avenue NE, then connects southeastward to the NE 195th Street system and continues flowing to the east. Most proposed alternative alignments crossing the sanitary sewer mains are not expected to create conflicts due to the depth of the sanitary sewer, with one exception: the sewer main crossing the NE 195th Street culvert which could conflict with the new deeper culvert proposed by Alternatives 1, 2, and 3. One way this can be mitigated is by having the sanitary sewer be placed within a protective "casing" pipe and routed through a specially design section of the replacement culvert (See Figure 3-4).

Upstream of the NE 195th Street culvert crossing, the sanitary sewer main runs along the toe of the roadway embankment for approximately 180 feet. Design for deepening of the existing stream channel located 10 to 35 feet east of the sewer main, as proposed under Alternatives 1, 2, and 3, will need to account for presence of this main and a manhole, although conflicts currently do not appear likely. Alternatives which cross side sewers will need to determine side sewer depth during design, as depth can vary greatly. Side sewers have been mapped on the west side

of 25th Avenue NE north of NE 195th Place and on the east side to the south of NE 195th Place.

No gas mains or services have been mapped within the project area.

Local Buildings

A private driveway on the west side of 25th Avenue NE across from NE 195th Place serves a small apartment building at 19533 25th Avenue NE and other residences at 19545 25th Ave NE. Under Alternatives 1, 2, 3, and 7 access to these residences via this driveway would likely be temporarily blocked during new culvert/pipe construction. Alternative access is available to 19533 25th Ave NE via Ballinger Way NE, but not to 19545 25th Ave NE.

The local homes the east side of 25th Avenue NE served by driveways within the project area, consisting of seven (7) four-plex buildings and one single family residence, would have significant impacts with any of the alternatives. All alternatives would propose some amount of work within the 25th Avenue NE ROW immediately west of these properties. Alternative 2 would have the greatest impact to this area as it requires utility work in this area, as discussed previously, as well as a longer section of the 3-sided open channel adjacent to these residences. Alternative 1 would have fewer impacts within the ROW immediately adjacent to these properties, but still a high level of disturbance in the general area. The three four-plexes located at the northeast corner of 25th Avenue NE and NE 195th Street (collectively found within the parcel identified as 2518 NE 195th Street) would be subjected to additional impacts due to deepening of the existing channel on that property and NE 195th Street culvert replacement work proposed by Alternatives 1, 2, and 3. The buyout proposed under Alternative 6 would seek to remove the westernmost of the four-plex buildings and construct flood reduction and storage improvements within the western half of the property.

At the northwest corner of 25th Avenue NE and Ballinger Way NE is a four-story mixed-use building built in 2004 and identified as "25th Place" (19500 Ballinger Way NE) which contains 36 residential units (condominiums), three (3) commercial units, and a partially underground lower parking level. The eastern foundation of this building is constructed directly along the west right-of-way line of 25th Avenue NE, apparently with a "zero setback". The proximity of this building's foundation to the right-of-way complicates the construction of the open channel section along the west side of the 25th Avenue NE ROW in this area as proposed by Alternative 1. Research by the project team has located the geotechnical report and structural plans for this building. However, the exact design of the structural foundation type and size could not be confirmed. Additional research would be recommended to further understand the foundation type, size, and location relative to the channel for Alternative 1. This information will aid a geotechnical engineer in evaluating and providing recommendations for wall configurations adjacent to this structure to limit impacts on the building due to settlement. Most walls are designed to resist the lateral loads after the wall deflects enough to engage the passive resistance pressures that hold and stabilize the wall systems. This initial lateral displacement is often acceptable for most transportation projects, but it may not be acceptable when

supporting an existing building. The types of walls that are often used in building construction to limit displacements and settlements are soldier pile walls with permanent ground anchors (PMAs) or possibly secant pile walls. For soldier pile walls with PMAs, the anchors would be drilled horizontally under the building and connected to the new wall to prevent lateral movement. These systems are relatively expensive compared with the other wall types proposed for this project and may be avoided with better information on the building's foundation design is obtained. If it is determined the walls are placed far enough away from the existing building or that settlement of the building is not a concern, it will still be likely that a cantilever soldier pile wall is the only type of wall that can be built adjacent to this building. For Alternative 1, the cost estimate assumes the wall along 19500 Ballinger Way NE is assumed to be 300 percent greater than other walls.

At the southeast corner of NE 195th Street and Ballinger Way NE, located within the City of Lake Forest Park, is a three-story multifamily residential building built in 1992 identified as "Canaan Condominiums" (2525 NE 195th Street), which contains ten (10) residential units. The southeast wall of this building, which faces Ballinger Way NE, is in fairly close proximity to the existing Ballinger Creek alignment and WSDOT gabion wall. Non-surveyed field measurements appear to indicate that this portion of the building is offset approximately 20 feet from the right-of-way boundary, and only about 30 feet from the existing Ballinger Creek alignment which flows directly along the base of the failing gabion wall. Alternatives 1, 2, and 3 propose replacing the NE 195th Street culvert, which creates a need to deepen the existing creek channel along the full length of the southwestern boundary of this property. Deepening the creek at this location will require moving it away from the failing gabion wall, which moves it closer to the building within a confined and narrow corridor and creates a likely need to acquire an easement along this portion of the property (currently estimated to be a 10 foot wide easement, see Figure 3-3 for example cross section). Work in this area would likely require removal of multiple large trees between the building and the creek, and create other temporary impacts, such as noise and construction disturbances. Residents of this building would also be impacted by any construction closures of NE 195th Street for the culvert replacement. Alternatives 6 and 7 would likely avoid creating any significant impacts to these residents.

In general, Alternative 7 would not have impacts to buildings.

Walls (for New Daylighted Channel)

Walls will be required to create the open channel reaches for all of the creek alignment alternatives proposed within the 25th Avenue NE right-of-way. The 25th Avenue NE roadway cross-sections require sidewalks, barriers and handrails, vehicular lanes, and even parking in several locations. The type of wall will likely be controlled by construction access, whether temporary open cuts adjacent to the wall can be made, and what is adjacent to the cut.

As discussed previously, walls constructed in proximity to the foundation of the existing building at 19500 Ballinger Way NE will likely need to be soldier pile or secant pile walls, possibly with permanent ground anchors to prevent lateral

movement. Other locations without room to temporarily lay back the soil to construct a spread footing for a cast-in-place (CIP) concrete retaining wall, or to lay in the reinforcing straps for a structural earth wall (SEW), will also require a soldier pile wall. SEW walls tend to be less expensive and can accelerate construction with the use of precast fascia panels, but they require the largest footprint for temporary cuts. CIP concrete cantilever walls may utilize special designs to eliminate the heel of the footing and reduce the temporary excavation limits, but CIP concrete takes longer in the construction schedule to complete. A 3-sided open top culvert section could also be used. All of these wall types will need to be considered and compared. There will be project constraints, such as right-of-way, movement of traffic (MOT), staging limits, utilities, existing structures, etc., that will make some wall types impractical.

The walls for the Horse Creek project, previously shown in Photo 1 as an example project, used sections of SEW wraps with precast panels in some areas, soldier pile cantilever walls with CIP fascia panels in others, and even some CIP cantilever concrete walls were the geometric constraints permitted. Under a future design phase for this project, the team geotechnical engineer will provide recommendations for what wall type are applicable on this project. The adjacent vehicular or building surcharges will also impact the wall selection. Oversized CIP roadway or sidewalk sections are required to transfer the impact forces of the barriers and railings to the wall system. These oversized reinforced roadway/sidewalk/curb sections are often referred to as moment slabs and are relatively expensive to construct. The benefit of these moment slab sections is that they resist the vehicular impact forces on the barrier system, thus reducing the demand and size of structural walls needed and decrease the wall costs. The design loading for the vehicular barriers will be TL-2 loading, based on the local residential traffic using this project area, and this will allow for more aesthetically pleasing barrier shapes as seen in Photo 1.

In comparing alternatives, the walls associated with Alternative 1 would be the costliest and most complex due to the portion of the wall next to 19500 Ballinger Way NE. Alternative 2 would have somewhat lower cost and complexity that Alternative 1, but would still have quite a bit more length of overall wall compared to Alternative 3 as Alternative 3 would not have walls within the NMF. Alternative 6 includes approximately 100 feet of short concrete wall/earth berm along the southeast portion of the property to be acquired, but its cost would be nearly negligible compare to Alternatives 1 through 3. Alternative 7 does not include any walls.

Buried Culverts

The culverts are assumed to be precast sections with water stops and wraps, as required. This construction methodology is selected to accommodate the high water tables, deep excavations, narrow work areas, and short construction windows where the creek channel is directly impacted (in-water work windows). All of the culverts will be relatively shallow. In these applications a 3-sided box with a lid is commonly used, which allows placement of the fish spawning gravels prior to placing the lid on the 3-sided box. Headwalls will be required at most if not all the culvert locations, and special details will be required to match the various channel sections that will

likely be part of this project. The skewed crossings will also impact the phasing of the road closures. It is recommended that a full closure be used during construction of the culverts under both the 25th Avenue NE and NE 195th Street locations.

The replacement culvert under NE 195th Street will require some special design. First, it may be desirable to vary the length of the precast section near the SPU 66-inch diameter waterline to facilitate easier installation underneath (e.g., it has to be slid into place so making it shorter and less heavy is an advantage). Second, a Length of special box culvert (possibly with a sump) may be needed to pass the sewer line as discussed under *Utilities* above. These considerations would be the same for Alternatives 1, 2 and 3.

In comparing alternatives, the culvert under NE 195th Street would be the same for Alternatives 1, 2 and 3. For the remainder of the major culverts (not including Alternative 7), the Alternative 1 culverts would likely be the costliest and more complex. This is because one of the culverts and a portion of the second would need be constructed adjacent to the building at 19500 Ballinger Way NE because it could add to shoring costs and protection of the building. It could even be possible that a pre-cast culvert sections may be challenging adjacent to the building because it would need outer shoring between the culvert and the building and that shoring would need to have lateral support (via ground anchors). An alternative approach could be to make the culvert integral to a wall, which would need to be further assessed during the design phase. The cost and complexity of the culverts for Alternative 2 would be lower than Alternative 1. Alternative 3 combined with Alternative 1 alignment would have reduced cost due to the elimination of a culvert, but would still have some complexities due to the building at 19500 Ballinger Way NE. Alternative 3 combined with the Alternative 2 alignment would be the least costly and less complex in terms of the culverts.

The culvert (and some storm drain pipe) work associated with Alternatives 6 and 7 would be minor in comparison to other alternatives.

Existing Walls Along Ballinger Way NE

As previously noted, WSDOT completed an emergency replacement of a portion of a failed gabion wall in October 2016 along the south side of NE 195th Street. The replacement wall design utilized drilled soldier pile shafts and steel plates for lagging to straddle the existing Ballinger Creek culvert outlet. The current City of Shoreline project's proposed profile for Alternatives 1, 2, and 3 lowers the culvert depth at NE 195th Street. The City's proposed lowering and upsizing of this culvert will present some major challenges because the channel immediately downstream of the culvert has aggraded (raised) the creek bed. Lowering this downstream profile to the depth needed to provide sufficient longitudinal slope for the creek will require channel excavation and grading along a significant length of base of the failing WSDOT gabion basket wall. As a part of the constructability review, BergerABAM recommended completing additional detailed survey cross sections at the face and near the culvert outlet, in part to physically locate the toe of the gabion wall. The gabion wall immediately adjacent to the culvert outlet will need to be protected or replaced using sheet piles or other means. Further south, for the remainder of the

channel lowering, this project seeks to relocate the creek away from the wall and add rock covered in soil to protect the wall. Appendix N in Volume II contains some additional details and recommendations.

The existing rockery near the outfall of the 25th Avenue NE pipe system is over steepened, and it was noted that a few rocks have been dislodged from the slope. Consideration should be given to replacing a portion of the rockery with an extension of the soldier pile wall where it is over steepened and adjacent to the creek.

Criterion #9: Property Impacts – Acquisitions, Easements, and Buffers. Properties that could be impacted from the project include 2525 NE 195th Street (Alternatives 1, 2, and 3) as well as the properties along 25th Avenue NE between Brugger's Bog Park and NE 195th Street. 2525 NE 195th Street would be impacted if the creek is moved away from Ballinger Way NE in order to protect the gabion wall along the roadway embankment. This may also result in the removal of trees adjacent to the building on the property which currently may muffle some of the traffic sound from Ballinger Way NE.

Also, as previously noted under the criteria "impacts to critical areas" depending on which alignment is selected, the newly daylighted creek may impact several of the properties located along 25th Avenue NE due to a change in buffer requirements. Daylighting within the 25th Avenue NE ROW for Alternatives 1 and 2, and daylighting within the NMF site for Alternative 3 would each impact the NMF site and possibly other adjacent properties with new buffers. South of the NMF, the degree of buffer impacts on which properties depends on which alternative is selected, although due to the width of the buffer it appears that daylighting on either side of the street could create new buffer on both sides of the street (with a much larger buffer projection occurring for properties on the near side of the street, and a more narrow buffer strip projected onto the property on the opposite side). Alternative 1 (and Alternative 3 if it follows the alignment along Alternative 1) may increase the buffer onto the property at 19500 Ballinger Way NE. Alternative 2 (and Alternative 3 if it follows the Alternative 2 alignment) may increase the buffer primarily on to the property at 2518 NE 195th Street and 2500 NE 195th Place according to the same regulations. The impacts to 19500 Ballinger Way NE from the Alternative 1 alignment are assumed to be minimal since the property is already completely built out to the creek alignment with newer, large construction, but may become an issue if the property is ever razed for redevelopment, presumably in the distant future. The impacts to 2500 NE 195th Place may be more significant since there is more currently underdeveloped land on that property where future development might be limited by a buffer. 2518 NE 195th Street currently is largely encumbered by buffer from the existing open channel at the southwest corner of the property and is unlikely to be further impacted by any significant amount from proposed project improvements. The city code SMC20.80.276.D.6.c also requires that the property owner agree to the changes in the buffer requirement which is unlikely since the requirement could impact the value of their property. For any of the daylighting options, the City would try to get a buffer reduction through the CASUP application in order to not adversely impact these properties as a result of daylighting the creek.

Alternative 6 proposes purchasing the western half of the parcel at 2518 NE 195th Street, including the western-most four-plex building, which would be razed and

replaced with a floodplain storage site. Accordingly, this alternative has property acquisition costs and other associated issues unlike any of the other alternatives. Alternative 7 would have minimal or no property impacts.

Criterion #10: Permanent Parking Impacts. There is currently heavy usage of roadside parking on both sides of 25th Avenue NE in the vicinity of NE 195th Place, with 25 cars or more in typical daily use, generally understood to be used primarily by residents at the 25th Place condominiums on the west side of 25th Avenue NE plus some residents from the four-plex buildings on the east side. Typical parking distribution in this area is as follows: 10 to 12 cars (in what appears to be the highest demand area) along the east side of 25th Avenue NE south of NE 195th Place; up to 10 cars each on both the west and east sides of 25th Avenue NE north of NE 195th Place. Available parking volume is currently maximized by residents using the shoulder on both sides of 25th Avenue NE for perpendicular parking, made possible by shoulder widths in excess of 17 feet in these areas. Refer to Section A on Figures 3-3 and 3-6 showing the existing 25th Avenue NE configuration south of NE 195th Place. Typical minimum length for perpendicular parking is 16 to 18 feet (depending on the size of the vehicle). Alternatives 1, 2, and 3 would all impact existing parking along 25th Avenue NE in different ways. Parking impacts are assessed assuming sidewalk, lane widths and parking within the 25th Avenue NE right-of-way which generally attempt to comply with the future roadway section as called for in the City's EDM (See Section B on Figures 3-3 and 3-6).

- Alternative 1 would directly eliminate all parking along the west side of 25th Avenue NE north of NE 195th Place. Installation of the new open channel on the west side of 25th Avenue NE south of NE 195th Place would shift existing travel lanes to the east, which would reduce the width of the eastern shoulder to 15 feet or less which is likely insufficient for continued perpendicular parking (although angled parking may be possible if the parking angle from the curb is kept low). Whenever new sidewalk is installed along the east side of 25th Ave NE (per the EDM guidance), the remaining perpendicular or angled parking along the east side of 25th Avenue NE would be converted to parallel parking (although this conversion would not be required directly by project improvements). See Sections C and D on Figure 3-3.
- Alternative 2 would have the greatest direct impact on parking, as it would directly eliminate all parking along the west side of 25th Avenue NE north of NE 195th Place, and directly require conversion from perpendicular to parallel parking along the east side of 25th Avenue NE south of NE 195th Place. Whenever new sidewalk is installed along the east side of 25th Ave NE (per the EDM guidance), the remaining perpendicular parking along the east side of 25th Avenue NE north of NE 195th Place would be converted to parallel parking (although this conversion would not be required directly by project improvements). See Sections C and D on Figure 3-6.
- Alternative 3 would have the smallest direct impact on roadside parking among Alternatives 1, 2, and 3. It would have no direct impact on 25th Avenue NE parking north of NE 195th Place, as project improvements would be contained within the NMF site. South of NE 195th Place, Alternative 3 parking impacts would be the same as the impacts of either Alternative 1 or 2 (depending on

which alignment is selected), which would require conversion of parking on the east side of 25th Avenue NE from parallel to either angled or perpendicular. Like Alternatives 1 and 2, whenever new sidewalks are installed along both sides of 25th Ave NE (per the EDM), the remaining perpendicular parking along the west side of 25th Avenue NE north of NE 195th Place will be eliminated, and on east side will be converted to parallel parking (although these changes would not be required directly by project improvements). Unlike Alternatives 1 and 2, Alternative 3 would allow for sidewalk, travel lane, parking, and amenity zone widths along 25th Avenue NE north of NE 195th Place which would be consistent with the EDM.

- Alternative 6 would have very limited parking impacts. Acquisition of one of the buildings at 2518 NE 195th could reduce parking demand along the street.
- Alternative 7 would not have any permanent parking impacts.

Criterion #11: Community Considerations. All of the alternatives will provide improvements which would benefit the neighborhood community. Daylighting Ballinger Creek (proposed by Alternatives 1, 2, and 3) improves the aesthetics of the area and provides the community the ability to better observe active natural systems, which tends to promote a greater appreciation and stewardship of the local ecosystem. Alternatives 1, 2, and 3 will extend sidewalk along 25th Avenue NE and increase safety for pedestrians in the area. Finally, Alternative 3 could provide the City with the opportunity to make the new floodplain storage and daylighted creek area, at minimum, into a park-like setting and effectively expand Brugger's Bog Park -- which would create a new aesthetic and recreational amenity for the community. In addition, by using the NMF property to daylight the creek, wider vegetated buffers can be provided which will protect the creek and improve water quality.

Alternative 6 would not include the level of neighborhood amenities as Alternatives 1, 2 and 3, but the conversion of the property to be acquired at 2518 NE 195th Street could form a smaller set of amenities including more of a park-like setting, and also would include some minor daylighting of the creek. A small portion of the acquired site could be grassed and set at an elevation in which it only floods during significant storms and in that way provide a small neighborhood amenity. Portions of the berm along the east side of the site could function as a trail (See Figure 3-12). That said, this alternative would only improve flooding for smaller rainfall events, thus allowing continued flooding for more significant events.

Alternative 7 would not include any of the amenities of the other alternatives. Alternative 7 would only improve flooding for smaller rainfall events, and flooding would continue for more significant events.

Criterion #12: Property Acquisition Needs.

- In order not to impact the gabion wall along Ballinger Way NE downstream of NE 195th Street, it is proposed to move the creek away from the roadway for Alternatives 1, 2, and 3. This will require an easement at 2525 NE 195th Street.

- Although it is already owned by the City of Shoreline, Alternative 3 proposes to use the NMF property for stream daylighting. Using the NMF property for the project means that the City will need to find an alternate location for the NMF.
- For Alternative 2, either temporary construction easements or permanent easements would be needed for private properties on the east side of the ROW. It would likely depend on the type of wall selected during final design. The most cost effective wall is likely structural earth wall (SEW), but these walls tend to have a large footprint that would extend into private property. If a portion of the wall extents into private property, a permanent easement is more desirable. Alternatively, a soldier pile wall may not extend unto private property. Even though it would not extend into private property, a temporary construction easement would likely be required for access and because the adjacent areas would be subject to some disturbance during construction activities.
- Alternative 6 proposes purchasing the western half of the parcel at 2518 NE 195th Street, including the western-most four-plex building, which would be razed and replaced with a floodplain storage site. Accordingly, this alternative has property acquisition costs and other associated issues unlike any of the other alternatives.
- Alternative 7 would have limited or no property acquisition needs. It potentially could require some limited temporary construction easements if improvements are proposed alongside the edge of the ROW and construction disturbance will occur on adjacent private property (primarily along the north side of Ne 195th Street or for access to the outlet of the NE 195th Street culvert).

Criterion #13: Maintenance. Maintenance issues include potential sediment deposition in the creek as well as maintenance of the culverts. Due to the lack of head room, the vertical openings of the proposed culverts are less than four feet high. Although many of the proposed culverts have a 4.6-foot rise, 1.1 feet of this rise will contain streambed sediment in order to provide a natural stream bottom throughout the culvert. Having a vertical opening of less than 4 feet means that a person does not have sufficient space to safely gain access to the inside of the culvert for maintenance. Maintenance access to the culvert interior can be provided by means of manhole or hatch accesses installed along the alignment of the longer culverts so vactor or other equipment or a person could access the culvert at that location and remove any debris blockages or sediment accumulation which may occur. Because Alternative 3 includes one fewer culvert, there would be less culvert maintenance required for that alternative compared to Alternatives 1 and 2.

Alternatives 3 and 6 would create a floodplain storage area which would require some initial vegetation establishment monitoring and maintenance (generally for 5 years) followed by long-term annual vegetative maintenance (such as invasive species removal and replacement of dead native plantings) and debris and litter removal.

Regular channel maintenance is expected to be required downstream from the NE 195th Street crossing for Alternatives 1, 2, and 3. Upstream of this location, the stream

gradient is proposed to be steepened in order to construct the new NE 195th Street culvert below the SPU water line. As a result, the overall stream gradient from the downstream end of the NE 195th Street culvert to the Ballinger Way NE culvert would be somewhat flatter than it is currently. Sediment tends to deposit at locations where the channel gradient flattens, so this area should be monitored to ensure any such deposition over time does not adversely impact the capacity of the NE 195th Street culvert. The City may conduct a study to assess the potential for sediment deposition, after selection of the preferred alternative.

Criterion #14: Temporary Traffic Impacts. Some of the work zone safety and mobility areas to consider on this project are as follows.

- Accommodations for pedestrian and bicycle traffic
- Consideration for schools, emergency services, and postal delivery
- Parking for residents currently reliant upon 25th Avenue NE roadside parking
- Work vehicles and equipment in work area
- Notices to residents and businesses
- Driveway access for local residents
- One lane closures on 25th Avenue NE, NE 195th Street, and possibly Ballinger Way NE; and likely full closures of 25th Avenue NE and NE 195th Street (separately) for limited periods during installation of the main culvert crossings of these streets
- Staging area for equipment and materials

A one-lane closure with a flagger at each end of the work area could control work activities at the north end of 25th Avenue NE, or where permitted elsewhere. When the work activities move closer to the Ballinger Way NE intersection, the project may need to consider a combination of law enforcement and flaggers. One-lane closures on 25th Avenue NE and NE 195th Street may be needed during excavation of the side channels. For Alternatives 1, 2, and 3, full road closures on 25th Avenue NE and NE 195th Street may likely be necessary to excavate the culverts where they cross the roads.

Depending on which alternative is selected, temporary impacts on street parking could range from low to extensive. Driveways need to remain open and maintained to the maximum extent possible for the duration of the project. Unavoidable limited closures of selected driveways may need to be negotiated with the local residents.

Alternative 1 will have a moderate impact on traffic. The work is in the west shoulder in front of the NMF site, the driveway serving residences at 19533 and 19545 25th Ave NE, and along 19500 Ballinger Way NE. The wall type selected may increase the impacts to traffic if extra excavation is required toward the 25th Avenue NE travel lanes immediately to the east. The driveways will have to remain open and maintained as much as practical. The street parking on the west side would be closed within and immediately adjacent to areas of active construction. Street parking on the east side of 25th Avenue NE could possibly remain open if there is sufficient clearance from construction activities and pending approval from the City's Traffic Engineer.

Alternative 2 will have more extensive impact on traffic. The driveways for the NMF site and residents on the east side of 25th Avenue NE will have to remain open and maintained as much as practical. Street parking on the both sides of 25th Avenue NE would be closed within and immediately adjacent to areas of active construction. Alternative 2 will have the greatest temporary impact of the alternatives.

Alternative 3 will reduce some of the impacts on traffic. The excavation through the NMF will not impact traffic or roadside parking on the adjacent section of 25th Avenue NE. The work south of the NMF will be similar to Alternative 1 or 2 depending on which alternative it is combined with.

Alternative 6 would have significantly lower traffic impacts compared to Alternatives 1, 2, and 3. Most of the work would occur outside of the right-of-way, so temporary and permanent impacts to traffic and parking would be minor.

Alternative 7 would have more impacts on traffic than 6 because of the pipeline work within 25th Avenue NE. However, it would still be minor in comparison to Alternatives 1, 2, and 3.

Criterion #15: Opportunities for Grant Funding. The City has researched available grant funding for the proposed project. The main objective of the project is to reduce flooding; however, Alternatives 1, 2, 3, and 6 also have some habitat restoration elements through daylighting Ballinger Creek and providing fish passage and habitat. Most available funding sources for fish habitat are focused on endangered species (i.e. Chinook salmon) or other native species that are not found within Ballinger Creek, therefore, grants targeted at providing fish habitat and restoration-based funding may not be directly applicable to this project. Both cutthroat trout and coho salmon were observed within the project area, so a favorable case can be made for Alternatives 1, 2, 3, and 6 providing additional fish passage and habitat to leverage grant funding for non-ESA listed fish species.

The City has already had some success in leveraging grant funding. In 2016, the City applied for and was successful in obtaining a King County Flood Control District (KCFCD) Flood Reduction Grant to fund pre-design and design development up to the 60% and Permitting phase, for costs totaling up to $472,000. This program targets medium and small local flood reduction projects including projects where the control of stormwater will have a direct benefit in reducing flooding. KCFCD is accordingly a project stakeholder and will provide review feedback on project pre-design and design topics. This project is also eligible to reapply for KCFCD Flood Reduction Grant funding for future phases if eligible.

The 25th Avenue NE project is also eligible for another source of KCFCD funding, which is the Sub-Regional Opportunity Fund (SROF). This fund is an annual allocation of a portion of the KCFCD levy made available to jurisdictions throughout the District on a proportional basis (based on assessed valuation). Eligible activities include flood control improvements such as this project. To date the City has elected to apply annual SROF allocations to this project for 2016 ($110,898) and 2017 ($113,548).

There are other potential grant funding opportunities of interest to the project. The Washington State Emergency Management Division (EMD), under the Federal

Emergency Management Agency (FEMA), issues funding through the Pre-Disaster Mitigation (PDM) Grant. The program was designed to assist applicants in implementing a sustained pre-disaster natural hazard mitigation program to reduce loss of life and property by lessening the impact of disasters. The City of Lake Forest Park received a PDM grant for their Lyon Creek flood mitigation project. The Washington EMD has indicated that the City of Shoreline's proposed project may be a competitive candidate for the PDM grant, assuming the City selects a design which meets grant criteria. It should be noted that PDM grant applications are extremely detailed and highly technical; a FEMA PDM grant application would involve a significant effort. As previously noted, Appendix G contains a summary table of potential grant opportunities.

Evaluation Summary

Table 3-6 provides a summary of the key considerations with each of the criteria listed above. For this table, it was organized by Alternatives 1 and 2, followed by Alternative 3 either combined with Alternative 1 or 2, then Alternatives 6 and 7. There are many similarities between the Alternatives 1, 2, and 3. Some of the key differences include:

- Alternative 3 was identified as a potential alternative only in the event that the City elects not to proceed with development of the NMF site for a new maintenance facility. If the City proceeds with the development as currently planned, the entire site will be needed for the maintenance facility and Alternative 3 would not be possible. If, however, the City does not proceed with the NMF, Alternative 3 combined with Alternative 1 or 2 would be the favored daylighting alternative. Alternative 3 is slightly less costly than Alternatives 1 and 2 (assuming that the project would not have to pay for the cost of land). Alternative 3 requires one less culvert and does not include the costly concrete channel walls for the portion of the project along NMF within the 25th Avenue NE right-of-way. This is offset by greater excavation quantities for the floodplain storage improvements along with an estimated cost allowance for handling and disposal of potential contaminated materials.

- Alternative 3 would also provide the greatest benefit in terms of fish passage, habitat restoration, and flood hazard reduction. It would provide an amenity to the community if the Brugger's Bog Park was expanded. One drawback of this alternative is the risk, and associated cost, of encountering contaminated soils/groundwater on the site that resulted from prior use by King County. Overall this is considered the best alternative should the City not proceed with the NMF. That said, prior to advancing this alternative further, it is recommended to perform more detailed site investigations to confirm that the presence of contaminated soils/groundwater would not significantly increase project costs.

- Between Alternative 1 and 2, there are many similarities. The key distinguishing factors between these are that Alternative 1 has greater risks associated with excavating the channel relatively close to the building at 19500 Ballinger Way NE, while a major drawback of Alternative 2 is the need to relocate several more utilities and greater direct parking impacts to the east side of 25th Avenue NE south of NE 195th Place. The major utility of concern in the joint Seattle City Light/CenturyLink poles as previously mentioned. Both Alternatives 1 and 2 reduce existing roadside parking usage of 25th Avenue NE, with slightly greater direct impacts from Alternative 2.

  Some thought was given to two modifications of the Alternative 2 alignment that would potentially reduce the impacts to utilities on the east side of 25th Avenue NE. One potential alignment modification is to switch the locations of the sidewalk and the open channel. That is, place the sidewalk to the outside of the channel and the channel in between the road and the sidewalk. This could potentially reduce some of the need to relocate major utilities (e.g., the power poles). However, a drawback of this would be the need for a structural barrier and guardrail between the road and

the channel which would add costs. The second alignment modification is to have the crossing of 25th Avenue NE shift just south of the access driveway between the north maintenance facility and the building at 19500 Ballinger Way NE. This alternative potentially eliminates a conflict with one of the utility poles, located in the northeast quadrant of 25th Avenue NE and NE 195th Place. The drawback of this modification is that a portion of the alignment would be close to the building at 19500 Ballinger Way NE and therefore would have some of the same issues and complexities as the Alternative 1 alignment. Because there did not seem to be a significant benefit for either of these modifications they were not considered further. However, if Alternative 2 is ultimately selected as the preferred alternative, these alignments may warrant further analysis.

- Alternative 6 provides only a modest increase in flood protection relative to Alternatives 1, 2, and 3. However, in the event that NE 195th Street culvert replacement (and associated work) is deemed too expensive and/or fraught with risks and other complexities, Alternative 6 provides a reasonable approach to reduce the impacts of flooding caused by this culvert while avoiding its replacement (because the NE 195th Street culvert is not owned by the City, there is no long-term obligation to replace it due to deteriorating pipe condition alone). However, the 25th Avenue NE conveyance system would still continue to have capacity issues and need to be eventually replaced due to pipe condition; so upstream of the property to be acquired under Alternative 6 conveyance improvements similar to those proposed under Alternatives 1, 2, or 3 would be required in the long-term. In addition, the properties to the east of the acquired property would receive a modest increase in level of protection, but would still be subject to flooding for about the 8-year flood event or greater.

- Alternative 7 provides the smallest increase in flood protection among the alternatives. However, Alternative 7 could be implemented in the near future as either (1) interim improvements installed prior to a much larger scope preferred approach, which will require (at minimum) two to three years to begin construction, or (2) as effectively "standalone" improvements in the event that the City opts to delay a decision on the preferred alternative in the near future to allow for more certainty about some of the project complexities (e.g. decision on the NMF site, available use of the Aldercrest Annex property, securing funding, and/or ability to get land easements/acquisitions.

Table 3-6: Alternative Analysis Summary

Alternative ID	Project Cost ($ in millions)	Flood Reduction Improvement	Expected Downstream Impacts	Fish Passage Improvement	Net Impact to Critical Areas	Permitting Requirements	Mitigation Requirements	Constructability (Complexity to Construct (excl. Utilities)	Complexity of Utility Conflicts	Property Impacts (Primarily Buffer Impacts)	Direct Permanent Parking Impacts	Community Benefits	Property Acquisition Needs	Maintenance Needs	Temporary Traffic Impacts	Attractiveness to Potential Grant Funding Sources
1	$7.20	>100 Year Event	Low	Yes	Positive	Federal, state, and local	Minor	High	High	High	High	High	Easement in LFP	Low to Moderate	High	Moderate
2	$6.70	>100 Year Event	Low	Yes	Positive	Federal, state, and local	Minor	High	Highest	Highest	Highest	High	Easement in LFP	Low to Moderate	Highest	Moderate
3-1	$6.60	>100 Year Event	Lower	Yes	Positive	Federal, state, and local	None	Highest	Moderate	Moderate	Moderate	Highest	Easement in LFP	High	Moderate	High
3-2	$6.40	>100 Year Event	Lower	Yes	Positive	Federal, state, and local	None	High	High	High	High	Highest	Easement in LFP	High	High	High
6	$1.90	2 Year (on 25th Ave), about 8 year (on properties east of 25th Ave)	None	No	Positive	Federal, state, and local	None	Low	Low	None	None	Moderate	Major property acquisition at 2518 NE 195th Street	Highest	Low	Moderate
7	$0.50	about 4 Year	None	No	None	Simple Federal (If within programmatic HPA)	None	Lowest	Low	None	None	Low	None	High	Moderate	None

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3.3 Recommended Plan

3.3.1 Description

This Draft Predesign Report does not yet include a recommendation for the preferred alternative. The City intends to distribute the Draft Predesign report to a broad selection of stakeholders (see Table 1-1) to solicit input which can then be incorporated to the final analysis and recommendation of the a preferred approach, which will be included in the Final Predesign Report.

The process to select the preferred design approach will involve a staff recommendation which is intended to propose the best overall elements as considered in the alternatives analysis and stakeholder input. City Council will then be presented with the results of the alternatives analysis and stakeholder input and justification for the staff recommendation, and be requested to approve the staff recommendation or direct staff to pursue another course of action.

The alternatives as presented have been developed using an extensive amount of available information and the best analytical methods as determined by the City and consultant team, working with early input from a number of key stakeholders. As always, some specific pieces information have been more difficult to obtain and are still being pursued by the project team. While this information would help to clarify details of certain issues, none of the missing information is currently thought to have a potential major impact on the overall viability or feasibility, or relative evaluations of the alternatives as presented. The project team will continue to pursue this information as a priority task; some of this information may become available in the interim between release of the Draft Predesign Report and completion of the Final Predesign Report, while other information may not be obtained until later in the design process. Further information is currently being pursued includes the following:

- Understanding potential availability of the NMF site for Alternative 3, and the NMF project schedule. City Council has recently authorized staff to pause development of the NMF and use the predesign facility programming information to identify alternative properties within the City that can meet the Public Works maintenance facility needs. The goal of this work is to identify a location that meets the Public Works maintenance facility needs at a lower cost than the NMF site or confirm the NMF site is the best location and value. Results of this study are currently expected in mid- 2017.
- Coordination with Seattle City Light and other utilities which use the SCL poles along the east side of 25th Avenue NE on potential issues/schedule for relocation of the overhead lines if needed for Alternative 2. The City's franchise agreement with SCL allows for one year for pole relocations from time of request.
- Further information regarding the building foundation at 19500 Ballinger Way NE and more detailed analysis of construction techniques needed to construct Alternative 1 to avoid excessive risk of settlement. The project team has contacted the architect, civil engineer, and structural engineer, and obtained the structural

design drawings and geotechnical report for this building. However, some information is still missing regarding verification of ground improvement techniques, for which additional research, such as locating and contacting the geotechnical engineering for the building, may shed additional light.

- Further coordination with WSDOT regarding potential sizing for the NE 195th Street culvert replacement (of particular interest is the minimum height requirement for the culvert opening which, due the need to go under the SPU 66" water pipeline, will have a significant effect on the channel depth both at this location and the channel upstream and far downstream).

3.3.2 Implementation and Phasing

FUNDING

The potential cost to the City of Shoreline for this project signifies a likely major expenditure that needs to be balanced with competing priorities. The City of Shoreline's current 2017-2022 Capital Improvement Plan (CIP) provides an $11.1 million (M) total for six-year funding of capital projects. Of this amount, approximately $3.8M is currently programmed for the 25th Avenue NE Flood Reduction Project, including $2.8M potentially allocated for 2019 construction.

The total $11.1 million 2017-2022 six-year CIP budget is funded by approximately $4M in bond revenues and $1.7M in currently-expected grant funding sources (including the KCFCD grant sources for this project described previously) with the remaining $5.4M balance of funding coming from Surface Water Fees. This means that the 6-year average contribution to Surface Water CIP funding coming directly from Surface Water Fees is less than $1M per year. There is effectively no "surplus" funding source of any type available in the current six-year budget, while at the same time there are a number of high-priority Surface Water CIP programs and projects competing for available funds.

It should be noted that the budget numbers listed above represent approximate amounts as projected by the most current available information, and can be expected to change somewhat over time. However, the relative unavailability of large amounts of funding available for this project's costs is expected to remain consistent. Thus, if project costs are expected to exceed the currently programmed amounts ($2.8M for 2019 construction) the City will likely need to aggressively seek outside funding sources (such as grants and/or contributions from other jurisdictions or sources). Depending on the success of obtaining such funding from outside sources, the schedule for implementation of improvements could largely depend on the overall availability of adequate funding. More specifically, budget limitations may create a situation where project improvements are phased for installation based upon available funds. For instance, a first major phase of improvements costing up to $2.8M could be installed in 2019; additional improvements could be phased for future "out" years not currently programmed in the CIP budget (2022 or later), which hypothetically have more available budget (although, again, there are many likely competing priorities).

POTENTIAL PHASING

A phased approach is more likely for Alternatives 1, 2, and 3 as having fairly large overall scope of work. Cost estimates were developed for these alternatives assuming that the overall project would be split into two main but separate projects: (1) work associated with the NE 195th Street culvert replacement and associated downstream channel improvements, and (2) work associated with daylighting Ballinger Creek and conveyance improvements along 25th Avenue NE. It is recommended that the NE 195th Street culvert replacement work be completed first. It is typically a best practice to complete surface water system improvements in a "downstream to upstream" sequence, so as not to increase the interim flood hazard potential of downstream areas. While this study shows that the downstream flow at Ballinger Way NE would not increase from the improvements, it does show increase in flows at the upstream side of NE 195th Street. Therefore, conducting the 25th Avenue NE improvements first would likely worsen flooding for the properties along the north side of NE 195th Street. If Alternative 2 is selected, this phasing would allow additional time to plan and implement relocation of utilities, namely the Seattle City Light/CenturyLink-owned utility poles.

OPTIMAL SCHEDULE

Permitting review time should typically be allotted up to one year following submittal of permit applications, which occurs around the completion of 60 percent design (assuming that an Individual Permit for Clean Water Act Section 404 compliance from USACE would not be necessary) development of a 60 percent design is expected to require at least six months following selection of the preferred approach. Following acquisition of all required permits, it is expected to take at least six more months to prepare final ad-ready documents for construction. Thus, the City should allow for a minimum of 2 years to finalize the design following selection of preferred approach, assuming a relatively smooth and straightforward process throughout.

Time for construction bidding, award, and contracting is expected to take at least three months, and construction involving in-stream work will be limited to a late summer fish window. Accordingly, the soonest that major construction of any improvements involving in-stream work could begin would be the summer of 2019, and again this assumes a relatively smooth and straightforward process throughout. Due to the fish window limitation, if a construction contract is not executed by early summer 2019 (for any reason), it is likely that any in-stream work need to be delayed by a year to the summer of 2020.

POTENTIAL SOURCES OF DELAY

There are several factors which, depending on the preferred approach selected, could delay the optimal timeframe described above.

For Alternatives 1, 2, and 3, it is assumed that the City of Shoreline will be required to work with the City of Lake Forest Park to obtain drainage easements for any shifts to the creek alignment along Ballinger Way NE. The new drainage easement would be within area already characterized as either wetland or wetland/stream buffer and as such

is generally not developable. Theoretically this critical area proximity should ease the potential challenges in obtaining an easement, but the actual time and coordination needed to obtain this easement is very difficult to predict until the process is underway.

Alternative 6 would require acquisition of a large portion of a private property parcel, which could add an indeterminate amount of time to the above-described schedule. A year or more should be allotted for the acquisition process, some portions of which may run "parallel" to design development although there is a potential for this process delay to the overall project schedule.

Other potential sources of delay to the project schedule include future coordination needs with a number of key stakeholders, including but not limited to the North Maintenance Facility project, City of Lake Forest Park, WSDOT, Seattle Public Utilities, and other utilities (for relocations, etc.). The design and permitting process could simply take longer than outlined above in due to the complexities of creating an engineering design which can successfully accommodate all the physical, regulatory, and jurisdictional challenges for this project – although it may be difficult to pinpoint specific potential sources of delay until the project advances further in the design process. There is a reasonable chance, due to the sheer number of such challenges, that an unforeseen issue and/or the funding issues described earlier could cause a delay pushing the date of soonest major construction from 2019 to 2020 or later.

POTENTIAL NEAR-TERM IMPROVEMENTS

Considering that even by optimal timeframes construction of improvements will likely not occur for at least two to three years (or longer) following completion of this report, the City may want to consider an array of smaller-scale improvements which could be implemented relatively easily in the near term. These potential near-term improvements, which generally included the elements of Alternative 7, could be implemented as either interim or first-phase long-term means to improve the existing system's base level of protection against flooding. These measures are described in the following section.

3.3.3 Potential Near-Term Flood Reduction Measures

The project team reviewed an array of smaller scale improvements that could be implemented in the near future as either (1) interim improvements installed prior to a much larger scope preferred approach which will require (at minimum) two to three years to begin construction, or (2) as effectively "standalone" improvements in the event that the City opts to delay a near-term selection of a preferred approach in order to allow for more resolution of current uncertainties (such as potential availability of the NMF and/or Aldercrest Annex sites, securing sufficient funding, viability of other property and/or easement acquisitions, etc.). The near-term measures would reduce the frequency and magnitude of flooding incrementally by implementing smaller, cost effective system improvements without time consuming permitting and/or property/easement acquisition processes.

One such measure already implemented due to an opportunity which arose during development of the pre-design report was cleaning the existing NE 195th Street culvert. During WSDOT's construction project to repair the failing gabion wall at the culvert outlet, the City of Shoreline took advantage of this opportunity to retain an on-call contractor to clean out, CCTV inspect, and remove sediment that was clogging the culvert (while the creek was temporarily diverted around the culvert under the WSDOT project's HPA permit). The WSDOT project itself re-established the outlet to the existing NE 195th Street culvert and excavated a small sump in the streambed near the outlet as required by the scope of the wall replacement work. Previously, the culvert outlet was buried under the failed wall and the pipe itself was approximately half clogged with sediment; the combination of these flow impediments would likely have significantly limited the existing pipe's carrying capacity. It should be noted that flows through this post-cleaning culvert are still somewhat impeded due to aggradation of the creek bed immediately downstream of the culvert (after years of sediment accumulation), which creates backwater conditions at this culvert such that the downstream end is fully submerged and the upstream end is partially submerged.

The recommended potential near-term measures generally function independently of each other and accordingly can be implemented selectively (singly, or in any groupings) in whatever sequence or to whatever extent that the City deems optimal. As mentioned above, these near-term measures generally align with the elements of Alternative 7 and described below as Near Term Measures. Some of the background and more detailed information about these measure is presented in the Alternative 7 description in Section 3.2.6 and not repeated below. Refer to Section 3.2.6 for more detailed information.

- **Near-Term Measure #1 – Pipe Repair by Means of Lining the Existing High Flow Bypass.** This includes pipe lining of the existing high flow bypass, which consists of approximately 225 feet of 24-inch-diameter CMP pipe and approximately 135 feet of 24-inch high x 36-inch wide CMP arch pipe. As previously noted, this system is believed to be above the Ballinger Creek Ordinary High Water delineation (OHW), exempting it from the in-water work permits which would typically be required from USACE and WDFW. If this system is, in fact, deemed to be below OHW, it is likely that these permitting processes would not allow lining repair of these pipes. Thus, determination of OHW extents relative to the existing bypass system is a critical requirement and an early action item for this work. **Approximate cost: $120,000**

- **Near-Term Measure #2 – Extend Existing High Flow Bypass.** This measure would extend the existing high flow bypass system by installing approximately 250 feet of new pipe and any necessary structures to discharge to the open channel section of the creek at 2518 NE 195th Street. The new bypass extension would need to discharge to the existing creek-side riprap rockery at a location above the stream OHW. Keeping all components of this measure above the OHW is a requirement for feasibility. **Approximate cost: $187,000**

- **Near-Term Measure #3 – Improve Drainage Overflow Path along NE 195th Street**. Work done under this measure would include light grading and ditch

maintenance along the north side of NE 195th Street between Ballinger Creek and an existing small pipe crossing NE 195th Street located approximately 200 feet to the east of the creek (at the low point of NE 195th Street). This measure would also include maintenance and/or replacement of the driveway culvert at 2526 NE 195th Street as well as maintenance of the existing 12-inch to 18-inch pipe that crosses NE 195th Street. The overall objective of these improvements would be to improve and formalize an overflow path for Ballinger Creek floodwaters on the north side of NE 195th Street. As previously noted, all of this work would take place within the city limits of Lake Forest Park and coordination with LFP and affected properties would be necessary. **Approximate cost: $87,000**

- **Near-Term Measure #4 – Improve Existing Driveway Berms and Other Small Berms Along the East Side of 25th Avenue NE**. This measure includes improvements and expansions to the existing asphalt driveway berms (which resemble small speed bumps) were previously installed as flood prevention measures along the driveways on the east side of 25th Avenue NE serving NE 195th Place and 2518 NE 195th Street. The effectiveness of these berms could be improved upon by installing an improved (newer, higher, more robust) and more complete (longer, better connected) array of engineered berms. A consideration would be to extend the berms beyond the existing driveways north and south along the east side of 25th Avenue NE to try and further contain any surface flows. **Approximate cost: $66,000**

- **Near-Term Measure #5 – In-Channel Sediment Maintenance/Removal Downstream of NE 195th Street.** The intent of this measure would be to perform minor stream channel excavation to remove deposited sediments where the channel has aggraded (filled in) and improve the flow characteristics downstream and affecting the NE 195th Street culvert. This measure assumes that this work would be conducted under the City's programmatic 2016-2012 HPA that allows the City to perform maintenance of stream channels to within 25-feet of the culvert. Thus, the permitting effort could be limited to a fairly simple USACE Nationwide Permit (#19 for minor dredging). This work would be in the City of Lake Forest Park and coordination with LFP and any affected properties would be necessary. **Approximate cost: $20,000**

Collectively, implementation of these near-term measures would be expected to increase the level of protection against flooding consistent with Alternative 7, from a 2-year flood event (i.e., 1 in 2 chance of flooding in any given year) to about a 4-year flood event (i.e., 1 in 4 chance of flooding in any given year) along the 25th Avenue NE system. This is based on the simplified analysis that was described in Section 3.2.5.

The near term measures are listed approximately in order of the assumed flood reduction effectiveness of each measure. Further analysis and prioritization of these measures would be valuable in the event that the City elects to move towards implementation of this approach.

3.3.4 Future Stakeholder Coordination

Table 1-1 summarized anticipated stakeholders affected by the project. The City has already conducted early outreach to a few key stakeholders to gather input and use this information to characterize the flooding problem and potential solutions (as described in Section 3.1). Following issuance of this Draft Report, the City will solicit detailed input from a broader field of all known stakeholders, including (but not necessarily limited to) those identified in Table 1-1. This input will be a key factor in evaluating the selection of the preferred approach. This input will also figure largely in other project planning going forward and during future design, permitting, and construction phases. Stakeholders with ongoing coordination needs will continue to be contacted regularly (and proactively) by the City's project management team throughout the project process. The City has created and continues to maintain a 25th Avenue NE Flood Reduction Project webpage (at http://www.shorelinewa.gov/government/departments/public-works-/capital-improvement-plan/25th-avenue-ne-flood-reduction-project); this webpage is typically updated on a monthly basis and serves as a centralized source for announcements and information (both current and archived) related to the project.

Section 4
References

AltaTerra, 2015. Lyon Creek Basin Plan. Prepared for City of Shoreline

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US ACOE (January 2010). HEC-RAS Version 4.1.0. Hydrologic Engineering Center, Davis, CA

US EPA (1989). HSPF Release 12.2. Office of Research and development Center for Exposure Assessment Modeling, Athens, Georgia.

Appendices

Appendix A
History of Flooding Summary Table and Sketch

City of Shoreline

Surface Water Management

Surface Water Facilities
- Hydrant
- Other Appertunance
- Distribution Main
- Service Connection
- Facility or Storage

Ballinger Creek condos Built 1983

Ballinger Commons Built 1969

0 10 20 40 Feet

NE 195TH PL
NE 195TH LN
NE 195TH ST
LLINGER WAY NE
25TH AVE NE
NE BALLINGER WY
19533
19500
19504
19230
19330
2500
19530
2610
2607
2609
2522
2524
2526
2518
CB-6843
CB-7724
CB-547
CB-7723
CB-2398
CB-12438
CB-3037
CB-8418
CB-8419
CB-4475
CB-4473
CB-8420
CB-4474
CB-6811
CB-6810
CB-8365
CB-727
CB-719
MH-400
MH-200
MH-201
MH-234
Steel 66"
FLOOD 11/18/2003
BUILT 1959
BUILT 1978
BUILT 2004
BUILT 1971
BUILT 1979
BUILT 1992
BUILT 1985
3rd time since near apts
FLOOD 8/6/04
FLOOD 11/18/2003 8/22/2004 12/2/2007
19512 25th 8/22/01 12/3/07 6/3/08
FLOOD 11/21/2001 11/18/2003 (19512)
(19510)
(2518)
FLOOD 11/18/03 8/6/04 8/22/04
11/19/03
12/3/07
ASTRACEN Between 2002-2011

Event date	# of unique service requests	Locations reporting flooding										Sea-Tac 24-hr prcp (in)	Notes/Narrative
		SW Fourplexes			NW properties		SE Fourplexes			Ballinger/ 195th/25th	NMF/ BB		
		19510	19512	2518	2500	19530	2522	2524	2526				
8/22/2001	1		1									1.46	Flooding at residence. Preceded by 0.5" rain on 8/21.
11/14/2001	1			1								2.39	Presumed earlier flooding date reported by 2518 NE 195th - 3.58" of rain fell 11/13-11/14
11/21/2001	2			1							1	0.15	Reported as 3rd drainage overflow/flood in 2 weeks at 2518. 1.11" of rain fell 11/19-11/20 and another 1.15" fell on 11/22/01. Possible flooding also at NMF site on 11/22.
10/20/2003	1						1					4.95	Claim made, not shown as paid
11/18/2003	5	1			1	1	1			1		2.06	Fire and police on site; Calls around 7am; Bldg flooded at 19510; at 2522 reported as 2nd flood in 1 month, said flooding due to "surface water coming down from the road"; implied flood at 2500
8/6/2004	4				1		1			2		0.56	Calls around 4pm; Bldg flooded at 2522 (1' of water); intersection flooded; "large amount of water"; at 2500 parking lot was impassable due to flood but building not flooded. Daily precip was 0.83" at Mukilteo airport (KPAE); 2-hr peak was 0.56"
8/22/2004	3					1	1			1		0.54	Police on site. At 19530 "house flooded," reported at 3rd time since the "new apt" went in (presumably this is the 2004-constructed condo building across 25th). Daily precip was 0.93" at Mukilteo airport (KPAE); 90-min peak was 0.72"
9/24/2004	1										1	0.01	Flooding of maintenance yard near culvert inlets. No significant rain this day, but there was measurable rain 14 of the 16 days preceding this reported date.
11/2/2004	1						1					0.89	High water "threatening" condos
5/16/2005	1												King County reported flooding of maintance site. May have been due to blockage of culvert entrance.
September 2005 installation of in-line stream improvements along Ballinger Creek upstream of NE 195th St													
12/11/2006	1										1	0.84	Roadway flooded near maintenance yard, reported by police
12/3/2007	6		1			1			1	3		3.77	Calls throughout the day. $12k claim paid to 2522/2524/2526 for damage; 2"-deep "river" reported in front yard at 19530 and flooded crawlspace; water in apartment at 19512; "a lot of water" on road at 195th; 50' dia pond x 1ft deep mentioned at 25th/Ballinger at 3:00am
6/3/2008	1		1									0.58	Creek flooding over lawn, 1 inches below building flood, surface water from street
11/19/2012	1		1									2.13	Backyard flooded, 2 inches below building flood
7/23/2014	2			1							1	0.76	1:30 pm "Wetlands behind townhouse flooding" on private property; 3:39pm Flooding near Brugger's Bog at NMF, reported by Cleanscapes, 1 lane of traffic affected (on 25th); some conflicting info - no flooding observed by CRT response (~2pm) in between flooding calls
10/10/2015	1										1	1.13	Apparent backup around CB-9172; original 10:30am call reported flooding on "private property" entering building originating from road/SD/ditch
Total calls	32	1	4	3	2	3	5	0	1	7	5		
Events	15												

Appendix B
Summary List of Prior Studies/Information

City of Shoreline

25th Avenue Flood Reduction Project
Subject: Summary of Relevant Data/Information

Date: 5/27/16 (Updated 6/20/16)

Item No.	Title & Reference (if applicable)	Description	Relevance
1	Lyon Creek Basin Plan (AltaTerra, 2015)	Basin Plan covering project area	Provides problem background. It included original development of HEC-RAS hydraulic model through project area.
2	City of Lake Forest Park Surface Water Management Plan (Otak, 2009)	Basin plan	Includes modeling and analysis of basin. Focus is on areas in Lake Forest Park, including downstream of Project Area.
3	Preliminary Geotechnical Engineering Report – Proposed North Maintenance Facility (Terracon, 2016)	Preliminary geotechnical investigation to provide recommendations for earthwork and foundations, groundwater control, walls, etc.	Provides some information of soils in vicinity of Project Area.
4	Environmental Limited Site Investigation, Proposed North Maintenance Facility (Terracon, 2016)	Limited investigation into the potential presence of contaminated groundwater/sediment within proposed North Maintenance Facility	It assesses potential for contaminants in Project Area. In conclusion, there is some potential for contaminated groundwater/sediment in project area.
5	City of Shoreline Maintenance Facility, Wetland and Stream Delineation Report – (two reports by Watershed, 2013 original and 2016 update)	Environmental Investigation of portion of Brugger's Park Bog adjacent to City's proposed North Maintenance Facility	Provides stream assessment, stream OHW marking, and wetland delineation/information for portion of Project Area upstream of 25th Ave NE in Brugger's Park Bog. Wetland delineation provided in AutoCad which can be incorporated into project base map.
5A	City of Shoreline North Maintenance Facility – Survey Base Map (Perteet, May 2016)	Survey base map (SNMF-Survey Base Map.dwg)	Provides based map for NMF including portions of 25th Ave NE.

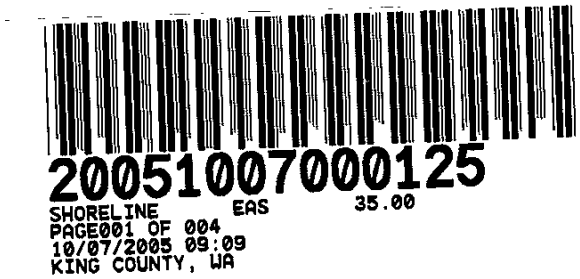
6	Standards for Utilities Installed in Proximity of Seattle Public Utilities Transmission Pipelines (SPU, 2006)	Provides design requirements for new utility crossings of Seattle's major water lines.	Provides requirements for replacement culvert of NE 195th Street where it crosses the City of Seattle 66" Tolt River Pipeline.
7	WSDOT Gabion Rock Wall Emergency Repair – Geotechnical Recommendations (WSDOT, April 2016)	Geotechnical investigations to support design of WSDOT's emergency repair.	Includes one boring to depth of about 55' and other soils information that could be helpful to design.
8	WSDOT Gabion Rock Wall Emergency Repair (WSDOT, April 2016)	Traffic control Drawings	Provides example traffic control drawings for assumed closure of NE 195th Street (that may be similar to required traffic control for culvert replacement).
9	WSDOT SR 104 (Ballinger Way at NE 195th St) Gabion Wall Memorandums (WSDOT, 1980)	Gabion Wall Report	Provides historical information about the design of the gabion wall at the culvert outlet on NE 195th Street and along the east bank of Ballinger Way road embankment
10	WSDOT SR 104 Jct. 25th NE Signals Foundation Report	Abbreviated soils report to support design of WSDOT signal pole	Provides limited soils information at north east corner of intersection. Boring only to depth of 6 feet.
10A	WSDOT SR 104/NE 195th Street Survey	CAD file of survey base map (DMA177_SR014_Xsections.dwg)	Provides base map survey in vicinity of gabion all on south side of NE 195th St.
11	HPA (2005, Andy Lock)	HPA for stream channel improvements upstream of NE 195th Street	Provides some background of stream channel improvements including placement of LWD in channel between NE 195th Street and 25th Ave NE
12	City of Mountlake Terrace – Storm GIS information (received 5-12-16)	GIS files of subbasins and drainage network	This information shows detailed pipe network in the portion of the Project Area basin that is with the City of Mountlake Terrace.
13	25th Ave NE Flood History Data (City of Shoreline 5/16)	Excel spreadsheet and accompanying .pdf map showing historical flooding and citizen complaint dates	Provide history of flooding complaint (note records per to 2001 are not readily available.
14	City Storm Drain CCTV Records and Information (City of Shoreline, 2015)	Video files and summary data sheets of storm drain CCTV work done as a part of the Lyon Creek Basin Plan.	Provides condition assessment of pipe segments within City of Shoreline's portion of the Project Area

15	City of Mountlake Terrace Six Year Stormwater Comprehensive Plan (Otak, 2008)	Basin plan cover in the Mountlake Terrace portion of the tributary area.	Provides basin delineations and projects proposed in the Mountlake Terrace portion of the tributary area.
16	One-Call Summary of Private Utilities	Following One-Call Utility Locate, the One-call Service provides a list of private utilities that may be in area and their telephone contact information	List of potential utilities in the project corridor which have the potential to be a conflict with new storm improvements.
17	City of Shoreline Stream and Wetland Inventory and Assessment (Tetra Tech/KCM, Inc., 2004)	Provides descriptions of area streams and wetlands	Provides some background information on streams and wetland within the project vicinity.

Appendix C
Survey Base Map and Easement Information

25TH AVE NE
NE 195TH ST
BALLINGER WAY NE
EDGE OF DENSE BRUSH
GARBAGE CAN
BRIDGE
GRAVEL DRIVEWAY
BOULDER PILE
BRUGGERS BOG PARK
CITY OF SHORELINE
TYPE 1 CB 3653
RIM=225.22
8"PVC E=222.84
TYPE 1 CB 3008
RIM=220.29
12"CMP N=218.34
18"CMP S=217.51
SANITARY MANHOLE 2144
RIM=219.48
8"CONC NE IN
12"CONC N IN/S OUT
FLOWLINE=208.91
NO PARKING SOUTH
ECO BLOCK WALL
6' TALL CHAIN LINK FENCE
TOP BACK OF WALL
GRAVEL
ASPHALT
ECO BLOCK WALLS
SEE GENERAL NOTE 7
SD MH
RIM 227.57
6" SW 216.32
8" W 216.27
6" NW 216.23
12" RCP SE 216.31
CONNECTIONS NOT FOUND
CB, TYPE 1
SOLID LID 224.04
12" RCP NW 217.79
12" RCP SE 217.92
(CONNECTIONS UNKNOWN)
CB, TYPE 1
GE 222.96
6" PVC E 220.39
CONNECTS TO ROOF DRAIN
METAL BLDG
CONC
FUEL PUMP ISLAND
CANOPY OVER FUEL ISLAND
SD MH
RIM 222.13
6" PVC W 218.98
8" CMP E 218.69
THIS LINE DRAINS TO SEWER LINE (PER CITY STAFF)
NOT ACCESSIBLE FOR INVERT MEASUREMENTS (TYPICAL)
YELLOW STRIPE
FUEL TANK (T) UNDER CONC LID ON CONC PAD
CONC TANK PAD
FUEL TANK
BOLLARDS (TYP.)
CB, TYPE 1
GE 220.16
6" PVC NW 217.14
12" RCP NW 213.98
12" RCP SE 213.21
CB, TYPE 1
GE 222.82
6" PVC N 217.87
6" PVC S 217.98
KING COUNTY BM 236, 3" BRASS DISK, AT GROUND LEVEL ELEVATION = 217.27'
CB, TYPE 1
GE 215.84
6" RCP E 214.89
SPLIT C 2x8"
CULVERT, 8" CMP
E NW END 215.74
IE SE END 215.44
(DRAINS TO GRAVEL STRIP)
STORM WATER MONITOR SYSTEM
NO PARKING NORTH
T.P.N. 042604-9043
19547 25th AVE NE
CITY OF SHORELINE
CONC WALL
CONC RAMP
SCALE
WOOD BLDG
CONC LANDING STAIRS
METAL SHACK
EXIT
ELECTRIC SCALE SIGN
METAL/WOOD BUILDING
BOLLARDS (TYP.)
CONC PLANTER
T.P.N. 042604-9048
19545 25th AVE NE
SLOAN STEVE
CB, TYPE 1
GE 215.79
12" RCP NW 210.92
12" RCP SE 210.73
24" CONCRETE PIPE
3' HIGH WALL
FENCE 41' P/L
FENCE 1.0 NORTH OF P/L
CONC
SUMMER MEDOW
#5 REBAR W/ CAP
WHP LS 39252
SS MH
RIM 224.93
8" RCP W 209.66
8" RCP SE 209.56
BUILDING LINE
TYPE 2 CB 2263
RIM=214.22
6"CPP W=212.87
8"CPP N=211.32
24"CMP S=211.10
5' TALL CHAIN LINK FENCE
CONC RET WALL
ECO BLOCK WALL
DECANT FACILITY
RISER
CONC RET WALL
SD MH
RIM 213.98
WATER LEVEL 210.8
6" NW 207.28
RISER TOP 208.80
6" SE 207.33
8" PVC SE 207.33
TYPE 2 CB 3088
RIM=213.06
30"CMP NE=210.37
30"CMP N=209.71
30"CMP S=209.51
TRUCK SYMBOL
ADOPT A ROAD
TYPE 1 CB 2296
RIM=213.16
24"CMP NW=210.39
"30 MPH" PAINTED ON ROAD, UNABLE TO SEE
CB, TYPE 1
SOLID LID 214.34
6" CMP N 210.88
12" CMP W 210.88
8" CMP S 210.84
CB, TYPE 1
GE 214.30
8" PVC NE 211.90
(FROM ROOF DRAIN)
12" CPP S 211.63
CB, TYPE 1
SOLID LID 214.31
12" RCP NW 210.01
12" RCP SE 209.91
CB, TYPE 1
GE 213.90
12" RCP NW 210.00
12" RCP E 209.73
TYPE 2 NORTH
FENCE 2.5' N OF P/L
SS MH
RIM 218.26
8" RCP NW 205.41
CB, TYPE 2
GE 212.37
8" PVC NE 210.72
(FROM ROOF DRAIN)
12" CPP S 208.87
12" RCP W 208.63
12" CMP E 208.63
CB, TYPE 1
SOLID LID 213.92
6" CMP W 209.29
12" CMP S 209.20
12" CMP SE 209.21
WATER VALVE 2027
RIM=213.61
TOP OF NUT=211.14
TYPE 1 CB 2328
RIM=213.58
12"SW SSE=210.50
12"CMP W=210.40
12"CMP ENE=210.34
TYPE 2 CB 2329
RIM=214.58
12"CMP SSW=210.04
18"CMP WSW=209.84
24"TALL X 36"WIDE CMP SE=208.66
24"TALL X 36"WIDE CMP N=208.64
CB APPROXIMATE LOCATION, NOT SHOT OR DIPPED
SANITARY MANHOLE 2338
RIM=213.78
8"N/E W/DROP
8"PVC W IN
12"CONC N IN/S OUT
FLOWLINE=202.88
TYPE 1 CB 3584
RIM=213.57
12"CONC SW=210.81
12"CONC NW=210.72
BIKE ROUTE
STREET NAMES
STORM MANHOLE 2367
RIM=212.90
30"CMP N=209.78
24"TALL X 36"WIDE CMP NW=209.70
24"TALL X 43"WIDE CMP S=209.03
DRIVEWAY
TYPE 2 CB 3237
RIM=216.51
18"CMP W=213.81
24"CMP N=213.44
30"CMP S=212.73
TYPE 2 CB 3185
RIM=215.08
27"N NW=213.96
24"CMP W=212.85
24"CMP S=212.63
STORM WATER MONITOR SYSTEM
CULVERT, 8" CMP
E NW END 215.74
IE SE END 215.44
(DRAINS TO GRAVEL STRIP)
NO PARKING NORTH
STORM WATER MONITOR SYSTEM
METAL/WOOD BUILDING
TYPE 2 CB 2250
RIM=215.32
30"CMP W=211.82
30"CMP S=211.67
TYPE 1 CB 3088
RIM=220.29
12"CMP N=218.34
18"CMP S=217.51
CULVERT 3600
24"CMP SC=213.22
CULVERT 3599
24"CMP S=214.18
SD CO, RIM 216.65
IE 210.98
WOOD POSTS
YELLOW STRIPE
CONC TANK PAD
FUEL TANK
FUEL TANK
BOLLARDS (TYP.)
ECO BLOCK WALL
GRAVEL
ASPHALT
CONC
CB, TYPE 1
GE 220.16
6" PVC NW 217.14
12" RCP NW 213.98
12" RCP SE 213.21
CONC WALL
CONC RAMP
SCALE
WOOD BLDG
CONC LANDING STAIRS
METAL SHACK
EXIT
ELECTRIC SCALE SIGN
CONC PLANTER
METAL/WOOD BUILDING
BOLLARDS (TYP.)
ASPHALT
TYPE 2 CB 2263
RIM=214.22
6"CPP W=212.87
8"CPP N=211.32
24"CMP S=211.10
5' TALL CHAIN LINK FENCE
CONC RET WALL
ECO BLOCK WALL
DECANT FACILITY
RISER
CONC RET WALL
SD MH
RIM 213.98
WATER LEVEL 210.8
6" NW 207.28
RISER TOP 208.80
6" SE 207.33
8" PVC SE 207.33
DRAIN VALVE
DRAIN TO SD
TYPE 2 CB 3088
RIM=213.06
30"CMP NE=210.37
30"CMP N=209.71
30"CMP S=209.51
TRUCK SYMBOL
ADOPT A ROAD
TYPE 1 CB 2296
RIM=213.16
24"CMP NW=210.39
"30 MPH" PAINTED ON ROAD, UNABLE TO SEE
CB, TYPE 1
SOLID LID 214.34
6" CMP N 210.88
12" CMP W 210.88
8" CMP S 210.84
CB, TYPE 1
GE 214.30
8" PVC NE 211.90
(FROM ROOF DRAIN)
12" CPP S 211.63
ASPHALT
BUILDING CANOPY
DRIVEWAY
DRIVEWAY
DRIVEWAY
STREET NAMES
STORM MANHOLE 2367
RIM=212.90
30"CMP N=209.78
24"TALL X 36"WIDE CMP NW=209.70
24"TALL X 43"WIDE CMP S=209.03
BIKE ROUTE
TYPE 1 CB 2451
RIM=214.42
12"CPP S=212.72
TYPE 1 CB 2448
RIM=213.07
12"CPP W=210.87
12"CMP N=210.62
STORM MANHOLE 2447
RIM=213.26
12"CMP E=210.39
30"TALL X 43"WIDE CMP N=208.86
S=208.59
SANITARY MANHOLE 2481
RIM=213.69
12"CONC N IN/SE OUT
FLOWLINE=201.84
NE 195TH PL
"WELCOME TO BALLINGER NEIGHBORHOOD"
WATER VALVE 3055
RIM=216.63
TOP NUT=215.00
WATER VALVE 3001
RIM=216.96
TOP NUT=214.98
WATER VALVE 2997
RIM=217.19
TOP NUT=214.81
CULVERT 3593
12"CONC IE=212.31
CULVERT 3200
30"TALL X 40" WIDE CMP
IE=207.49
FF=212.2
6'VBF
FF=211.8
FF=211.0
TYPE 2 CB 3084
RIM=217.11
12"CONC S=213.19
TOP OF OVERFLOW TO 8"PVC=214.85
12"CONC E=213.09
TYPE 1 CB 3085
RIM=222.33
12"CONC W=220.68
12"CONC N=220.63
BIKE ROUTE
APPROXIMATE AREA OF LS & STO
UNDERGROUND
FF=211.2
WATER VALVE 3006
RIM=223.53
TOP NUT=221.08
WATER VALVE 3007
RIM=223.53
TOP NUT=221.03
SANITARY MANHOLE 20000
RIM=209.58
12"CONC NW IN/SE OUT
FLOWLINE=200.68
CULVERT 2637
24"x36"CMP IE=204.09
SANITARY MANHOLE 2861
RIM=213.31
12"CONC NW IN/E OUT
FLOWLINE=200.02
"NO PARKING"
3"CLF
"STOP HERE ON RED"
WATER VALVE 3850
RIM=220.20
TOP NUT=218.18
WATER VALVE 2851
RIM=220.06
TOP NUT=217.76
WATER VALVE 2849
RIM=220.60
TOP NUT=218.04
CONCRETE SIDEWALK TO NORTH, ASPHALT SIDEWALK TO SOUTH
GABION WALL BEGINS
2132 IE OF SEPARATED PIPE=203.51
TOP OF COUPLING=204.84
TOP OF DETACHED CMP PIPE=204.70
SANITARY MANHOLE 3590
RIM=207.34
8"CN W/DROP NWM=202.14
8"SW IE=198.20
12"CONC W IN/E OUT
FLOWLINE=197.87
FF=207.8
GROUND=203.2
GROUND=202.9
FF=207.6
GROUND=203.7
FF=207.7
GABION WALL ENDS
SCR 1
SCR 2
SCR 3
SCR 4
SCL 1
SCL 2
SCL 3
SCL 4
STORM MANHOLE
RIM=198.50
8"CMP W/FLOW CONTROL
TOP OF OVERFLOW=203.90
E. RIM=199.60
30"CMP NE=198.96
8"CMP E=199.48
30"CMP E=198.96
ASPHALT
CONCRETE
SCOUR
DAMAGED 30"CMP 5060 REPAIRED INSIDE TO FLOWLINE OF PIPE DONE IN THE PAST, RAISING THE FLOWLINE 5.1' RESTRICTING THE PIPE SIZE SHOT TOP OF PIPE=199.24
FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'

After Recording Please Return To:
City Clerk
City of Shoreline
17544 Midvale Avenue North
Shoreline, WA 98133



EASEMENT FOR SURFACE WATER AND STORM DRAINAGE
Assessor Acct. No.: 402290111
Address: 2518 NE 195th St., Shoreline, WA 98155
Legal Description: THE WEST 1/2 OF LOTS 9 & 10, BLK 5, FIRST ADDITION TO LAKE FOREST PARK, ACCORDING TO THE PLAT RECORDED IN VOLUME 20 OF PLATS, PG. 82, IN KING COUNTY, WASHINGTON, EXCEPT THE N 140' OF SAID LOT 10
Grantor: Carolyn Uht
Grantee: City of Shoreline

EXCISE TAX NOT REQUIRED
King County Records Division
BY: Walter Chaffee, Deputy

20051007000125

Easement No. 5

SURFACE AND STORM WATER DRAINAGE EASEMENT

I. Grant of Easement. For a valuable consideration, receipt of which is hereby acknowledged, the GRANTOR(s), Carolyn Uht, the owner(s) in fee of that certain parcel of land, located at 2518 NE 195th Street, Shoreline, WA 98155, Assessor's Tax Parcel Number 402290111, legally described as follows:

> THE WEST 1/2 OF LOTS 9 & 10, BLK 5, FIRST ADDITION TO LAKE FOREST PARK, ACCORDING TO THE PLAT RECORDED IN VOLUME 20 OF PLATS, PG. 82, IN KING COUNTY. WASHINGTON, EXCEPT THE N. 140' OF SAID LOT 10.
>
> (hereafter "Property")

hereby grants and conveys to the City of Shoreline, a political subdivision of the State of Washington (CITY or GRANTEE), its successors and assigns, a perpetual surface and storm water drain easement over, through, under and across the easement area depicted in Exhibit A and described as follows:

> Irregular in shape, the easement area follows the said property's western edge from NE 195th Pl to NE 195th St thence east approximately 120', thence north by northwest for approximately 100' thence north approximately 70' thence west approximately 30' to 25th Ave NE.
> (hereafter "Easement Area")

II. Purpose. The purpose of the Easement is to allow the City to construct, install, operate, maintain and repair Ballinger Creek, surface conduits and surface water drain lines, and necessary appurtenances, for the purpose of conveyance and restoration of surface water and storm water.

III. General Conditions. This Easement is granted subject to the following general terms and conditions:

1. Any use of, or activity on, the Easement Area by GRANTEE or the public that is inconsistent with the purposes of this Easement is prohibited, and GRANTEE agrees that they will not conduct, engage in or permit any such activities. GRANTOR reserves for itself and its successors, and assigns, any use of, or activity on. the Easement Area which is consistent with the purposes of the Easement.

2. GRANTEE shall hold harmless, indemnify, and defend GRANTOR, its employees, agents successors and assigns, including owners of the residential access easement over a portion of the Easement Area (collectively "Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims demands or judgments, including reasonable

attorney's fees, arising from any negligent act or omission of GRANTEE, its employees, agents, invitees or licensees unless due to the sole negligence of the Indemnified Parties.

3. The GRANTOR shall not obstruct the Easement Area in any manner that will prevent or interfere with use of this Easement for the purposes identified herein, or allow any third party to obstruct the premises in a manner that will prevent or interfere with use of the Easement for the purposes identified herein.

4. In carrying out any work under this Easement, the GRANTEE shall do no unnecessary injury to any trees, shrubs, lawns, buildings, fences, or appurtenances within the Property and shall restore the surface of the ground to the same condition in which it was before the start of the improvements, or as near as such restoration can be made.

5. The maintenance costs of the Easement described herein shall be the responsibility of the GRANTEE and their respective successors and assigns.

6. This Easement, and all of the terms, conditions, rights and obligations herein contained shall run with the land and shall be binding upon the GRANTOR, its successors, lessees and assigns.

Carolyn Uht
GRANTOR(s)

STATE OF WASHINGTON)
)
COUNTY OF KING) ss.

On this date, I certify that I know or have satisfactory evidence that _____
Carolyn Uht _____
is/are the ~~person~~(s) who appeared before me, and said person(s) acknowledged that he/she/they signed this instrument and acknowledged it to be his/her/their free and voluntary act for the uses and purposes mentioned in the instrument.

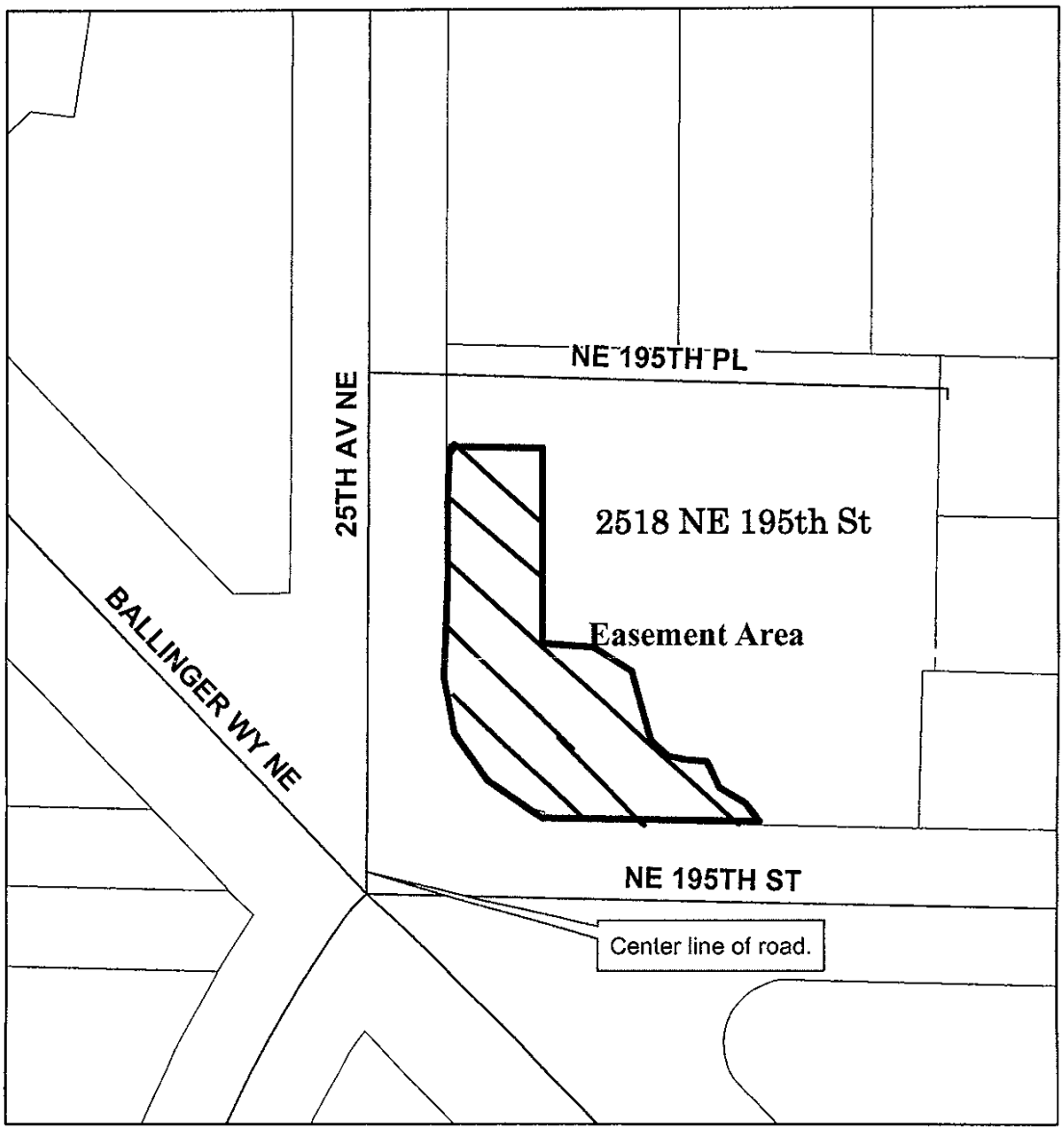
Given under my hand and official seal this 19th day of August, 2005.

Notary Public
State of Washington
ROSELYN A. MIRANDA
My Appointment Expires Dec 3, 2005

Roselyn A Miranda
NOTARY PUBLIC in and for the State of Washington, residing at Snohomish County.
My commission expires: 12/03/2005

Approved as to form:
Jeannie P. Colby
Shoreline City Attorney

Return Address:
City of Shoreline
17544 Midvale Ave N
Shoreline, WA 98133



Feet
0 15 30 60 90 120

Easement for Surface Water Maintenance
Parcel No. 4022901112
2518 NE 195th St
Shoreline, WA 98155

Exhibit A

September, 2004

Boundary is approximate.

City of Shoreline
No warranties of any sort,
including accuracy, fitness, or merchantability,
accompany this product.

Appendix D
Preliminary Alternative Evaluation (Seven Alternatives)

City of Shoreline

NE 25th Flood Prevention Project

Preliminary Alternatives - Draft 10/18/16

Alternative	Abbreviated Name	Brief Description	Property Acquisition or Easement Need	Fish/Habitat Benefit[2]	Mitigation	Utility Conflicts	Street Parking Impact	Maintenance Need/Risk	Order of Magnitude Cost (Million)
1	Maximum Feasibility	Max daylight within 25th Ave NE ROW - long culvert	No[1,3]	Provides fish passage, but long culvert that exceeds L<= 10*W, and daylighted channel straight, narrow, and highly confined Possible issue with new buffer from daylighted creek extending onto neighboring properties	Storage to mitigate peak flows may be required	Moderate utility conflicts (likely lower than Alternatives 2 , but more than all other alternatives.	Loss of existing parking in front of NMF site	Moderate maintenance needs. Wide culverts will tend to pass most debris and sediment. Long culvert could be difficult to clear if it does become plugged.	$8.2
2	Maximum Feasibility - more daylighting	Max daylight within 25th Ave NE ROW - more daylight variation	No[1,3]	Provides better fish passage than Alternative A by splitting up long culvert into two shorter culverts. Daylighted channel is still straight, narrow, and highly confined Possible issue with new buffer from daylighted creek extending onto neighboring properties	Storage to mitigate peak flows may be required	High utility conflicts likely within area on east side of 25th Ave NE between NE 195th Lane and NE 195th Place.	Loss of existing parking between NE 195th Lane and NE 195th Place and in front of NMF site	Minimal maintenance needs. The wide culverts will tend to pass most debris and sediment.	$8.2+
3	Daylight in NMF	Daylight creek within NMF (assuming its development does not move forward and land is avialable. Transition to either Alternative 1 or 2 at approximately NE 195th Pl NE	No[1,3]	Provides maximum fish passage and habitat benefit by creating new larger buffer (at least through NMF). Could include off-channel habitat within NMF.	Flood storage could be added to stream through NMF, so likely no mitigation required.	Likley fewer than Alt. 1 or 2, but more than other alternatives	Loss of existing parking between NE 195th Lane and NE 195th Place	Higher risk of encountering contaminated sediment within NMF (and potentially groundwater) that could include more cleanup.	$7.8
4	Closed Conveyance	25th Ave NE system to be replaced with pipe system (sized for conveyance) and fish passable culvert at NE 195th St.	No[1]	Provides adult fish passage at NE 195th St only and does not meet WDFW fish passage criteria, so likely requires offsite mitigation.	Likely requires off-site habitat and/or passage mitigation. Storage to mitigate peak flows may be required	Moderate utility conflicts (likely lower than Alternatives 1-3 and more than 5-7	No change to existing parking.	Maintenance would be similar to any other closed-pipe drainage system.	$6.7
5	High-Flow Bypass	High Flow Bypass that replaces and extends the existing high flow bypass to south of NE 195th St.	No[1]	The design for the high-flow bypass does not meet fish passage criteria.[5]	Likely requires off-site habitat and/or passage mitigation. Storage to mitigate peak flows may be required	Lower utility conflicts than 1-4, but more than 6 and 7.	No change to existing parking.	Maintenance would be similar to any other closed-pipe drainage system. If a fish screen is required, it could become a significant maintenance issue.[4]	$6.8
6	Buy-Out Option	Buyout flooded properties in area between 25th Ave. NE and NE 195th St. Flooding of 25th Ave would continue	Yes[1]	Stream between 25th Ave NE and NE 195th Street could be improved, with floodplain storage, but existing fish passage problems would continue to exist.	Some flood storage and/or wetland creation could be included. Likely no other mitigation	Lowest utility conflicts	No change to existing parking, and parking demand would decrease	Flooding of 25th Avenue NE would continue at current level. Flooding of the non-buyout properties would only be for significant events.	$5.1
7	Flood Proofing	Miscellanious improvements to provide incremental increase in flood prevention (e.g. 2-year to 5-year)	No	No real impact to fish passage/habitat. Existing fish passage problems would continue to exist.	Likely no mitigation required as not getting permits.	Lower utility conflicts that all Alternative, except Alt. 6	No change to existing parking.	Level of flood protection would be increase from approximately 2-yr to 5-yr, so issues with flooding would continue.	$0.6

Notes

(1) There may be potential need for easement south of NE 195th Street to shift creek to east and reduce the potential to impact existing WSDOT gabion wall.

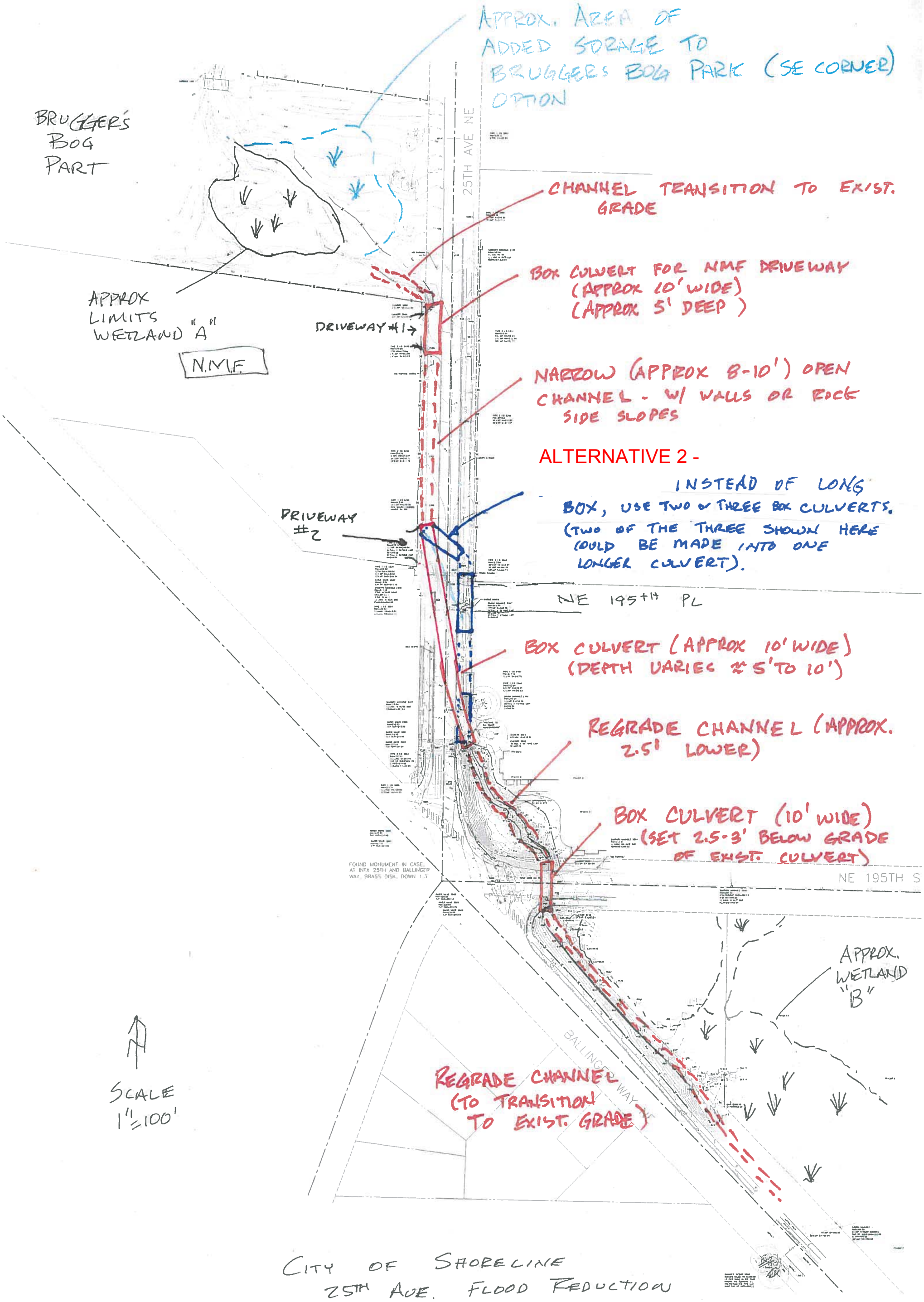
(2) Existing upstream fish habitat (particularly spawning habitat) is limited/fair quality, and the potential to create habitat (primarily for spawning) is limited to within the extents of Brugger's Bog Park. There is no documented fish presence (howver, this could be result that fish are flushed out of they system due to lack of off channel habitat and because of lack of upstream fish passage, are not able to recolonize). This information may support non-fish passage alternative if equitable off-site mitigation can be negotiated.

(3) Per current code (SMC 20.80.056), daylighting creek creates new "added" buffer requirement on adjacent property. Potential variance from this requirement currently being discussed with City Planning.

(4) The openings in fish screens tend to be very small which can clog easily. The probability of it being clogged during a significant event can be reduced by sizing it so that the total open area is several times the required open area or using a self-cleaning drum screen.

(5) Would have to show that fish would not be attracted to using the high-flow bypass by setting the bypass above fish-passage flow and/or the use of a fish screen. Also may be able to show that there is little to no fish habitat upstream. Because it does not provide fish passage, offsite mitigation likely required.

(6) There may be a question as to whether cars would be able to part in R/W if in buffer next to school property?


APPROX. AREA OF ADDED STORAGE TO BRUGGERS BOG PARK (SE CORNER) OPTION
BRUGGER'S BOG PART
25TH AVE NE
CHANNEL TRANSITION TO EXIST. GRADE
BOX CULVERT FOR NMF DRIVEWAY (APPROX 10' WIDE) (APPROX 5' DEEP)
APPROX LIMITS WETLAND "A"
DRIVEWAY #1
N.M.F.
NARROW (APPROX 8-10') OPEN CHANNEL - W/ WALLS OR ROCK SIDE SLOPES
ALTERNATIVE 2 -
INSTEAD OF LONG BOX, USE TWO OR THREE BOX CULVERTS. (TWO OF THE THREE SHOWN HERE COULD BE MADE INTO ONE LONGER CULVERT).
DRIVEWAY #2
NE 195th Pl
BOX CULVERT (APPROX 10' WIDE) (DEPTH VARIES ≈ 5' TO 10')
REGRADE CHANNEL (APPROX. 2.5' LOWER)
BOX CULVERT (10' WIDE) (SET 2.5-3' BELOW GRADE OF EXIST. CULVERT)
FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'
NE 195TH S
APPROX. WETLAND "B"
BALLINGER WAY
REGRADE CHANNEL (TO TRANSITION TO EXIST. GRADE)
SCALE 1"=100'
CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES
ALTERNATIVE 1 & 2 - MAX FEASIBILITY

ALTERNATIVE 1

"Maximum Feasibility" seeks to daylight the maximum feasible length of Ballinger Creek within currently available space – the 25th Avenue NE right-of-way. The west side of 25th Ave NE (in front of the future NMF) is preferred due to multiple major utility conflicts on the east side; potential length of daylighted channel here is about 220', assuming the future NMF has driveways at both north and south corners of property. Coordination with the NMF and 25th Ave NE Sidewalk City CIP projects will be important to determine exactly where within the ROW that the daylighted channel can be located. A new culvert approximately 250' long would connect the new daylighted channel to the existing open channel at 2518 NE 195th St; the existing open channel at this location will need to be deepened.

ALTERNATIVE 2-

...In lieu of the 250' culvert described in Alt 1 above, a variation of this option could cross 25 Ave NE with a 70' culvert, enter a second daylighted channel (100' long) segment on the east side of 25th Ave NE within the ROW in front of 2500 NE 195th Pl, then enter an 80' driveway crossing culvert before connecting to the existing open channel at 2518 NE 195th St. Daylighting the channel at this location would need to consider issues with utility conflicts, parking/sidewalk needs, and buffer impacts at this location.

Alternative 1

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 10x5)	LF	372	$ 2,000	$ 744,000	
2	Headwall	EA	5	$ 50,000	$ 250,000	
3	Conc. Wall for Stream Side Slope	LF	360	$ 300	$ 108,000	
4	Stream Excavation	CY	1110	$ 40	$ 44,400	360 + 250 + 500
5	Stream Planting and Restoration	SY	2764	$ 100	$ 276,444	(8*260+570*30)
6	Road restoration	SY	1333	$ 200	$ 266,667	assume 300' x 40'
7	Utility Relocations	LS	1	$ 50,000	$ 50,000	
	Subtotal				$ 1,739,511	
	Items Estimated by % of Subtotal					
8	Mobilization	10%			$ 173,951	
9	TESC including temp diversions	15%			$ 260,927	
10	Traffic Control	10%			$ 173,951	
11	Dewatering	15%			$ 260,927	
12	Construction Survey and As-builting	5%			$ 86,976	
13	Removal of Structures and Obstructions	10%			$ 173,951	
14	Miscellaneous Small Bid Items	20%			$ 539,248	
	Subtotal Construction				$ 3,409,442	
	Construction Contingency	40%			$ 1,363,777	
	Planning Level Construction Cost (rounded nearest $10k)				$ 4,770,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 715,500	
	Permitting and Design + City Staff time	20%			$ 954,000	
	Design contingency	15%			$ 715,500	
	Property Acquisition	EST.				
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Offsite Mitigation	LS			$ 100,000	Assuming buffer restoration within BB Park
	Additional Items Subtotal				$ 2,505,000	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 8,180,000	

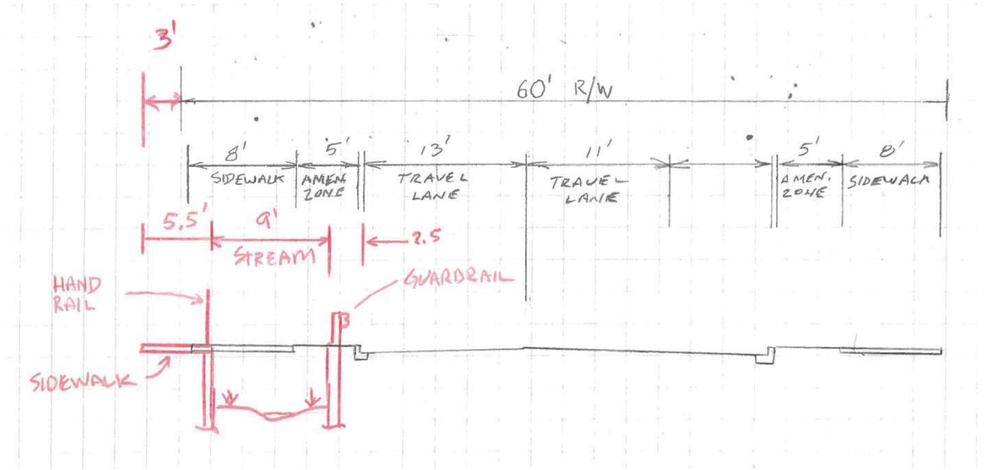


Figure 1-channel between sidewalk and street version

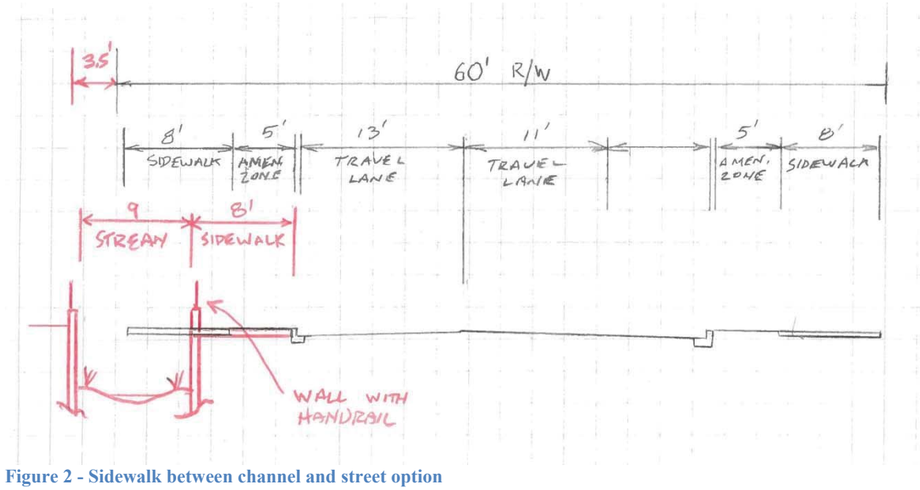


Figure 2 - Sidewalk between channel and street option

BRUGGER'S BOG PART

25TH AVE NE

TRANSITION TO DAYLIGHTED CHANNEL THROUGH NMF SITE

APPROX LIMITS WETLAND "A"

N.M.F.

NEW FLOODPLAIN STORAGE/ WETLAND

ASSUME ONE CULVERT TO NMF SITE (TO PROVIDE ACCESS)

TRANSITION TO EITHER ALT. 1 OR ALT. 2

NE 195th PL

FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'

NE 195TH ST

APPROX. WETLAND "B"

BALLINGER WAY NE

SCALE 1"=100'

CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES

ALTERNATIVE 3 - DAYLIGHT THROUGH NMF

ALTERNATIVE 3

"Daylight Through NMF". This alternative would daylight the creek through the NMF property and transitioning to either Alternative 1 or Alternative 2 south of NMF. This alternative would only be feasible if the NMF site development does not move forward as currently envisioned and that the City develops a future maintenance facility at an alternative location. If this were to be the case, the City owned site could be used for storm drainage and park uses, and possibly mitigation for other City projects. It was assumed that this alternative would include floodplain storage and also fish habitat enhancements.

Figure 1 – larger scale version of Alternative B concept

Figure 2 – more confined version of Alternative B concept

Alternative 3

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 10x5)	LF	250	$ 2,000	$ 500,000	
2	Headwall	EA	5	$ 50,000	$ 250,000	
3	Conc. Wall for Stream Side Slope	LF	220	$ 300	$ 66,000	
4	Stream Excavation	CY	980	$ 40	$ 39,200	250 + 500 + 230
5	Stream Planting and Restoration	SY	2633	$ 100	$ 263,333	(100*9)+(570*30)
5	Road restoration	SY	756	$ 200	$ 151,111	assume 170' x 40'
6	Floodplain Storage Excavation (NMF)	CY	6019	$ 30	$ 180,556	assume 130' x 250' x 5'
7	Planting Floodplain Storage (NMF)	SY	3611	$ 100	$ 361,111	assume 130' x 250' x 5'
8	Utility Relocations	LS	1	$ 70,000	$ 70,000	
	Subtotal				$ 1,881,311	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 188,131	
10	TESC including temp diversions	15%			$ 282,197	
11	Traffic Control	10%			$ 188,131	
12	Dewatering	15%			$ 282,197	
13	Construction Survey and As-builting	5%			$ 94,066	
14	Removal of Structures and Obstructions	10%			$ 188,131	
15	Miscellaneous Small Bid Items	20%			$ 583,206	
	Subtotal Construction				$ 3,687,370	
	Construction Contingency	40%			$ 1,474,948	
	Planning Level Construction Cost (rounded nearest $10k)				$ 5,160,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 774,000	
	Permitting and Design + City Staff time	20%			$ 1,032,000	
	Design contingency	15%			$ 774,000	
	Property Acquisition	AC	0	$ -	$ -	
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Offsite Mitigation	LS			$ -	Assume self mitigating
	Additional Items Subtotal				$ 2,600,000	
	Conceptual Level Cost Estimate				$ 7,760,000	

APPROX AREA ADDED STORAGE

BRUGGER'S BOG PART

APPROX LIMITS WETLAND "A"

N.M.F.

25TH AVE NE

REPLACE EXIST. HIGH FLOW BYPASS W/ NEW LARGE DIA. CONVEYANCE PIPE (± 72-INCH)(TO BE CONFIRMED)

NE 195th PL

REGRADE PORTION OF CHANNEL FOR TRANSITION

BOX CULVERT

(SAME AS 1)

FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'

NE 195TH ST

APPROX. WETLAND "B"

REGRADE CHANNEL (TO TRANSITION TO EXIST. GRADE)

BALLINGER WAY NE

SCALE 1"=100'

CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES

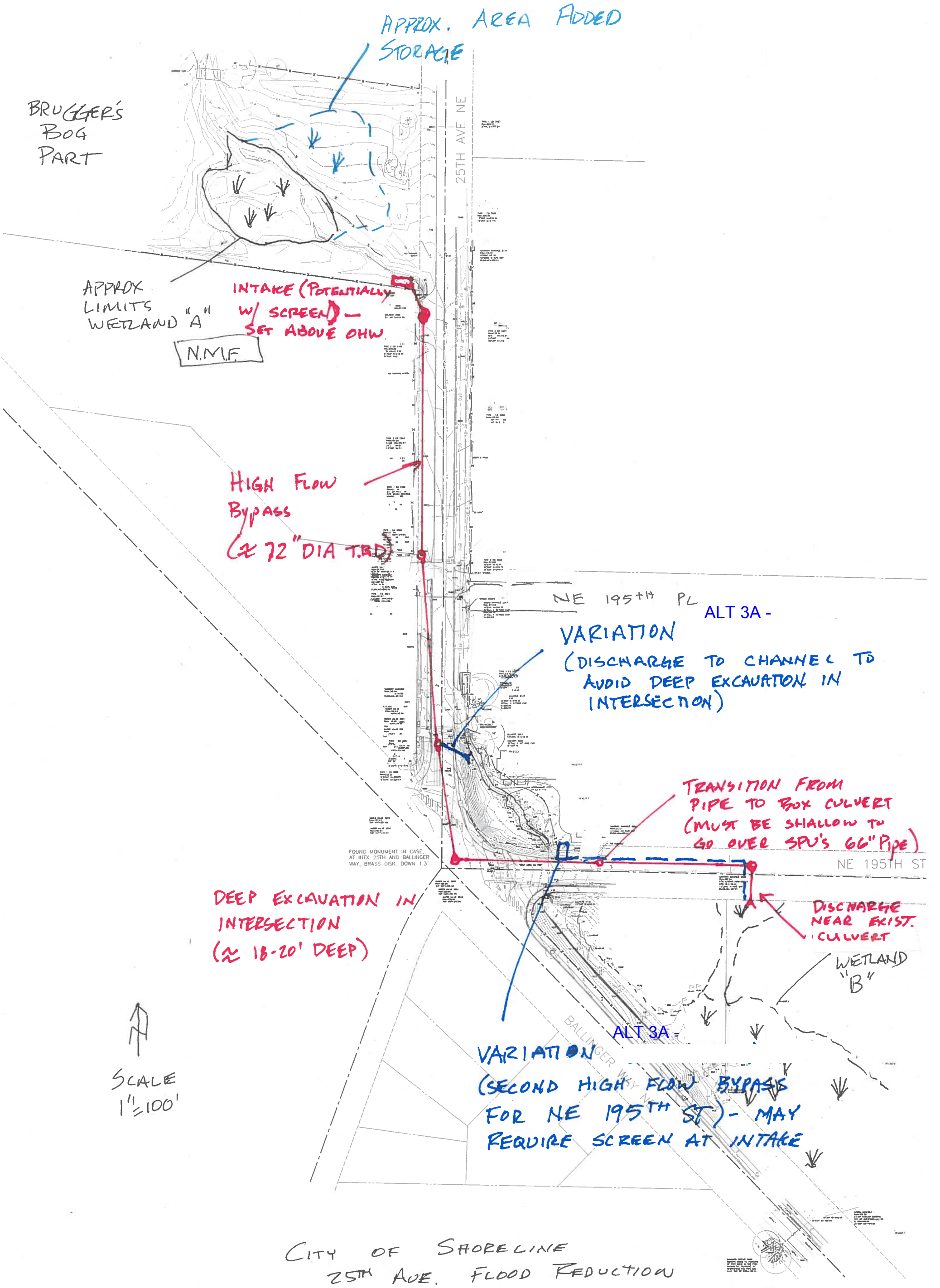
ALTERNATIVE 4 - CLOSED CONVEYANCE

ALTERNATIVE 4 - "Closed Conveyance" seeks to avoid potential space conflicts with other priority right of way uses (such as parking, sidewalk, driveway, and roadway) by replacing the existing piped stream system with conveyance sufficiently upsized to convey flood flows. Compliance with likely permitting/regulatory fish passage requirements could be challenging under this option. It is likely that off-site mitigation would be required. This Option most closely matches the project concepts presented in the Lyon Creek Basin Plan

Alternative 4

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 10x5)	LF	61	$ 2,000	$ 122,000	
2	Headwall	EA	1	$ 50,000	$ 50,000	
3	Conc. Wall for Stream Side Slope	LF	0	$ 300	$ -	
4	Stream Excavation	CY	750	$ 40	$ 30,000	250 + 500
5	Stream Planting and Restoration	SY	2533	$ 100	$ 253,333	(570*30)
5	Road restoration	SY	1400	$ 200	$ 280,000	assume 40x40 plus 450x20 plus 50x40
6	72-inch Pipe (approx)	LF	520	$ 650	$ 338,000	
7	96-inch manhole	EA	3	$ 15,000	$ 45,000	
8	Utility Relocations	LS	1	$ 50,000	$ 50,000	
	Subtotal				$ 1,168,333	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 116,833	
10	TESC including temp diversions	15%			$ 175,250	
11	Traffic Control	10%			$ 116,833	
12	Dewatering	15%			$ 175,250	
13	Construction Survey and As-builting	5%			$ 58,417	
14	Removal of Structures and Obstructions	10%			$ 116,833	
15	Miscellaneous Small Bid Items	20%			$ 362,183	
	Subtotal Construction				$ 2,289,933	
	Construction Contingency	40%			$ 915,973	
	Planning Level Construction Cost (rounded nearest $10k)				$ 3,210,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 481,500	
	Permitting and Design + City Staff time	20%			$ 642,000	
	Design contingency	15%			$ 481,500	
	Property Acquisition	AC	0.75	$ -	$ -	nearby multi family land assessment $1mill for .8 ac (or :
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Offsite Mitigation	LS			$ 1,000,000	Can be highly variable.
	Additional Items Subtotal				$ 2,625,000	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 6,740,000	

Figure 1 - Concept of what NE 195th St culvert could look like



ALTERNATIVE 5 - HIGH FLOW BYPASS

ALTERNATIVE 5 - “High Flow Bypass” seeks to resolve flooding issue by installing a bypass system for peak flows while avoiding costs and complications associated with replacing the perennial stream conveyance. It is likely that off-site mitigation would be required.

Alternative 3

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 4x4) Storm Drain in Low Cover	LF	200	$ 600	$ 120,000	
2	High Flow inlet Structure	EA	1	$ 100,000	$ 100,000	Assume 30'x 6' wide x 8' deep vault (not including screer
3	Conc. Wall for Stream Side Slope	LF	0	$ 300	$ -	
4	Stream Excavation	CY	100	$ 40	$ 4,000	
5	Stream Planting and Restoration	SY	100	$ 100	$ 10,000	
5	Road restoration	SY	2222	$ 200	$ 444,444	assume 1000x20
6	54-inch Pipe (approx)	LF	800	$ 400	$ 320,000	
7	84-inch manhole	EA	6	$ 10,000	$ 60,000	
8	Utility Relocations	LS	1	$ 120,000	$ 120,000	
	Subtotal				$ 1,178,444	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 117,844	
10	TESC including temp diversions	15%			$ 176,767	
11	Traffic Control	10%			$ 117,844	
12	Dewatering	15%			$ 176,767	
13	Construction Survey and As-builting	5%			$ 58,922	
14	Removal of Structures and Obstructions	10%			$ 117,844	
15	Miscellaneous Small Bid Items	20%			$ 365,318	
	Subtotal Construction				$ 2,309,751	
	Construction Contingency	40%			$ 923,900	
	Planning Level Construction Cost (rounded nearest $10k)				$ 3,230,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 484,500	
	Permitting and Design + City Staff time	20%			$ 646,000	
	Design contingency	15%			$ 484,500	
	Property Acquisition	AC	0.75	$ -	$ -	
	Property Easement Acquisition	SF	333	$ 5	$ 1,667	assume 150 x 20
	Offsite Mitigation	LS			$ 1,000,000	Can be highly variable.
	Additional Items Subtotal				$ 2,616,667	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 6,751,667	

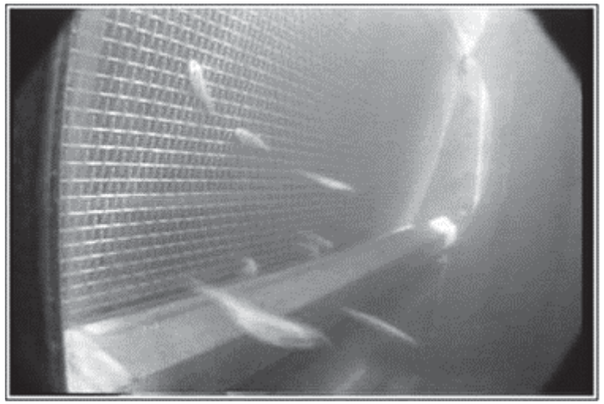
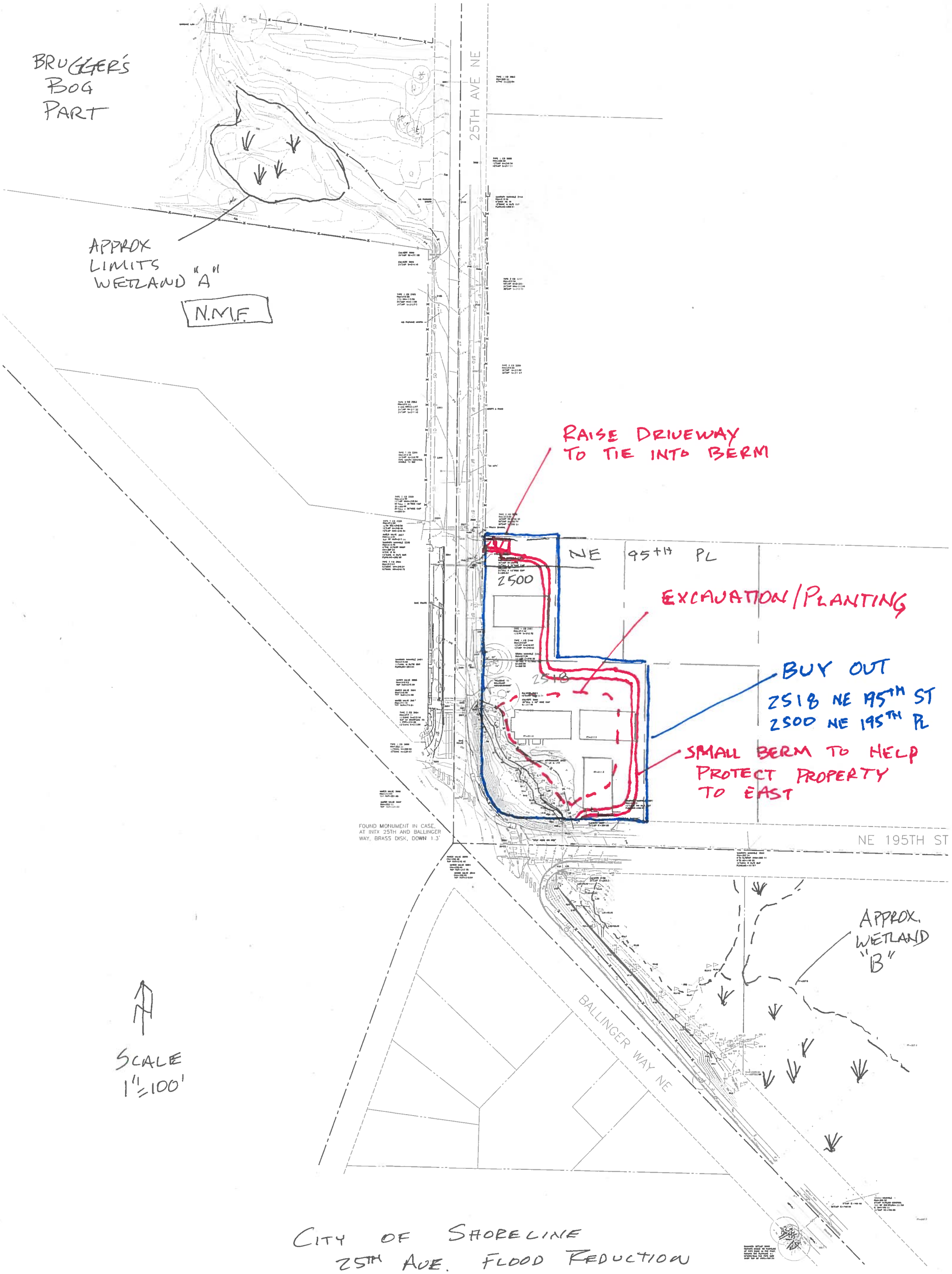


Figure 1 - Fish screens could be required at bypass inlets



CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES

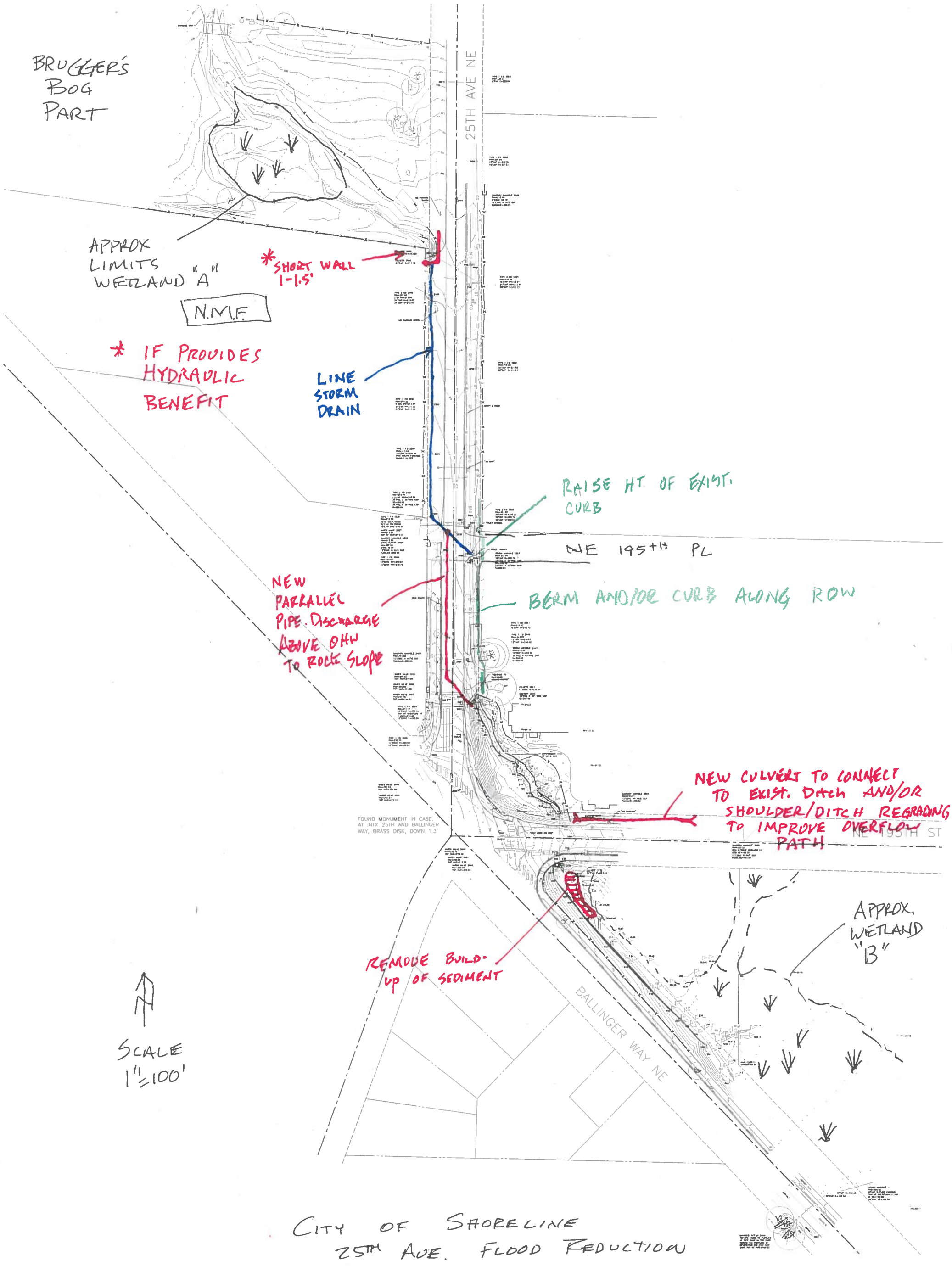
ALT 6 – BUY OUT OPTION

ALTERNATIVE 6 - The "Buy Out" alternative considers an approach of the City acquiring private properties that are subject to frequent flooding as a way of eliminating a portion of the problem without having to improve the drainage systems along 25th Avenue NE and the NE 195th culvert crossing. Properties selected are shown on the attached figure. The project could include restoring the purchased properties with a stormwater amenity such as providing flood storage. It is noted that under this alternative flooding conditions would continue for other properties and along 25th Avenue NE. This is because the existing system would not be replaced. This alternative does however include some berming that could provide some additional flood protection for the properties east of the properties considered for the buy-out.

Figure 1 - Possible concept similar to Buy Out option improvements

Alternative 6

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Structure Removal	EA	4	$ 5,000	$ 20,000	lower cost assuming some salvage value
2	Site Planting and Restoration	SY	1322	$ 50	$ 66,111	
3	Stream Excavation	CY	2017	$ 40	$ 80,667	0.25 acres by ave 5' deep
4	Private Drive Restoration	SY	178	$ 200	$ 35,556	assume 80' x 20' (raising grade to protect property to eas
5	Utility Abandonement	LS	1	$ 5,000	$ 5,000	
	Subtotal				$ 207,333	
	Items Estimated by % of Subtotal					
6	Mobilization	10%			$ 20,733	
7	TESC including temp diversions	0%			$ -	
8	Traffic Control	5%			$ 10,367	
9	Dewatering	10%			$ 20,733	
10	Construction Survey and As-builting	5%			$ 10,367	
11	Removal of Structures and Obstructions	0%			$ -	included above
12	Miscellaneous Small Bid Items	20%			$ 53,907	
	Subtotal Construction				$ 323,440	
	Construction Contingency	40%			$ 129,376	
	Planning Level Construction Cost (rounded nearest $10k)				$ 450,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 67,500	
	Permitting and Design + City Staff time	20%			$ 90,000	
	Design contingency	15%			$ 67,500	
	Property Acquisition	LS	1	$ 2,660,000	$ 2,660,000	Parcel at 2518 NE 195th St (2015 assessed + 20%)
	Property Acquisition	LS	2	$ 830,000	$ 1,660,000	Parcel at 2500 NE 195th Pl (2015 assessed + 20%)
	Relocation Expenses	LS	1	$ 120,000	$ 120,000	Estimate at $10k/unit (or $120,000) per City input
	Offsite Mitigation	LS			$ -	Assume self mitigating
	Additional Items Subtotal				$ 4,665,000	
	Conceptual Level Cost Estimate				$ 5,115,000	



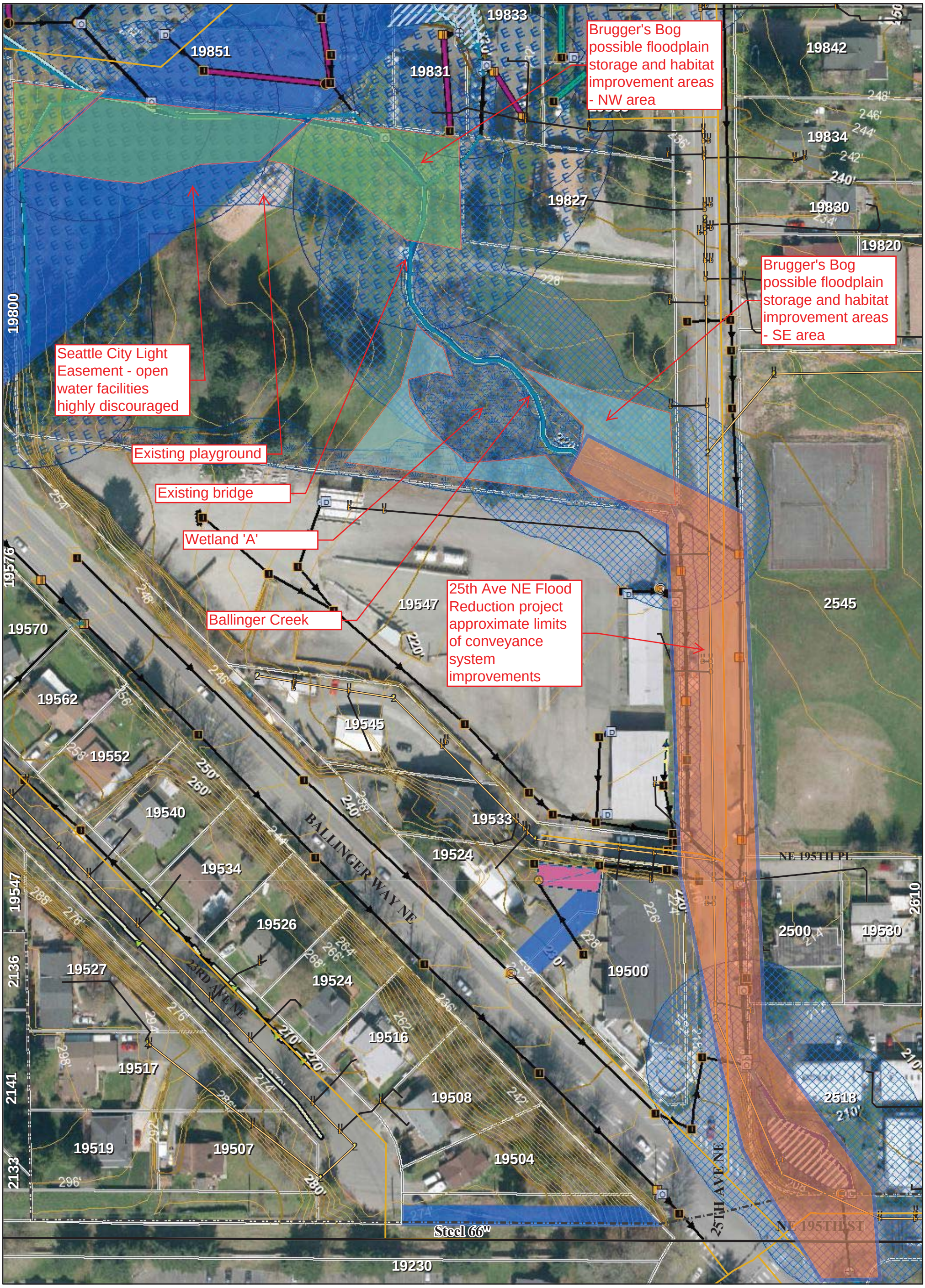
CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES

ALT 7- FLOOD PROOFING

ALTERNATIVE 7 - The "Flood Proofing" alternative seeks to reduce the frequency and magnitude of flooding incrementally by implementing cost effective system improvements without full system replacement. It includes more limited types of improvements that that seek to either increase the capacity of the system or provide berms help protect frequently flooded areas. Note that based on modeling, the current system has a level of protection of against a 2-year storm (i.e. there is a one in two chance in any given year). Under this Alternative, the level of protection against flooding may be increase to a 5-year storm (i.e., (i.e. there is a one in five chance in any given year). The elements are shown on the attached sketch. It is also noted that under this alternative, no improvements are directly made within the ordinary high water of waters of the state, which would trigger permits and require system improvements to be designed to provide fish passage. Under this alternative roadway and property flooding would continue for storms approximately larger than the 5-year event.

Alternative 7

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Slip Line existing 24-inch High Flow Bypass	LF	360	$ 150	$ 54,000	lower cost assuming some salvage value
2	Berm short wall at pipe entrance on 25th Ave NE	LS	1	$ 40,000	$ 40,000	
3	Stream Excavation (remove some of the high point	CY	83	$ 40	$ 3,319	80' x 2' x 10' + 40% contingency
4	Private Drive Restoration	SY	22	$ 200	$ 4,444	assume similar to speed humps
5	Curb/Berm along edge of ROW	LF	200	$ 100	$ 20,000	
6	Rockery Restoration	LS	1	$ 4,000	$ 4,000	
	Subtotal				$ 125,763	
	Items Estimated by % of Subtotal					
7	Mobilization	15%			$ 18,864	
8	TESC	10%			$ 12,576	
9	Traffic Control	10%			$ 12,576	
10	Dewatering	10%			$ 12,576	
11	Construction Survey and As-builting	5%			$ 6,288	
12	Removal of Structures and Obstructions	10%			$ 12,576	included above
13	Miscellaneous Small Bid Items	20%			$ 37,729	
	Subtotal Construction				$ 238,950	
	Construction Contingency	40%			$ 95,580	
	Planning Level Construction Cost (rounded nearest $10k)				$ 330,000	
	Additional Items					
	Construction Engineering & Administration	25%			$ 49,500	
	Permitting and Design + City Staff time	30%			$ 99,000	
	Design contingency	25%			$ 82,500	
	Property Acquisition	LS	0		$ -	
	Property Acquisition	LS	0		$ -	
	Relocation Expenses	LS	0		$ -	
	Offsite Mitigation	LS			$ -	
	Additional Items Subtotal				$ 231,000	
	Conceptual Level Cost Estimate				$ 561,000	



0 50 100 200 Feet

25th Ave NE Flood Reduction Project
Site Plan Existing Conditions

Buffers shown are existing stream buffers only; wetland buffers not shown for clarity

CITY OF SHORELINE

N W E S

Floodplain Storage Site(s) within Brugger's Bog Park would be a possible complement to all options in order to provide attenuation of peak flows and minimize size of other system improvements and downstream impacts. Two primary areas are being considered for potential floodplain storage sites: within the southeast corner of the park northeast of existing Wetland "A"; and within the northwestern quadrant of the park alongside existing channel in an area presently overgrown with invasive blackberry. In addition to providing storage volume, floodplain storage sites would (1) avoid adverse impacts to existing critical areas and significant trees, (2) restore native vegetation, and (3) function as a park improvement/amenity. For Alternative 1 only, these areas may also contain anadromous fish habitat and gravel supply.

Buggers Bog Park Floodplain storage

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
4	Stream Excavation	CY	2444	$ 40	$ 97,778	220 by 60 by ave 5' deep
5	Stream Planting and Restoration	SY	1467	$ 100	$ 146,667	220 by 60
	Subtotal				$ 244,444	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 24,444	
10	TESC including temp diversions	15%			$ 36,667	
12	Dewatering	10%			$ 24,444	
13	Construction Survey and As-builting	5%			$ 12,222	
14	Removal of Structures and Obstructions	5%			$ 12,222	
15	Miscellaneous Small Bid Items	20%			$ 68,444	
	Subtotal Construction				$ 422,889	
	Construction Contingency	40%			$ 169,156	
	Planning Level Construction Cost (rounded nearest $10k)				$ 590,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 88,500	
	Permitting and Design + City Staff time	20%			$ 118,000	
	Design contingency	15%			$ 88,500	
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Additional Items Subtotal				$ 315,000	
	Conceptual Level Cost Estimate				$ 905,000	

Figure 1 - Possible concept similar to Brugger's Bog improvements

Appendix E
Cost Estimates

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 1

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
SCHEDULE A: NE 195TH STREET						
1	MOBILIZATION (10%)	1	LS	$107,000	$107,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$40,000	$40,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	164	SY	$18	$2,952	
7	REMOVE CURB AND GUTTER	45	LF	$12	$540	
8	REMOVE SIDEWALK	35	SY	$20	$700	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	988	CY	$4	$3,953	
11	GRAVEL BORROW INCL HAUL	988	CY	$30	$29,650	
12	CHANNEL EXCAVATION	464	CY	$25	$11,595	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	1133	CY	$30	$33,990	
14	SHORING OR EXTRA EXCAVATION CLASS B	854	SF	$10	$8,540	
15	9’ W x 3.6’ H x61'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$132,000	$132,000	
16	WING WALLS	1050	SF	$50	$52,500	
17	CRUSHED SURFACING TOP COURSE	120	TN	$35	$4,199	2" FOR PAVEMENT RESTORATION
18	HMA CL. 1/2 IN. PG	24	TN	$200	$4,726	2"
19	ASPHALT TREATED BASE	18	TN	$190	$3,455	4"
20	PLANING BITUMINOUS PAVEMENT	71	SY	$15	$1,067	
21	CEMENT CONC. TRAFFIC CURB AND GUTTER	45	LF	$25	$1,125	
22	CEMENT CONC. SIDEWALK	35	SY	$100	$3,500	
23	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	0	SY	$110	$0	
24	STREAMBED SEDIMENT	458	TN	$40	$18,315	
25	WATER SERVICE RELOCATION	0	EA	$2,000	$0	
26	SEWER CASING	100	LF	$300	$30,000	PADDEN BID PRICE
27	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	1,236	EA	$10.00	$12,360	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
28	TREES	28	EA	$1,000.00	$28,000	
29	SOD INSTALLATION	0	SY			
30	TOPSOIL	635	CY	$50.00	$31,728	
31	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$50,000	$50,000	
32	LARGE WOODY DEBRIS	13	EA	$1,200	$15,655	FOX AND BOLTON 11 KEY PIECES PER 100M
33	EARTH ANCHORS	26	EA	$800	$20,873	
34	HANDRAIL	80	LF	$180	$14,400	
35	BEAM GUARDRAIL	80	LF	$60	$4,800	FACTORED UP TO ACCOUNT FOR WALL INTEGRATION
36	ABANDON/PLUG EXISTING PIPE	0	EA	$2,000	$0	
37	HABITAT BOULDERS	25	TN	$85	$2,125	
38	EROSION/WATER POLLUTION CONTROL	1	LS	$45,000	$45,000	
39	SPECIAL HANDLING 66" DIA PIPE	1	LS	$20,000	$20,000	
40	PROTECT EXISTING UTILITIES	1	LS	$10,000	$10,000	
41	ROCK PROTECTION	617	TN	$70	$43,167	
42	EARTH FILLED GEOCELLS	500	SY	$50	$25,000	
43	GABION OUTLET PROTECTION	1	LS	$15,000	$15,000	
44	STREAM ACCESS ROAD	185	TN	$35	$6,475	
45	DEWATERING	1	LS	$40,000	$40,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE A CONSTRUCTION COST					$929,390	
CONSTRUCTION CONTINGENCY				30%	$278,817	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$1,209,000	
SALES TAX				9.5%	$114,860	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX AND CONTINGENCY					**$1,323,900**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$133,000	
DESIGN AND PERMITTING					$384,000	BASED ON CURRENT CONTRACT
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$199,000	
EASEMENT		4500	SF	$30.00	$135,000	15' WIDE DRAINAGE EASEMENT. KC LAND VALUE/AREA
SPECIAL TESTING AND INSPECTIONS				5%	$67,000	
TOTAL SCHEDULE A PROJECT COST					$2,242,000	
SCHEDULE B: 25TH AVENUE NE						
1	MOBILIZATION (10%)	1	LS	$244,000	$244,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (8%)	1	LS	$139,000	$139,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	348	SY	$18	$6,264	
7	REMOVE CURB AND GUTTER	160	LF	$12	$1,920	
8	REMOVE SIDEWALK	134	SY	$20	$2,680	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	2186	CY	$4	$8,743	
11	GRAVEL BORROW INCL HAUL	2186	CY	$30	$65,569	
12	CHANNEL EXCAVATION	973	CY	$25	$24,317	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	3454	CY	$30	$103,620	
14	SHORING OR EXTRA EXCAVATION CLASS B	5886	SF	$5	$29,430	
15	9’ W x 4.6’ H x75'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$135,000	$135,000	
16	9’ W x 4.6’ H x70'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$126,000	$126,000	
17	9’ W x 4.6’ H x60'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$108,000	$108,000	
18	9’ W x 4.6’ H x56'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$100,800	$100,800	
19	WALL	3,500	SF	$50	$175,000	
20	WALL NEAR BUILDING	1,435	SF	$150	$215,250	Assume 3x std. wall (for piles and PMA)
21	CATCHBASIN TYPE 1	5	EA	$1,500	$7,500	
22	CORRUGATED POLYETHYLENE STORM SEWER PIPE 12 IN. DI	100	LF	$45	$4,500	
23	CRUSHED SURFACING TOP COURSE	530	TN	$35	$18,554	2" FOR PAVEMENT RESTORATION
24	HMA CL. 1/2 IN. PG	222	TN	$110	$24,386	2"
25	ASPHALT TREATED BASE	81	TN	$100	$8,107	4"
26	PLANING BITUMINOUS PAVEMENT	1553	SY	$15	$23,292	
27	CEMENT CONC. TRAFFIC CURB AND GUTTER	452	LF	$25	$11,300	
28	CEMENT CONC. SIDEWALK	402	SY	$100	$40,178	
29	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	300	SY	$110	$33,000	
30	STREAMBED SEDIMENT	712	TN	$40	$28,490	
31	WATER SERVICE RELOCATION	5	EA	$2,000	$10,000	
32	WATER RELOCATION 6" DIA	30	LF	$120	$3,600	
33	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	486	EA	$10.00	$4,860	4' spacing on center, includes establishment,(6384-9*150)+(540-70-70-60-56)*6 SF TRIANGLE PATTERN
34	TREE MITIGATION	20	EA	$1,000.00	$20,000	
35	SOD INSTALLATION	77	SY	$30.00	$2,305	
36	TOPSOIL	250	CY	$50.00	$12,500	
37	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$20,000	$20,000	
38	LARGE WOODY DEBRIS	15	EA	$1,200	$17,868	FOX AND BOLTON 11 KEY PIECES PER 100M
39	EARTH ANCHORS	30	EA	$800	$23,824	
40	HANDRAIL	572	LF	$180	$102,960	
41	BEAM GUARDRAIL	540	LF	$60	$32,400	FACTORED UP FOR WALL INTEGRATION
42	ABANDON/PLUG EXISTING PIPE	2	EA	$2,000	$4,000	
43	HABITAT BOULDERS	25	TN	$85	$2,125	
44	EROSION/WATER POLLUTION CONTROL	1	LS	$20,000	$20,000	
45	STREAM ACCESS ROAD	77	TN	$35	$2,698	
46	DEWATERING	1	LS	$100,000	$100,000	
47	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE B CONSTRUCTION COST					$2,119,041	
CONSTRUCTION CONTINGENCY				30%	$635,712	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$2,755,000	
SALES TAX				9.5%	$261,730	
TOTAL SCHEDULE B CONSTRUCTION COST WITH TAX AND CONTINGENCY					**$3,017,000**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$302,000	
DESIGN AND PERMITTING					$874,000	BASED ON CURRENT CONTRACT
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$453,000	
TEMPORARY AND PERMANENT EASEMENT NEGOTIATION				5%	$151,000	
SPECIAL TESTING AND INSPECTIONS				5%	$151,000	
TOTAL SCHEDULE B PROJECT COST					$4,948,000	
				TOTAL ESTIMATED PROJECT COST SCHEDULES A AND B:	**$7,190,000**	Estimate based on 2016 dollars, rounded to nearest $1000; costs will need to be adjusted for Time Value of Money (TMV) when programming funds.

Prepared by: MBW Date Prepared 11/16/2016
Checked by: Date Checked

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 2

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
SCHEDULE A: NE 195TH STREET						
1	MOBILIZATION (10%)	1	LS	$107,000	$107,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$40,000	$40,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	164	SY	$18	$2,952	
7	REMOVE CURB AND GUTTER	45	LF	$12	$540	
8	REMOVE SIDEWALK	35	SY	$20	$700	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	908	CY	$4	$3,631	
11	GRAVEL BORROW INCL HAUL	908	CY	$30	$27,233	
12	CHANNEL EXCAVATION	464	CY	$25	$11,595	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	1221	CY	$30	$36,630	
14	SHORING OR EXTRA EXCAVATION CLASS B	854	SF	$10	$8,540	
15	9’ W x 3.6’ H x61'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$132,000	$132,000	
16	WING WALLS	1050	SF	$50	$52,500	
17	CRUSHED SURFACING TOP COURSE	120	TN	$35	$4,199	2" FOR PAVEMENT RESTORATION
18	HMA CL. 1/2 IN. PG	24	TN	$200	$4,726	2"
19	ASPHALT TREATED BASE	18	TN	$190	$3,455	4"
20	PLANING BITUMINOUS PAVEMENT	71	SY	$15	$1,067	
21	CEMENT CONC. TRAFFIC CURB AND GUTTER	45	LF	$25	$1,125	
22	CEMENT CONC. SIDEWALK	35	SY	$100	$3,500	
23	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	0	SY	$110	$0	
24	STREAMBED SEDIMENT	458	TN	$40	$18,315	
25	WATER SERVICE RELOCATION	0	EA	$2,000	$0	
26	SEWER CASING	100	LF	$300	$30,000	PADDEN BID PRICE
27	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	1,236	EA	$10.00	$12,360	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
28	TREE	28	EA	$1,000.00	$28,000	
29	SOD INSTALLATION	0	SY			
30	TOPSOIL	635	CY	$50.00	$31,728	
31	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$50,000	$50,000	
32	LARGE WOODY DEBRIS	13	EA	$1,200	$15,655	FOX AND BOLTON 11 KEY PIECES PER 100M
33	EARTH ANCHORS	26	EA	$800	$20,873	
34	HANDRAIL	80	LF	$180	$14,400	
35	BEAM GUARDRAIL	80	LF	$60	$4,800	FACTORED UP FOR WALL INTEGRATION
36	ABANDON/PLUG EXISTING PIPE	0	EA	$2,000	$0	
37	HABITAT BOULDERS	25	TN	$85	$2,125	
38	EROSION/WATER POLLUTION CONTROL	1	LS	$45,000	$45,000	
39	SPECIAL HANDLING 66" DIA PIPE	1	LS	$20,000	$20,000	
40	PROTECT EXISTING UTILITIES	1	LS	$10,000	$10,000	
41	ROCK PROTECTION	617	TN	$70	$43,167	
42	EARTH FILLED GEOCELLS	500	SY	$50	$25,000	
43	GABION OUTLET PROTECTION	1	LS	$15,000	$15,000	
44	STREAM ACCESS ROAD	185	TN	$35	$6,475	
45	DEWATERING	1	LS	$40,000	$40,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE A CONSTRUCTION COST					$929,291	
CONSTUCTION CONTINGENCY				30.0%	$278,787	
SUBTOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$1,209,000	
SALES TAX				9.5%	$114,860	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX AND CONTINGENCY					**$1,323,900**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$133,000	
DESIGN					$384,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$199,000	
EASEMENT		4500	SF	$ 30.00	$135,000	
SPECIAL TESTING AND INSPECTIONS				5%	$67,000	
TOTAL SCHEDULE A PROJECT COST					$2,242,000	
SCHEDULE B: 25TH AVENUE NE						
1	MOBILIZATION (10%)	1	LS	$216,000	$216,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (8%)	1	LS	$123,000	$123,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	392	SY	$18	$7,056	
7	REMOVE CURB AND GUTTER		LF	$12	$0	
8	REMOVE SIDEWALK		SY	$20	$0	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	2187	CY	$4	$8,747	
11	GRAVEL BORROW INCL HAUL	2187	CY	$30	$65,605	
12	CHANNEL EXCAVATION	973	CY	$25	$24,317	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	3421	CY	$30	$102,630	
14	SHORING OR EXTRA EXCAVATION CLASS B	5756	SY	$5	$28,780	
15	9’ W x 4.6’ H x70'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$126,000	$126,000	
16	9’ W x 4.6’ H x75'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$135,000	$135,000	
17	9’ W x 4.6’ H x30'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$54,000	$54,000	
18	9’ W x 4.6’ H x52'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$93,600	$93,600	
19	WALL	5,260	SF	$50	$263,000	
20	CATCHBASIN TYPE 1	5	EA	$1,500	$7,500	
21	CORRUGATED POLYETHYLENE STORM SEWER PIPE 12 IN. DI	100	LF	$45	$4,500	
22	CRUSHED SURFACING TOP COURSE	486	TN	$35	$17,014	2" FOR PAVEMENT RESTORATION
23	HMA CL. 1/2 IN. PG	137	TN	$110	$15,083	2"
24	ASPHALT TREATED BASE	91	TN	$100	$9,139	4"
25	PLANING BITUMINOUS PAVEMENT	1567	SY	$15	$23,508	
26	CEMENT CONC. TRAFFIC CURB AND GUTTER	471	LF	$25	$11,775	
27	CEMENT CONC. SIDEWALK	419	SY	$100	$41,867	
28	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	150	SY	$110	$16,500	
29	STREAMBED SEDIMENT	712	TN	$40	$28,490	
30	WATER SERVICE RELOCATION	7	EA	$2,000	$14,000	
31	WATER RELOCATION 6" DIA	170	LF	$120	$20,400	Assume need to replace adjacent to culverts and wall
32	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	494	EA	$10.00	$4,940	4' spacing on center, includes establishment,(6384-9*150)+(530-70-75-30-52)*6 SF TRIANGLE PATTERN
33	TREE MITIGATION	20	EA	$1,000.00	$20,000	
34	SOD INSTALLATION	0	SY	$30.00	$0	
35	TOPSOIL	250	CY	$50.00	$12,500	
36	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$15,000	$15,000	
37	LARGE WOODY DEBRIS	15	EA	$1,200	$18,000	FOX AND BOLTON 11 KEY PIECES PER 100M
38	EARTH ANCHORS	30	EA	$800	$24,000	
39	HANDRAIL	594	LF	$180	$106,920	
40	BEAM GUARDRAIL	562	LF	$60	$33,720	FACTORED UP FOR WALL INTEGRATION
41	ABANDON/PLUG EXISTING PIPE	2	EA	$2,000	$4,000	
42	HABITAT BOULDERS	25	TN	$85	$2,125	
43	EROSION/WATER POLLUTION CONTROL	1	LS	$20,000	$20,000	
44	STREAM ACCES ROAD	77	TN	$35	$2,698	
45	DEWATERING	1	LS	$100,000	$100,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE B CONSTRUCTION COST					$1,876,412	
CONSTRUCTION CONTINGENCY				30.0%	$562,924	
TOTAL SCHEDULE B CONSTRUCTION COST WITH CONTINGENCY					$2,440,000	
SALES TAX				9.5%	$231,800	
TOTAL SCHEDULE B CONSTRUCTION COST WITH TAX AND CONTINGENCY					**$2,672,000**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$268,000	
DESIGN AND PERMITTING					$874,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$401,000	
TEMPORARY AND PERMANENT EASEMENT NEGOTIATION				5%	$134,000	
SPECIAL TESTING AND INSPECTIONS				5%	$134,000	
TOTAL SCHEDULE B PROJECT COST					$4,483,000	
TOTAL ESTIMATED PROJECT COST SCHEDULES A AND B:					**$6,725,000**	Estimate based on 2016 dollars, rounded to nearest $1000; costs will need to be adjusted for Time Value of Money (TMV) when programming funds.

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 3 - Alternative 1 alignment

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
SCHEDULE A: NE 195TH STREET						
1	MOBILIZATION (10%)	1	LS	$107,000	$107,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$40,000	$40,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	164	SY	$18	$2,952	
7	REMOVE CURB AND GUTTER	45	LF	$12	$540	
8	REMOVE SIDEWALK	35	SY	$20	$700	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	908	CY	$4	$3,631	
11	GRAVEL BORROW INCL HAUL	908	CY	$30	$27,233	
12	CHANNEL EXCAVATION	464	CY	$25	$11,595	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	1221	CY	$30	$36,630	
14	SHORING OR EXTRA EXCAVATION CLASS B	854	SY	$10	$8,540	
15	9' W x 3.6' H x61'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$132,000	$132,000	
16	WING WALLS	1050	SF	$50	$52,500	
17	CRUSHED SURFACING TOP COURSE	120	TN	$35	$4,199	2" FOR PAVEMENT RESTORATION
18	HMA CL. 1/2 IN. PG	24	TN	$200	$4,726	2"
19	ASPHALT TREATED BASE	18	TN	$190	$3,455	4"
20	PLANING BITUMINOUS PAVEMENT	71	SY	$15	$1,067	
21	CEMENT CONC. TRAFFIC CURB AND GUTTER	45	LF	$25	$1,125	
22	CEMENT CONC. SIDEWALK	35	SY	$100	$3,500	
23	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	0	SY	$110	$0	
24	STREAMBED SEDIMENT	458	TN	$40	$18,315	
25	WATER SERVICE RELOCATION	0	EA	$2,000	$0	
26	SEWER CASING	100	LF	$300	$30,000	PADDEN BID PRICE
27	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	1,236	EA	$10.00	$12,360	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
28	TREES	28	EA	$1,000.00	$28,000	
29	SOD INSTALLATION	0	SY			
30	TOPSOIL	635	CY	$50.00	$31,728	
31	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$50,000	$50,000	
32	LARGE WOODY DEBRIS	13	EA	$1,200	$15,655	FOX AND BOLTON 11 KEY PIECES PER 100M
33	EARTH ANCHORS	26	EA	$800	$20,873	
34	HANDRAIL	80	LF	$180	$14,400	
35	BEAM GUARDRAIL	80	LF	$60	$4,800	FACTORED FOR WALL INTEGRATION
36	ABANDON/PLUG EXISTING PIPE	0	EA	$2,000	$0	
37	HABITAT BOULDERS	25	TN	$85	$2,125	
38	EROSION/WATER POLLUTION CONTROL	1	LS	$45,000	$45,000	
39	SPECIAL HANDLING 66" DIA PIP	1	LS	$20,000	$20,000	
40	PROTECT EXISTING UTILITIES	1	LS	$10,000	$10,000	
41	ROCK PROTECTION	617	TN	$70	$43,167	
42	EARTH FILLED GEOCELLS	500	SY	$50	$25,000	
43	GABION PROTECTION	1	LS	$15,000	$15,000	
44	STREAM ACCESS ROAD	185	TN	$35	$6,475	
45	DEWATERING	1	LS	$40,000	$40,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE A CONSTRUCTION COST					$929,291	
CONSTRUCTION CONTINGENCY				30%	$278,787	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$1,209,000	
SALES TAX				9.5%	$114,860	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX					**$1,323,900**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$133,000	
DESIGN AND PERMITTING					$384,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$199,000	
EASEMENT	4500	SF	$	30.00	$135,000	
SPECIAL TESTING AND INSPECTIONS				5%	$67,000	
TOTAL SCHEDULE A PROJECT COST					$2,242,000	
SCHEDULE B: 25TH AVENUE NE						
1	MOBILIZATION (10%)	1	LS	$211,000	$211,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$78,000	$78,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	265	SY	$18	$4,770	
7	REMOVE CURB AND GUTTER	160	LF	$12	$1,920	
8	REMOVE SIDEWALK	134	SY	$20	$2,680	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	1420	CY	$4	$5,679	
11	GRAVEL BORROW INCL HAUL	1420	CY	$30	$42,595	
12	CHANNEL EXCAVATION	4888	CY	$25	$122,198	
13	CHANNEL EXCAVATION WITH SPECIAL DISPOSAL[1]	1387	CY	$100	$138,749	See Note [1]
14	STRUCTURE EXCAVATION CLASS B INCL. HAUL	2233	CY	$30	$66,990	
15	SHORING OR EXTRA EXCAVATION CLASS B	311	SY	$5	$1,555	
16	9' W x 4.6' H x76'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$135,000	$135,000	
17	9' W x 4.6' H x60'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$108,000	$108,000	
18	9' W x 4.6' H x55'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$100,800	$100,800	
19	WALL	770	SF	$50	$38,500	
20	CATCHBASIN TYPE 1	3	EA	$1,500	$4,500	
21	CORRUGATED POLYETHYLENE STORM SEWER PIPE 12 IN. DI	60	LF	$45	$2,700	
22	WALL NEAR BUILDING	1,435	SF	$150	$215,250	Assume 3x std. wall (for piles and PMA)
23	CRUSHED SURFACING TOP COURSE	276	TN	$35	$9,664	2" FOR PAVEMENT RESTORATION
24	HMA CL. 1/2 IN. PG	124	TN	$110	$13,660	2"
25	ASPHALT TREATED BASE	62	TN	$100	$6,170	4"
26	PLANING BITUMINOUS PAVEMENT	800	SY	$15	$12,000	
27	CEMENT CONC. TRAFFIC CURB AND GUTTER	198	LF	$25	$4,950	
28	CEMENT CONC. SIDEWALK	162	SY	$100	$16,178	
29	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	225	SY	$110	$24,750	
30	STREAMBED SEDIMENT	712	TN	$40	$28,490	
31	WATER SERVICE RELOCATION	5	EA	$2,000	$10,000	
32	WATER RELOCATION 6" DIA	30	LF	$120	$3,600	
33	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	2,139	EA	$10.00	$21,390	4' spacing on center, includes establishment,(6384-9*150)+(540-70-70-60-56)*6 SF TRIANGLE PATTERN
34	TREES	20	EA	$1,000.00	$20,000	
35	SOD INSTALLATION	191	SY	$30.00	$5,725	
36	TOPSOIL	1,111	CY	$50.00	$55,526	
37	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$15,000	$15,000	
38	LARGE WOODY DEBRIS	20	EA	$1,200	$24,000	FOX AND BOLTON 11 KEY PIECES PER 100M
39	EARTH ANCHORS	40	EA	$800	$32,000	
40	HANDRAIL	284	LF	$180	$51,120	
41	BEAM GUARDRAIL	270	LF	$60	$16,200	FACTORED UP FOR WALL INTEGRATION
42	ABANDON/PLUG EXISTING PIPE	2	EA	$2,000	$4,000	
43	HABITAT BOULDERS	25	TN	$85	$2,125	
44	EROSION/WATER POLLUTION CONTROL	1	LS	$20,000	$20,000	
45	DEWATERING	1	LS	$100,000	$100,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE B CONSTRUCTION COST					$1,832,436	
CONSTRUCTION CONTINGENCY				30%	$549,731	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$2,383,000	
SALES TAX				9.5%	$226,390	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX					**$2,609,400**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$261,000	
DESIGN AND PERMITTING					$874,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$392,000	
TEMPORARY AND PERMANENT EASEMENT NEGOTIATION				5%	$131,000	
SPECIAL TESTING AND INSPECTIONS				5%	$131,000	
TOTAL SCHEDULE B CONSTRUCTION COST					$4,398,400	
				TOTAL ESTIMATED PROJECT COST SCHEDULES A AND B:	**$6,641,000**	Estimate based on 2016 dollars, rounded to nearest $1000; costs will need to be adjusted for Time Value of Money (TMV) when programming funds.

[1]Assumes 25% exceeds MOTCA standards and requires special disposal. This allowance does not cover full site clean up if required.

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 3 - Alternative 2 Alignment

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
SCHEDULE A: NE 195TH STREET						
1	MOBILIZATION (10%)	1	LS	$107,000	$107,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$40,000	$40,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	164	SY	$18	$2,952	
7	REMOVE CURB AND GUTTER	45	LF	$12	$540	
8	REMOVE SIDEWALK	35	SY	$20	$700	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	908	CY	$4	$3,631	
11	GRAVEL BORROW INCL HAUL	908	CY	$30	$27,233	
12	CHANNEL EXCAVATION	464	CY	$25	$11,595	
13	STRUCTURE EXCAVATION CLASS B INCL. HAUL	1221	CY	$30	$36,630	
14	SHORING OR EXTRA EXCAVATION CLASS B	854	SY	$10	$8,540	
15	9’ W x 3.6’ H x61'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$132,000	$132,000	
16	WING WALLS	1050	SF	$50	$52,500	
17	CRUSHED SURFACING TOP COURSE	120	TN	$35	$4,199	2" FOR PAVEMENT RESTORATION
18	HMA CL. 1/2 IN. PG	24	TN	$200	$4,726	2"
19	ASPHALT TREATED BASE	18	TN	$190	$3,455	4"
20	PLANING BITUMINOUS PAVEMENT	71	SY	$15	$1,067	
21	CEMENT CONC. TRAFFIC CURB AND GUTTER	45	LF	$25	$1,125	
22	CEMENT CONC. SIDEWALK	35	SY	$100	$3,500	
23	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	0	SY	$110	$0	
24	STREAMBED SEDIMENT	458	TN	$40	$18,315	
25	WATER SERVICE RELOCATION	0	EA	$2,000	$0	
26	SEWER CASING	100	LF	$300	$30,000	PADDEN BID PRICE
27	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	1,236	EA	$10.00	$12,360	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
28	TREES	28	EA	$1,000.00	$28,000	
29	SOD INSTALLATION	0	SY			
30	TOPSOIL	635	CY	$50.00	$31,728	
31	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$50,000	$50,000	
32	LARGE WOODY DEBRIS	13	EA	$1,200	$15,655	FOX AND BOLTON 11 KEY PIECES PER 100M
33	EARTH ANCHORS	26	EA	$800	$20,873	
34	HANDRAIL	80	LF	$180	$14,400	
35	BEAM GUARDRAIL	80	LF	$60	$4,800	FACTORED UP FOR WALL
36	ABANDON/PLUG EXISTING PIPE	0	EA	$2,000	$0	
37	HABITAT BOULDERS	25	TN	$85	$2,125	
38	EROSION/WATER POLLUTION CONTROL	1	LS	$45,000	$45,000	
39	SPECIAL HANDLING 66" DIA PIP	1	LS	$20,000	$20,000	
40	PROTECT EXISTING UTILITIES	1	LS	$10,000	$10,000	
41	ROCK PROTECTION	617	TN	$70	$43,167	
42	EARTH FILLED GEOCELLS	500	SY	$50	$25,000	
43	GABION PROTECTION	1	LS	$15,000	$15,000	
44	STREAM ACCESS ROAD	185	TN	$35	$6,475	
45	DEWATERING	1	LS	$40,000	$40,000	
46	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE A CONSTRUCTION COST					$929,291	
CONSTRUCTION CONTINGENCY				30%	$278,787	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$1,209,000	
SALES TAX				9.5%	$114,860	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX					**$1,323,900**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$133,000	
DESIGN AND PERMITTING					$384,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$199,000	
EASEMENT	4500	SF	$30		$135,000	
SPECIAL TESTING AND INSPECTIONS				5%	$67,000	
TOTAL SCHEDULE A CONSTRUCTION COST					$2,242,000	
SCHEDULE B: 25TH AVENUE NE						
1	MOBILIZATION (10%)	1	LS	$196,000	$196,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$72,000	$72,000	Assume access to residences maintained during construction
3	SURVEYING	1	LS	$20,000	$20,000	
4	SPCC PLAN	1	LS	$5,000	$5,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	309	SY	$18	$5,562	
7	REMOVE CURB AND GUTTER		LF	$12	$0	
8	REMOVE SIDEWALK		SY	$20	$0	
9	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$20,000	$20,000	
10	EMBANKMENT COMPACTION	2056	CY	$4	$8,225	
11	GRAVEL BORROW INCL HAUL	2056	CY	$30	$61,686	
12	CHANNEL EXCAVATION	4888	CY	$25	$122,198	
13	CHANNEL EXCAVATION WITH SPECIAL DISPOSAL[1]	1387	CY	$100	$138,749	See Note [1]
14	STRUCTURE EXCAVATION CLASS B INCL. HAUL	2820	CY	$30	$84,600	
15	SHORING OR EXTRA EXCAVATION CLASS B	350	SY	$5	$1,750	
16	9’ W x 4.6’ H x70'L CONCRETE BOX CULVERT STRUCTURE	0	EA	$126,000	$0	
17	9’ W x 4.6’ H x75'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$135,000	$135,000	
18	9’ W x 4.6’ H x30'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$54,000	$54,000	
19	9’ W x 4.6’ H x52'L CONCRETE BOX CULVERT STRUCTURE	1	EA	$93,600	$93,600	
20	WALL	2,530	SF	$50	$126,500	
21	CATCH BASIN TYPE 1	3	EA	$1,500	$4,500	
22	CORRUGATED POLYETHYLENE STORM SEWER PIPE 12 IN. DI	60	LF	$45	$2,700	
23	CRUSHED SURFACING TOP COURSE	419	TN	$35	$14,678	2" FOR PAVEMENT RESTORATION
24	HMA CL. 1/2 IN. PG	84	TN	$110	$9,197	2"
25	ASPHALT TREATED BASE	72	TN	$100	$7,202	4"
26	PLANING BITUMINOUS PAVEMENT	816	SY	$15	$12,240	
27	CEMENT CONC. TRAFFIC CURB AND GUTTER	471	LF	$25	$11,775	
28	CEMENT CONC. SIDEWALK	419	SY	$100	$41,867	
29	CEMENT CONC DRIVEYWAY ENTRANCE TYPE_	0	SY	$110	$0	
30	STREAMBED SEDIMENT	712	TN	$40	$28,490	
31	WATER SERVICE RELOCATION	6	EA	$2,000	$12,000	
32	WATER RELOCATION 6" DIA	170	LF	$120	$20,400	Assume need to replace adjacent to culverts and wall
33	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	1,236	EA	$10.00	$12,360	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
34	TREES	20	EA	$1,000.00	$20,000	
35	SOD INSTALLATION	0	SY	$30.00	$0	
36	TOPSOIL	250	CY	$50.00	$12,500	
37	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$15,000	$15,000	
38	LARGE WOODY DEBRIS	16	EA	$1,200	$19,035	FOX AND BOLTON 11 KEY PIECES PER 100M
39	EARTH ANCHORS	32	EA	$800	$25,380	
40	HANDRAIL	594	LF	$180	$106,920	
41	BEAM GUARDRAIL	562	LF	$60	$33,720	FACTORED FOR WALL INTEGRATION
42	ABANDON/PLUG EXISTING PIPE	2	EA	$2,000	$4,000	
43	HABITAT BOULDERS	25	TN	$85	$2,125	
44	EROSION/WATER POLLUTION CONTROL	1	LS	$20,000	$20,000	
45	STREAM ACCESS ROAD	185	TN	$35	$6,475	
46	DEWATERING	1	LS	$100,000	$100,000	
47	RECORD DRAWINGS	1	LS	$5,000	$5,000	
SUBTOTAL SCHEDULE B CONSTRUCTION COST					$1,697,435	
CONSTRUCTION CONTINGENCY				30%	$509,231	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$2,207,000	
SALES TAX				9.5%	$209,670	
TOTAL SCHEDULE A CONSTRUCTION COST WITH TAX					**$2,416,700**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$242,000	
DESIGN AND PERMITTING					$874,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$363,000	
TEMPORARY AND PERMANENT EASEMENT NEGOTIATION				5%	$121,000	
SPECIAL TESTING AND INSPECTIONS				5%	$121,000	
TOTAL SCHEDULE B CONSTRUCTION COST					$4,138,000	
				TOTAL ESTIMATED PROJECT COST SCHEDULES A AND B:	**$6,380,000**	Estimate based on 2016 dollars, rounded to nearest $1000; costs will need to be adjusted for Time Value of Money (TMV) when programming funds.

[1]Assumes 25% exceeds MOTCA standards and requires special disposal. This allowance does not cover full site clean up if required.

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 6

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$29,000	$29,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$11,000	$11,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$10,000	$10,000	
4	SPCC PLAN	1	LS	$2,000	$2,000	
5	CLEARING AND GRUBBING	1	LS	$5,000	$5,000	
6	REMOVE ASPHALT CONC. PAVEMENT	364	SY	$18	$6,552	
7	REMOVAL OF STRUCTURE AND OBSTRUCTION	1	LS	$5,000	$5,000	
8	BUILDING DEMOLITION SALVAGE/DISPOSAL	1	LS	$20,000	$20,000	
9	CHANNEL EXCAVATION	1694	CY	$25	$42,350	0.25 AC BY AVG 3' DEEP + 40%
10	STRUCTURE EXCAVATION CLASS B INCL. HAUL	36	CY	$30	$1,080	
11	CEMENT CONC. TRAFFIC CURB AND GUTTER	20	LF	$25	$500	
12	PSIPE - 1 GAL PLANTS - RIPARIAN PLANTINGS	785	EA	$10.00	$7,850	4' spacing on center, includes establishment,17133 SF TRIANGLE PATTERN
13	TREES	20	EA	$150.00	$3,000	
14	TOPSOIL	403	CY	$50.00	$20,150	0.25 AC BY 1' DEEP
15	STREAMFLOW DIVERSION / FLOW BYPASS	1	LS	$10,000	$10,000	
16	LARGE WOODY DEBRIS	6	EA	$1,200	$7,200	FOX AND BOLTON 11 KEY PIECES PER 100M
17	EARTH ANCHORS	12	EA	$800	$9,600	
18	LOW HEIGHT CONCRETE WALL	100	LF	$200	$20,000	
19	ABANDON EXISTING UTILITY	1	LS	$5,000	$5,000	
20	HABITAT BOULDERS	15	TN	$85	$1,275	
21	EROSION/WATER POLLUTION CONTROL	1	LS	$15,000	$15,000	
22	STREAMBED SEDIMENT	54	TN	$40	$2,171	1.5' DEEP, 3' CHANNEL WIDTH
23	PROTECT EXISTING UTILITIES	1	LS	$3,000	$3,000	
24	DEWATERING (10%)	1	LS	$10,000	$10,000	
25	RECORD DRAWINGS	1	LS	$2,000	$2,000	
SUBTOTAL CONSTRUCTION COST					$248,728	
CONSTRUCTION CONTINGENCY				30%	$74,618.30	
TOTAL SCHEDULE A CONSTRUCTION COST WITH CONTINGENCY					$324,000	
SALES TAX				9.5%	$30,780	
TOTAL CONSTRUCTION COST WITH TAX					**$354,800**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$36,000	
DESIGN AND PERMITTING				20%	$71,000	
DESIGN CONTINGENCY				15%	$54,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$54,000	
PROPERTY ACQUISITION		1	LS	$923,611	$923,611	1/3 OF 2518 NE 195TH ST (2016 value $2,231,000) +25%
PROPERTY CONTINGENCY				25%	$230,903	
RELOCATION EXPENSES		1	LS	$120,000	$120,000	$10K/UNIT PER CITY INPUT
SPECIAL TESTING AND INSPECTIONS				5%	$18,000	
TOTAL CONSTRUCTION COST					$1,863,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measures 1-5						
Interim Measure #	**Interim Measure Description**				**Amount**	**Assumptions/Notes**
1	LINE EXISTING HIGH-FLOW BYPASS				$120,000	
2	EXTEND EXISTING HIGH-FLOW BYPASS				$187,000	Assume access to residences maintained during construction
3	IMPROVE DRAINAGE OVERFLOW PATH ALONG NE 195TH ST				$87,000	
4	RAISE EXISTING DRIVEWAY CURBS AND BERMING ALONG 25TH AVE NE				$66,000	Assume 1' deep average over 1450 sf
5	MINOR CHANNEL EXCAVATION DOWNSTREAM OF NE 195TH ST				$20,000	
TOTAL CONSTRUCTION COST					$480,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measure 1

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$6,000	$6,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL	1	LS	$4,000	$4,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$2,000	$2,000	
4	24" CIPP LINING	225	LF	$80	$18,000	
5	24"x36" CIP ARCH PIPE LINING	135	LF	$100	$13,500	
6	RECORD DRAWINGS	1	LS	$2,000	$2,000	
SUBTOTAL CONSTRUCTION COST					$45,500	
CONSTRUCTION CONTINGENCY				40%	$18,200.00	
TOTAL CONSTRUCTION COST WITH CONTINGENCY					$64,000	
SALES TAX				9.5%	$6,080	
TOTAL CONSTRUCTION COST WITH TAX					**$70,100**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$8,000	
DESIGN AND PERMITTING				20%	$15,000	
DESIGN CONTINGENCY				15%	$11,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$11,000	
SPECIAL TESTING AND INSPECTIONS				5%	$4,000	
TOTAL CONSTRUCTION COST					$120,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measure 2

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$9,000	$9,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL	1	LS	$5,000	$5,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$3,000	$3,000	
4	SPCC PLAN	1	LS	$2,000	$2,000	
5	REMOVE ASPHALT CONC. PAVEMENT	180	SY	$18	$3,240	Based on city detail 802, assuming 4.5' wide trench
6	STORM DRAIN, 24-INCH DIAMTER (CPEP)	212	LF	$80	$16,960	
7	CATCH BASIN TYPE 2- 48-INCH DIAMTER	2	EA	$3,000	$6,000	
8	CONNECT NEW CB TO EXISTING PIPE	1	EA	$1,000	$1,000	
9	RESOLUTION OF UTILITY CONFLICTS	1	LS	$5,000	$5,000	
10	HMA CL. 1/2 IN. PG	40	TN	$110	$4,400	4" thick based on city std detail 802
11	ASPHALT TREATED BASE	39	TN	$100	$3,900	4" thick based on city std detail 802
12	CRUSHED SURFACING TOP COURSE	164	TN	$35	$5,740	For trench backfill based on city std detail 802
13	RESTORE ROCKERY	1	LS	$3,000	$3,000	
14	TRENCH SAFETY SYSTEMS	1	LS	$2,000	$2,000	
15	RECORD DRAWINGS	1	LS	$2,000	$2,000	
SUBTOTAL CONSTRUCTION COST					$72,240	
CONSTRUCTION CONTINGENCY				40%	$28,896.00	
TOTAL CONSTRUCTION COST WITH CONTINGENCY					$102,000	
SALES TAX				9.5%	$9,690	
TOTAL CONSTRUCTION COST WITH TAX					**$111,700**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$12,000	
DESIGN AND PERMITTING				20%	$23,000	
DESIGN CONTINGENCY				15%	$17,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$17,000	
SPECIAL TESTING AND INSPECTIONS				5%	$6,000	
TOTAL CONSTRUCTION COST					$187,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measure 3

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$4,000	$4,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$2,000	$2,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$2,000	$2,000	
4	REMOVE ASPHALT CONC. PAVEMENT	60	SY	$18	$1,080	Based on city detail 802, assuming 4.5' wide trench
5	STORM DRAIN, 12-INCH DIAMTER (CMP)	31	LF	$40	$1,240	
6	STORM DRAIN, 18-INCH DIAMTER (CMP)	40	LF	$45	$1,800	
7	CONNECT NEW STORM PIPE TO EXISTING CATCH BASIN	1	EA	$1,000	$1,000	
8	DITCH EXCAVATION	500	CY	$25	$12,500	
9	HMA CL. 1/2 IN. PG	14	TN	$110	$1,540	4" thick based on city std detail 802
10	ASPHALT TREATED BASE	13	TN	$100	$1,300	4" thick based on city std detail 802
11	CRUSHED SURFACING TOP COURSE	55	TN	$35	$1,925	For trench backfill based on city std detail 802
12	RECORD DRAWINGS	1	LS	$2,000	$2,000	
SUBTOTAL CONSTRUCTION COST					$32,385	
CONSTRUCTION CONTINGENCY				40%	$12,954.00	
TOTAL CONSTRUCTION COST WITH CONTINGENCY					$46,000	
SALES TAX				9.5%	$4,370	
TOTAL CONSTRUCTION COST WITH TAX					**$50,400**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$6,000	
DESIGN AND PERMITTING				20%	$11,000	
DESIGN CONTINGENCY				15%	$8,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$8,000	
SPECIAL TESTING AND INSPECTIONS				5%	$3,000	
TOTAL CONSTRUCTION COST					$87,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measure 4

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$3,000	$3,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$2,000	$2,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$1,000	$1,000	
4	REMOVE CURB AND GUTTER	42	LF	$12	$504	
5	NEW (LARGER) DRIVEWAY SPEED BUMP	50	LF	$35	$1,750	
6	EARTHEN BERM (CLEARING, FILL, PLANTING)	300	LF	$50	$15,000	
7	RECORD DRAWINGS	1	LS	$2,000	$2,000	
SUBTOTAL CONSTRUCTION COST					$25,254	
CONSTRUCTION CONTINGENCY				40%	$10,101.60	
TOTAL CONSTRUCTION COST WITH CONTINGENCY					$36,000	
SALES TAX				9.5%	$3,420	
TOTAL CONSTRUCTION COST WITH TAX					**$39,400**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$4,000	
DESIGN AND PERMITTING				20%	$8,000	
DESIGN CONTINGENCY				15%	$6,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$6,000	
SPECIAL TESTING AND INSPECTIONS				5%	$2,000	
TOTAL CONSTRUCTION COST					$66,000	

Table 1. Planning Level Design, Permitting, and Construction Cost Estimate for Alternative 7 - Interim Measure 5

Spec Section	Bid Item Description	Quantity	Unit	Unit Cost	Amount	Assumptions/Notes
1	MOBILIZATION (10%)	1	LS	$1,000	$1,000	
2	PROJECT TEMPORARY TRAFFIC CONTROL (5%)	1	LS	$1,000	$1,000	Assume access to residences maintained during construction
3	SURVEYING (5%)	1	LS	$0	$0	
4	CHANNEL EXCAVATION	30	CY	$50	$1,481	Assume 2' deep average over 400 sf
SUBTOTAL CONSTRUCTION COST					$3,481	
CONSTRUCTION CONTINGENCY				40%	$1,392.59	
TOTAL CONSTRUCTION COST WITH CONTINGENCY					$5,000	
SALES TAX				9.5%	$480	
TOTAL CONSTRUCTION COST WITH TAX					**$5,500**	
OTHER APPROXIMATED PROJECT COSTS						
ADMINISTRATIVE COSTS				10%	$1,000	
DESIGN AND PERMITTING		1	LS	$10,000	$10,000	Coord. With LF Park
DESIGN CONTINGENCY				15%	$1,000	
CONSTRUCTION MANAGEMENT/CONSTRUCTION ADMINISTRATION				15%	$1,000	
SPECIAL TESTING AND INSPECTIONS				5%	$1,000	
TOTAL CONSTRUCTION COST					$20,000	

Appendix F

Stakeholder Information

Appendix F.1
Coordination with Regulatory Stakeholders

25th Avenue NE Flood Reduction Project

Meeting Summary Minutes - FINAL

Meeting Date: October 18, 2016 (10 am – noon)
Meeting Location: City of Shoreline City Hall – Conference Room 301 (site visit followed)

Attendees:

Andrew Shuckhart, US Army Corps of Engineers (USACE)
Kathy Curry, USACE
Rebekah Padgett, Washington Department of Ecology (via phone)
Larry Fisher, Washington Department of Fish and Wildlife (WDFW)
John Featherstone, City of Shoreline
Mike Giseburt, Louis Berger
Shelby Petro, Herrera Environmental Consultants
(Note: Karen Walter, Muckleshoot Indian Tribe Fisheries Division (MITFD), was invited but unable to attend)

Purpose of Meeting: *To obtain feedback for regulatory agencies on selected preliminary flood prevention alternatives being considered by the City. Prior to the meeting, the City sent out a packet of information including an agenda, project summary, and brief summary of alternatives being considered.*

Summary of Discussion Items:

Comments – general and/or related to multiple alternatives:

1) Kathy, Andrew, and Larry were interested in potential to daylight Ballinger Creek on school district property on east side of 25th Ave NE. The City responded that the School District has been contacted and will continue to be coordinated with, but to date their response has indicated that use of their property for daylighting is unlikely, particularly within the currently expected timeframe of the 25th Ave NE project. Kathy inquired if the project could be postponed long enough to allow the School District time to integrate the creek in their upcoming master planning efforts. The City responded that the 25th Ave NE project timeline to date has been largely

driven by the North Maintenance Facility (NMF) project schedule, and has transitioned from a very tight schedule to a looser, less defined timeframe. Ultimately it may be possible for the 25th Ave NE project schedule to align with a School District timeframe (if other factors allow), but at this time difficult to predict how exactly this would work.

2) Within permit applications, include a narrative to discuss the naming of Brugger's Bog Park and explain that the resources within the park are NOT actually a bog (assuming this is true). This is because bogs are regulated more stringently (e.g., for the protection of rare plant species). **(Action item: check geo tech boring for peat and provide narrative in permit applications.)**
3) Where daylighting in ROW consider using novel LID approaches (such as Silva Cell) in the sidewalk to get optimize/enhance the effective presence of native vegetation within new stream buffer
4) Updates are coming to USACE Nationwide Permits (NWPs) and Regional General Conditions (RGCs) in 2017 (effective March 19, 2017)(**Action item: Review draft 2017 NWP changes.)**
    a) RGC will stipulate that culverts must meet the stream simulation methodology – consistent with WDFW's HPA requirements
    b) RGC will effectively require no perennial stream loss
    c) If can't meet stream simulation, projects required to provide equivalent or better benefits than use of stream simulation would provide
    d) The draft regulations aren't final, but Andrew did not think current changes being contemplated would affect this project.
    e) Due to timing limitations (need to apply more or less immediately) it is unlikely to impossible that this project could be grandfathered in prior to these regulations in place.
5) Make sure City keeps Karen (MITFD) in the loop, especially to obtain feedback on fish use and habitat.
6) City noted that Ballinger Creek runs along a retaining wall along the north side of the Brugger's Bog Park made up of creosote timbers. Moving the stream away from this wall was recommended in the Lyon Creek Basin Plan and should be considered among the options for mitigation in this area.
7) Rebecca asked if stream was 303d listed. The answer was no.
8) City noted that during ongoing WSDOT emergency retaining wall repair project, their contractor conducted electrofishing as part of the diversion work. The City requested copies of WSDOT's fish exclusion report; the City was told that during initial fish exclusion efforts on October 11, 2016, two (2) cutthroat trout and one (1) coho (all 3 roughly 4-6 inches in length) were found in the Ballinger Creek open channel segment just upstream of the NE 195th St culvert.
9) Any culverts must meet the stream simulation methods to get a NWP (2017 NWPs); (stream sim already required for HPA fish passage design)
10) Both WDFW and USACE expressed reservations about the speculation that WSDOT may look at using a shotcrete-like material to repair the failing Ballinger Way gabion wall which runs parallel to Ballinger Creek. Use of sheet piles to protect gabion wall

toe would likely be preferred; Larry also noted that while gabions are undesirable, in other areas they have been allowed and are sometimes required to have stainless steel wire. It was acknowledged that it will be a challenge to lower the channel in this narrow corridor between the failing gabion wall and private property featuring a building with minimal setback.

11) Roughened channel upstream of NE 195th St - which could be used in order to keep the 25th Ave NE system improvements more shallow - would not be preferred by WDFW. It would require monitoring because it is still considered experimental (Larry).
12) Both WDFW and USACE expressed concerns about potential project impacts to existing Wetland B hydrology and connectivity to the creek. A specific concern was that wetland benches that are within OHWM that might no longer be within OHWM after channel lowering. (Larry, Kathy)
13) USACE permit pathway could be through NWP 14 (Linear Projects) because the driver of the project is protecting the road from flooding or NWP 3 (Maintenance), NWP 13 (Bank Stabilization), or NWP 27 (Restoration). Projects permitted under NWP 27 can only be approved if the primary project purpose is to improve ecological function and it may authorize some mitigation components. If project exceeds thresholds of any NWP it may then require an Individual permit. The potential permitting pathways should be discussed in more detail with USACE when the preferred alternative is identified. **(Action item: Review draft NWP requirements to confirm if project elements will likely conform to NWP 14, if we can make minor modifications to project elements for better fit, or if we will need to consider other options.)**
14) Anytime a USACE individual permit becomes required, project must demonstrate that preferred alternative is the least environmentally damaging. When asked if offsite mitigation can make up for an alternative not being the least environmentally damaging, Andrew indicated that avoidance and minimization is always the top priority for mitigation, while compensatory mitigation off site is at the bottom of the federal mitigation rule for mitigation sequencing (Banks>In lieu fees>on-site/in-kind>off-site/out-of-kind), meaning the other types of mitigation would have to be reviewed and exhausted before off-site mitigation can be considered. 404(b)(1) requires LEDPA (least environmentally damaging practicable alternative), so USACE wouldn't allow the selection of any design by "buying down the impact" with compensatory mitigation if a less damaging design was practicable. The technical case for offering off-site mitigation would need to be, "This is the LEDPA given the site constraints, and the following mitigation will be provided to compensate for the unavoidable impacts.".

Comments – specific to individual alternatives:

<u>Alternative 1 (daylight in ROW)</u>

15) Confirmed removal of high and low flow pipes under 25th Ave (Larry)

16) Long culvert crossing under 25th Ave NE: MITFD will likely prefer the culverts in 1A (Larry); long culvert can't be permitted under a proposed NWP (Andrew) because doesn't meet stream simulation. Take away: Long culvert as shown on Alternative 1 likely infeasible from permitting perspective.

Alternative 2 (closed conveyance)

17) A non-fish passable culvert would likely not be permitted under the 2017 NWPs; General Condition 17 for tribal rights would not be met; an Individual Permit would require an alternatives analysis under Section 404(b)(1) of the Clean Water Act to select the least environmentally damaging alternative, which would likely be the daylighting or no action alternative (Andrew)
18) Concerns regarding open channel upstream of NE 195tt St culvert becoming a "fish sink" with passage to potentially better fish habitat within Brugger's Bog Park remaining blocked under this approach.

Alternative 3 (high flow bypass)

19) This is least preferred by both WDFW and USACE because it doesn't meet the stream simulation methodology
20) Bypass would not meet the requirements of the new NWPs so USACE would require an Individual Permit.
21) WDFW would likely not approve HPA based on the understanding that there are clearly better alternatives (Larry)

Memorandum

DATE: Wednesday, October 12, 2016

TO: Karen Walter, Muckleshoot Indian Tribe Fisheries Division
Larry Fisher, Washington State Department of Fish and Wildlife
Rebekah Padgett, Washington State Department of Ecology
Andrew Shuckhart, US Army Corps of Engineers

FROM: John Featherstone, City of Shoreline

RE: 25th Ave NE Flood Reduction Project Early Pre-Design Feedback

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This memorandum provides some background information which will be useful for discussion of project concepts for the 25th Avenue NE Flood Reduction Project, a City of Shoreline (City) Surface Water Utility Capital Improvement Project. The project team includes me as project manager with Louis Berger as the lead engineering design consultant and Herrera Environmental Consultants as the team's environmental and permitting specialists.

In this initial meeting, the project team seeks to solicit feedback from selected important stakeholders regarding concepts related to the development of various design alternatives. The project team understands that this project will likely require additional future coordination related to permitting.

Description of Proposed Project

Since 2001 the City has received reports of Ballinger Creek flooding areas along 25th Avenue NE between Brugger's Bog Park and NE 195th Street on at least 15 separate occasions. Nearby public and private properties have flooded, including multifamily residences, public rights-of-way, and the City's North Maintenance Facility (NMF) site.

The 25th Avenue NE Flood Reduction Project, which was recommended as a high priority in the City's recently-completed Lyon Creek Basin Plan, is currently evaluating flood reduction approaches potentially affecting a reach of Ballinger Creek extending

2,000 feet from Brugger's Bog Park downstream to the culvert crossing Ballinger Way NE approximately 450 feet south of NE 195th Street.

Hydrologic and hydraulic modeling efforts have confirmed historical and anecdotal observations that this system floods at an approximate 2-year frequency. Modeling determined that the existing piped system – which generally ranges in size from 24 to 36 inches in diameter -- is far below needed capacity.

The portions of the project within and south of NE 195th Street are located within City of Lake Forest Park (LFP) and WSDOT rights-of-way (ROW); the project team has already begun and will continue to coordinate with LFP and WSDOT for their regulations and permitting requirements within this area. The portions of the project north of NE 195th St are located within the City of Shoreline, for which permitting will be coordinated internally with the City of Shoreline Planning and Community Development department.

The project team has recently completed initial investigations including hydrologic and hydraulic modeling, survey, environmental, and geotechnical. The team created a large matrix intended to consider the full range of potential approaches to reduce the flood hazards and used results of these investigations and other discussions to narrow this list to a smaller selection of the most feasible solutions. These alternatives are intended to allow the City to consider an array of potential approaches to resolve the existing flooding issue with minimal downstream impacts while complying with critical stakeholder needs and accounting for various constraints, such as spatial/physical and cost limitations.

Notable project challenges include:

- The existing stream is conveyed through approximately 575 LF of closed pipe system within the 25th Ave NE right-of-way downstream of Brugger's Bog Park. It is a long stream reach that is piped and it is confined to the right-of-way, which is the only currently available location for any potential improvements to the stream conveyance system (such as daylighting). This right of way is dedicated to other uses which will need to be coordinated with any potential improvements, including:
    - Underground and pole-mounted utilities (generally concentrated on the east side of 25th)
    - Parking
    - Sidewalks – existing and future
    - Driveways
    - Travel lanes for street traffic
- NE 195th St culvert crosses below a 66 inch diameter SPU water distribution main (Tolt River Pipeline). The location of this pipe and required clearances will determine the elevation of any potential replacement culvert, which will in turn determine the upstream and downstream stream bed elevations. When replacing this culvert with a fish passable culvert, it will likely require the stream invert elevation to be lowered up to 2-3 feet.
- As mentioned, portions of the project within and south of NE 195th Street are located within City of Lake Forest Park (LFP) and WSDOT rights-of-way

(ROW), which will require inter-agency coordination and additional permitting and other design review processes.

- The existing gabion wall at the downstream end of NE 195th Street is in a failed condition. WSDOT is currently starting an "Emergency" repair project at this location and it will likely be under construction at the time of our field visit. We have coordinated with WSDOT with the goal of having their repair done in a way to allow a larger future fish passable culvert.

The project team wishes to primarily present three potential conceptual solutions for review and discussion in this meeting. There are a few additional potential conceptual solutions also under consideration for further evaluation, but it is the following three which (a) are most feasible to potentially implement under existing known conditions, and (b) have some degree of uncertainty regarding likely permitting requirements.

Alternative 1 – "Maximum Feasibility" seeks to daylight the maximum feasible length of Ballinger Creek within currently available space – the 25th Avenue NE right-of-way. The west side of 25th Ave NE is preferred due to multiple major utility conflicts on the east side; potential length of daylighted channel here is about 220'. Coordination with the City of Shoreline's North Maintenance Facility and 25th Ave NE Sidewalk projects will be important to determine exactly where within the ROW that the daylighted channel can be located. A new culvert approximately 250' long would connect the new daylighted channel to the existing open channel at 2518 NE 195th St; the existing open channel at this location will need to be deepened. The NE 195th St culvert would be replaced with a large fish passable box culvert and channel deepening downstream of the culvert as needed based on the new culvert's depth.

Alternative 1A – In lieu of the 250' culvert described in Alternative 1 above, a variation of this alternative could cross 25th Ave NE with a 70' culvert, enter a second daylighted channel (100' long) segment on the east side of 25th Ave NE within the ROW in front of 2500 NE 195th Pl, then enter an 80' driveway crossing culvert before connecting to the existing open channel at 2518 NE 195th St. Daylighting the channel at this location on the east side of 25th Ave NE would need to consider issues with utility conflicts, parking/sidewalk needs, and buffer impacts at this location.

Alternative 2 – "Closed Conveyance" seeks to avoid potential space conflicts with other priority right of way uses (such as parking, sidewalk, driveway, and roadway) by replacing the existing piped stream system along 25th Avenue NE with conveyance sufficiently upsized to convey flood flows. The NE 195th St culvert would be replaced with a large fish passable box culvert and channel deepening downstream of the culvert as needed based on the new culvert's depth.

Alternative 3 – "High Flow Bypass" seeks to resolve flooding issue by installing a bypass system for peak flows while avoiding costs and complications associated with replacing the perennial stream conveyance.

All Alternatives – Floodplain Storage Site(s) within Brugger's Bog Park would be a possible complement to all alternatives in order to provide attenuation of peak flows and minimize size of other system improvements and downstream impacts. Two primary areas are being considered for potential floodplain storage sites: within the southeast corner of the park northeast of existing Wetland "A"; and within the northwestern quadrant of the park alongside existing channel in an area presently overgrown with invasive blackberry. In addition to providing storage volume, floodplain storage sites would (1) avoid adverse impacts to existing critical areas and significant trees, (2) restore native vegetation, and (3) function as a park improvement/amenity. For Alternative 1 and 1A, these areas may also contain anadromous fish habitat and gravel supply.

Conceptual site plan sketches have been provided for the above alternatives, as well as an existing condition site plan showing aerial photography, property boundaries, streams and stream buffers within the project area.

AGENDA

City of Shoreline
25th Avenue NE Flood Reduction Project

Date: October 18, 2016
Time: 10:00am-noon
Location: City of Shoreline City Hall – Conference Room 301 (site visit to follow)

Purpose: To obtain feedback for regulatory agencies and Muckleshoot Indian Tribe Fisheries Division on preliminary flood prevention alternatives being considered by the City.

Invitees:
Andrew Shuckhart, US Army Corps of Engineers
Rebekah Padgett, Washington Department of Ecology
Larry Fisher, Washington Department of Fish and Wildlife
Karen Walter, Muckleshoot Indian Tribe Fisheries Division
John Featherstone, City of Shoreline
Mike Giseburt, Louis Berger
Shelby Petro, Herrera Environmental Consultants

Meeting Agenda

1. Introductions (John/All)

2. Project Background and Need for Improvements
    a. Existing Stream and Drainage System (John)
    b. History of Flooding (John)
    c. Existing Stream/Wetland Conditions/Fish Use (Shelby)
    d. Project Challenges (John)

3. Work Completed to Date (Mike)
    a. Field Survey (including utility potholing)
    b. Critical Areas Report
    c. Geotechnical Report
    d. Hydrologic/Hydraulic Modeling
    e. Coordination with WSDOT on Emergency Repair

4. Alternative Screening Process (Mike)

5. Three Main Alternatives (Mike)
    a. Alternative 1 – "Max Feasibility" (Daylight)
    b. Alternative 2 – Closed Conveyance
    c. Alternative 3 – High Flow Bypass

6. Specific Feedback (All)
    a. Design feedback on size and length of culverts/stream channel
        i. (specifically) Alternative 1 long culvert
    b. Permitting specifics:
        i. What permits (NWPs vs Individual) will be necessary?
        ii. What design elements may make permitting more or less complex?
    c. Mitigation possibilities:
        i. What design elements, if any, would trigger mitigation (on-site or off-site) beyond restoration of temporary impacts and "self-mitigation" of stream daylighting?
        ii. More specifically, what type and size/scale of mitigation (if any) would likely be required for each of three Alternatives presented?
7. Closing (John/All)
    a. Discussion of next steps
    b. Confirmation of any to-do items

Memorandum

DATE: Wednesday, October 12, 2016

TO: Karen Walter, Muckleshoot Indian Tribe Fisheries Division
Larry Fisher, Washington State Department of Fish and Wildlife
Rebekah Padgett, Washington State Department of Ecology
Andrew Shuckhart, US Army Corps of Engineers

FROM: John Featherstone, City of Shoreline

RE: 25th Ave NE Flood Reduction Project Early Pre-Design Feedback

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City of Shoreline

NE 25th Flood Prevention Project

Preliminary Alternatives - Draft 9/16/16

Alternative	Abbreviated Name	Brief Description	Property Acquisition or Easement Need	Fish/Habitat Benefit[2]	Mitigation	Utility Conflicts	Street Parking Impact	Maintenance Need/Risk	Order of Magnitude Cost (Million)
1	Maximum Feasibility	Max daylight within 25th Ave NE ROW - long culvert	No[1,3]	Provides fish passage, but long culvert that exceeds L<= 10*W, and daylighted channel straight, narrow, and highly confined Possible issue with new buffer from daylighted creek extending onto neighboring properties	Storage to mitigate peak flows may be required	Moderate utility conflicts (likely lower than Alternatives 1A , but more than 2 and 3)	Loss of existing parking in front of NMF site	Moderate maintenance needs. Wide culverts will tend to pass most debris and sediment. Long culvert could be difficult to clear if it does become plugged.	$8.2
1A	Maximum Feasibility - more daylighting	Max daylight within 25th Ave NE ROW - more daylight variation	No[1,3]	Provides better fish passage than Alternative A by splitting up long culvert into two shorter culverts. Daylighted channel is still straight, narrow, and highly confined Possible issue with new buffer from daylighted creek extending onto neighboring properties	Storage to mitigate peak flows may be required	High utility conflicts likely within area on east side of 25th Ave NE between NE 195th Lane and NE 195th Place.	Loss of existing parking between NE 195th Lane and NE 195th Place and in front of NMF site	Minimal maintenance needs. The wide culverts will tend to pass most debris and sediment.	$8.2+
2	Closed Conveyance	25th Ave NE system to be replaced with pipe system (sized for conveyance) and fish passable culvert at NE 195th St.	No[1]	Provides adult fish passage at NE 195th St only and does not meet WDFW fish passage criteria, so likely requires offsite mitigation.	Likely requires off-site habitat and/or passage mitigation. Storage to mitigate peak flows may be required	Moderate utility conflicts (likely lower than Alternatives A and more than 3)	No change to existing parking.	Maintenance would be similar to any other closed-pipe drainage system.	$6.7
3	High-Flow Bypass	High Flow Bypass that replaces and extends the existing high flow bypass to south of NE 195th St.	No[1]	The design for the high-flow bypass does not meet fish passage criteria.[5]	Likely requires off-site habitat and/or passage mitigation. Storage to mitigate peak flows may be required	Lowest utility conflicts - only Alternative which does not cross under SPU 66" main	No change to existing parking.	Maintenance would be similar to any other closed-pipe drainage system. If a fish screen is required, it could become a significant maintenance issue.[4]	$6.8

Notes

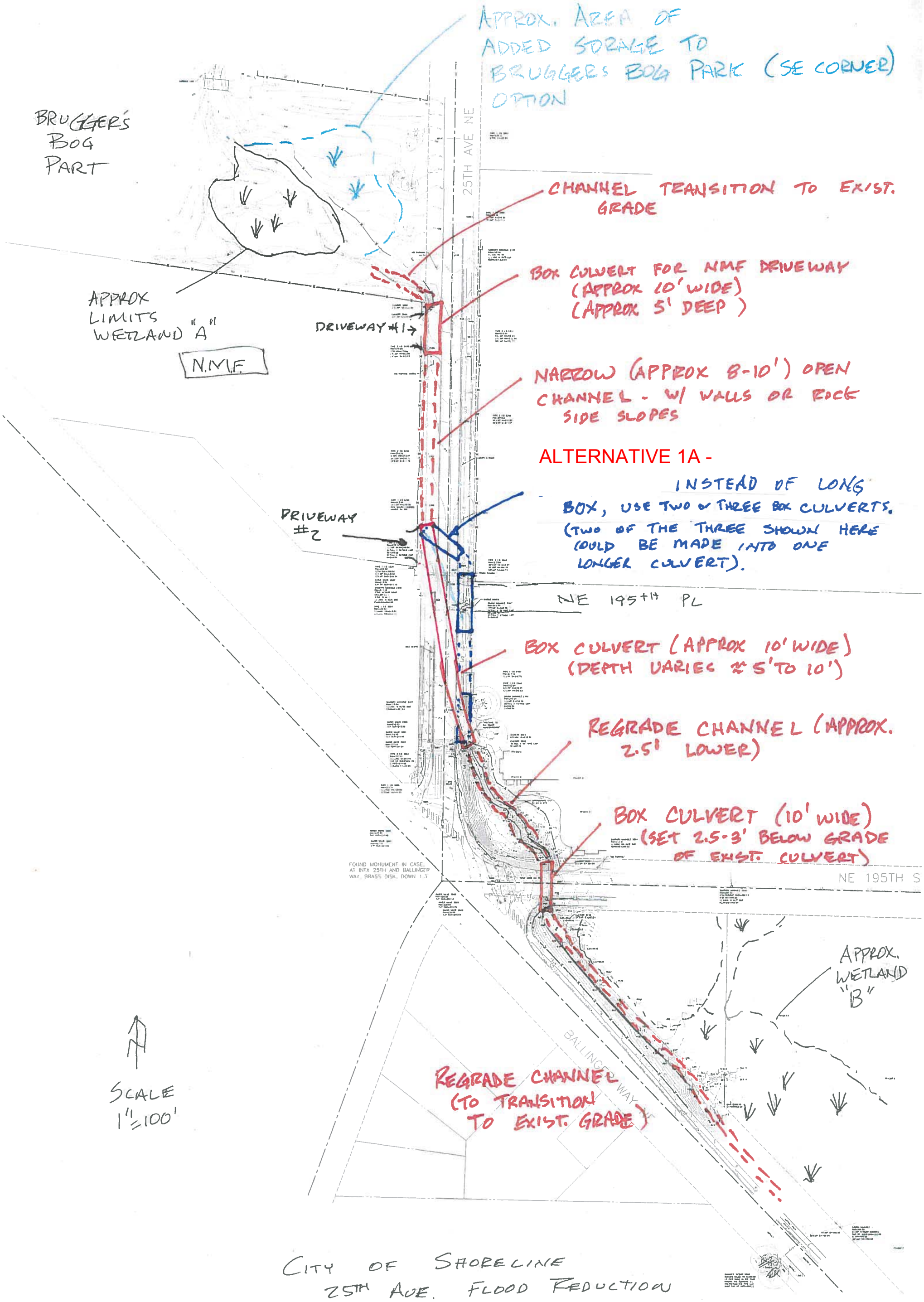
(1) There may be potential need for easement south of NE 195th Street to shift creek to east and reduce the potential to impact existing WSDOT gabion wall.

(2) Existing upstream fish habitat (particularly spawning habitat) is limited/fair quality, and the potential to create habitat (primarily for spawning) is limited to within the extents of Brugger's Bog Park. There is no documented fish presence (howver, this could be result that fish are flushed out of they system due to lack of off channel habitat and because of lack of upstream fish passage, are not able to recolonize). This information may support non-fish passage alternative if equitable off-site mitigation can be negotiated.

(3) Per current code (SMC 20.80.056), daylighting creek creates new "added" buffer requirement on adjacent property. Potential variance from this requirement currently being discussed with City Planning.

(4) The openings in fish screens tend to be very small which can clog easily. The probability of it being clogged during a significant event can be reduced by sizing it so that the total open area is several times the required open area or using a self-cleaning drum screen.

(5) Would have to show that fish would not be attracted to using the high-flow bypass by setting the bypass above fish-passage flow and/or the use of a fish screen. Also may be able to show that there is little to no fish habitat upstream. Because it does not provide fish passage, offsite mitigation likely required.


APPROX. AREA OF ADDED STORAGE TO BRUGGERS BOG PARK (SE CORNER) OPTION
BRUGGER'S BOG PART
25TH AVE NE
CHANNEL TRANSITION TO EXIST. GRADE
BOX CULVERT FOR NMF DRIVEWAY (APPROX 10' WIDE) (APPROX 5' DEEP)
APPROX LIMITS WETLAND "A"
DRIVEWAY #1
N.M.F.
NARROW (APPROX 8-10') OPEN CHANNEL - W/ WALLS OR ROCK SIDE SLOPES
ALTERNATIVE 1A -
INSTEAD OF LONG BOX, USE TWO OR THREE BOX CULVERTS. (TWO OF THE THREE SHOWN HERE COULD BE MADE INTO ONE LONGER CULVERT).
DRIVEWAY #2
NE 195th PL
BOX CULVERT (APPROX 10' WIDE) (DEPTH VARIES ≈ 5' TO 10')
REGRADE CHANNEL (APPROX. 2.5' LOWER)
BOX CULVERT (10' WIDE) (SET 2.5-3' BELOW GRADE OF EXIST. CULVERT)
FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'
NE 195TH S
APPROX. WETLAND "B"
BALLINGER WAY
REGRADE CHANNEL (TO TRANSITION TO EXIST. GRADE)
SCALE 1"=100'
CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES
ALTERNATIVE 1 - MAX FEASIBILITY

ALTERNATIVE 1

"Maximum Feasibility" seeks to daylight the maximum feasible length of Ballinger Creek within currently available space – the 25th Avenue NE right-of-way. The west side of 25th Ave NE (in front of the future NMF) is preferred due to multiple major utility conflicts on the east side; potential length of daylighted channel here is about 220', assuming the future NMF has driveways at both north and south corners of property. Coordination with the NMF and 25th Ave NE Sidewalk City CIP projects will be important to determine exactly where within the ROW that the daylighted channel can be located. A new culvert approximately 250' long would connect the new daylighted channel to the existing open channel at 2518 NE 195th St; the existing open channel at this location will need to be deepened.

ALTERNATIVE 1A -

In lieu of the 250' culvert described in Alt 1 above, a variation of this option could cross 25th Ave NE with a 70' culvert, enter a second daylighted channel (100' long) segment on the east side of 25th Ave NE within the ROW in front of 2500 NE 195th Pl, then enter an 80' driveway crossing culvert before connecting to the existing open channel at 2518 NE 195th St. Daylighting the channel at this location would need to consider issues with utility conflicts, parking/sidewalk needs, and buffer impacts at this location.

Alternative 1

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 10x5)	LF	372	$ 2,000	$ 744,000	
2	Headwall	EA	5	$ 50,000	$ 250,000	
3	Conc. Wall for Stream Side Slope	LF	360	$ 300	$ 108,000	
4	Stream Excavation	CY	1110	$ 40	$ 44,400	360 + 250 + 500
5	Stream Planting and Restoration	SY	2764	$ 100	$ 276,444	(8*260+570*30)
6	Road restoration	SY	1333	$ 200	$ 266,667	assume 300' x 40'
7	Utility Relocations	LS	1	$ 50,000	$ 50,000	
	Subtotal				$ 1,739,511	
	Items Estimated by % of Subtotal					
8	Mobilization	10%			$ 173,951	
9	TESC including temp diversions	15%			$ 260,927	
10	Traffic Control	10%			$ 173,951	
11	Dewatering	15%			$ 260,927	
12	Construction Survey and As-builting	5%			$ 86,976	
13	Removal of Structures and Obstructions	10%			$ 173,951	
14	Miscellaneous Small Bid Items	20%			$ 539,248	
	Subtotal Construction				$ 3,409,442	
	Construction Contingency	40%			$ 1,363,777	
	Planning Level Construction Cost (rounded nearest $10k)				$ 4,770,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 715,500	
	Permitting and Design + City Staff time	20%			$ 954,000	
	Design contingency	15%			$ 715,500	
	Property Acquisition	EST.				
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Offsite Mitigation	LS			$ 100,000	Assuming buffer restoration within BB Park
	Additional Items Subtotal				$ 2,505,000	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 8,180,000	

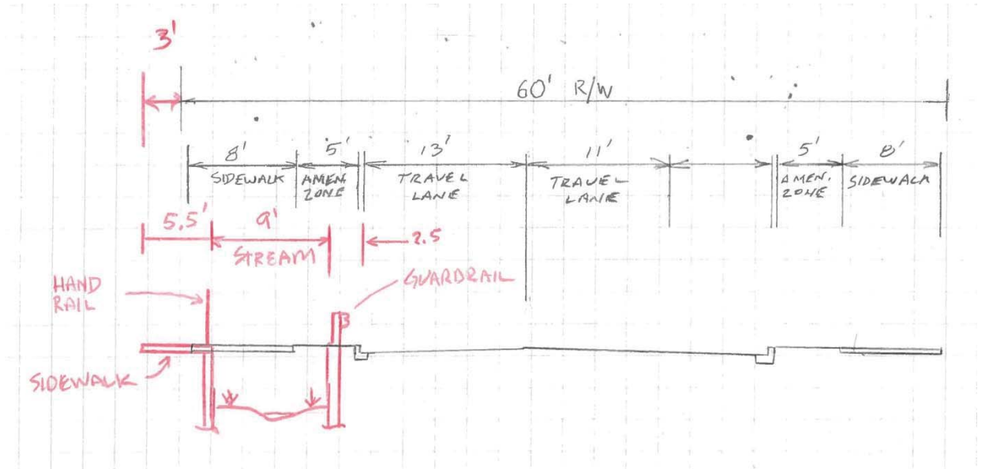


Figure 1-channel between sidewalk and street version

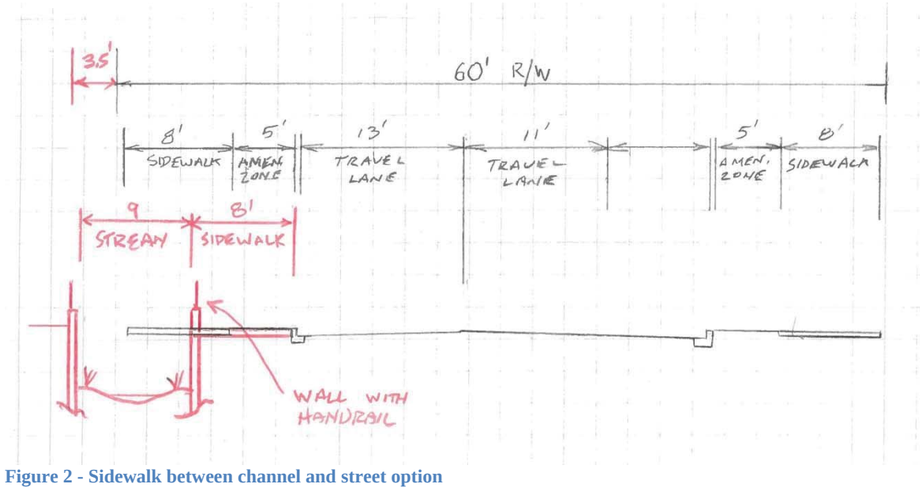


Figure 2 - Sidewalk between channel and street option

APPROX AREA ADDED STORAGE

BRUGGER'S BOG PART

APPROX LIMITS WETLAND "A"

N.M.F.

25TH AVE NE

REPLACE EXIST. HIGH FLOW BYPASS W/ NEW LARGE DIA. CONVEYANCE PIPE (± 72-INCH)(TO BE CONFIRMED)

NE 195th PL

REGRADE PORTION OF CHANNEL FOR TRANSITION

BOX CULVERT

(SAME AS 1)

FOUND MONUMENT IN CASE, AT INTX 25TH AND BALLINGER WAY, BRASS DISK, DOWN 1.3'

NE 195TH ST

APPROX. WETLAND "B"

REGRADE CHANNEL (TO TRANSITION TO EXIST. GRADE)

BALLINGER WAY NE

SCALE 1"=100'

CITY OF SHORELINE
25TH AVE. FLOOD REDUCTION
PRELIMINARY ALTERNATIVE SKETCHES

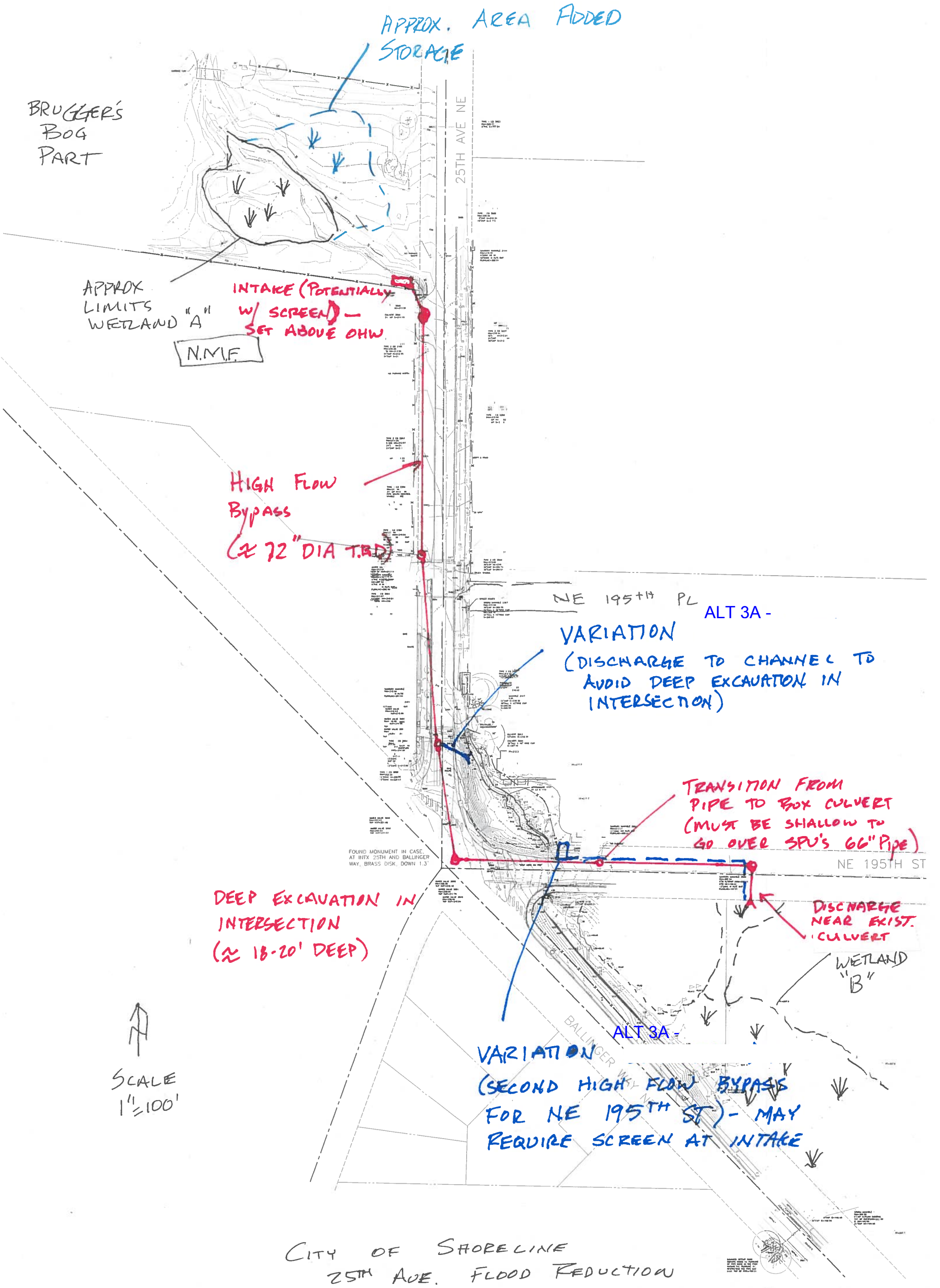
ALTERNATIVE 2 - CLOSED CONVEYANCE

ALTERNATIVE 2 - "Closed Conveyance" seeks to avoid potential space conflicts with other priority right of way uses (such as parking, sidewalk, driveway, and roadway) by replacing the existing piped stream system with conveyance sufficiently upsized to convey flood flows. Compliance with likely permitting/regulatory fish passage requirements could be challenging under this option. It is likely that off-site mitigation would be required. This Option most closely matches the project concepts presented in the Lyon Creek Basin Plan

Alternative 2

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 10x5)	LF	61	$ 2,000	$ 122,000	
2	Headwall	EA	1	$ 50,000	$ 50,000	
3	Conc. Wall for Stream Side Slope	LF	0	$ 300	$ -	
4	Stream Excavation	CY	750	$ 40	$ 30,000	250 + 500
5	Stream Planting and Restoration	SY	2533	$ 100	$ 253,333	(570*30)
5	Road restoration	SY	1400	$ 200	$ 280,000	assume 40x40 plus 450x20 plus 50x40
6	72-inch Pipe (approx)	LF	520	$ 650	$ 338,000	
7	96-inch manhole	EA	3	$ 15,000	$ 45,000	
8	Utility Relocations	LS	1	$ 50,000	$ 50,000	
	Subtotal				$ 1,168,333	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 116,833	
10	TESC including temp diversions	15%			$ 175,250	
11	Traffic Control	10%			$ 116,833	
12	Dewatering	15%			$ 175,250	
13	Construction Survey and As-builting	5%			$ 58,417	
14	Removal of Structures and Obstructions	10%			$ 116,833	
15	Miscellaneous Small Bid Items	20%			$ 362,183	
	Subtotal Construction				$ 2,289,933	
	Construction Contingency	40%			$ 915,973	
	Planning Level Construction Cost (rounded nearest $10k)				$ 3,210,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 481,500	
	Permitting and Design + City Staff time	20%			$ 642,000	
	Design contingency	15%			$ 481,500	
	Property Acquisition	AC	0.75	$ -	$ -	nearby multi family land assessment $1mill for .8 ac (or :
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Offsite Mitigation	LS			$ 1,000,000	Can be highly variable.
	Additional Items Subtotal				$ 2,625,000	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 6,740,000	

Figure 1 - Concept of what NE 195th St culvert could look like



ALTERNATIVE 3 - HIGH FLOW BYPASS

ALTERNATIVE 3 - “High Flow Bypass” seeks to resolve flooding issue by installing a bypass system for peak flows while avoiding costs and complications associated with replacing the perennial stream conveyance. It is likely that off-site mitigation would be required.

Alternative 3

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
1	Box Culvert (approx. 4x4) Storm Drain in Low Cover	LF	200	$ 600	$ 120,000	
2	High Flow inlet Structure	EA	1	$ 100,000	$ 100,000	Assume 30'x 6' wide x 8' deep vault (not including screer
3	Conc. Wall for Stream Side Slope	LF	0	$ 300	$ -	
4	Stream Excavation	CY	100	$ 40	$ 4,000	
5	Stream Planting and Restoration	SY	100	$ 100	$ 10,000	
5	Road restoration	SY	2222	$ 200	$ 444,444	assume 1000x20
6	54-inch Pipe (approx)	LF	800	$ 400	$ 320,000	
7	84-inch manhole	EA	6	$ 10,000	$ 60,000	
8	Utility Relocations	LS	1	$ 120,000	$ 120,000	
	Subtotal				$ 1,178,444	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 117,844	
10	TESC including temp diversions	15%			$ 176,767	
11	Traffic Control	10%			$ 117,844	
12	Dewatering	15%			$ 176,767	
13	Construction Survey and As-builting	5%			$ 58,922	
14	Removal of Structures and Obstructions	10%			$ 117,844	
15	Miscellaneous Small Bid Items	20%			$ 365,318	
	Subtotal Construction				$ 2,309,751	
	Construction Contingency	40%			$ 923,900	
	Planning Level Construction Cost (rounded nearest $10k)				$ 3,230,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 484,500	
	Permitting and Design + City Staff time	20%			$ 646,000	
	Design contingency	15%			$ 484,500	
	Property Acquisition	AC	0.75	$ -	$ -	
	Property Easement Acquisition	SF	333	$ 5	$ 1,667	assume 150 x 20
	Offsite Mitigation	LS			$ 1,000,000	Can be highly variable.
	Additional Items Subtotal				$ 2,616,667	
	Brugger Bog Floodplain Storage				$ 905,000	
	Conceptual Level Cost Estimate				$ 6,751,667	

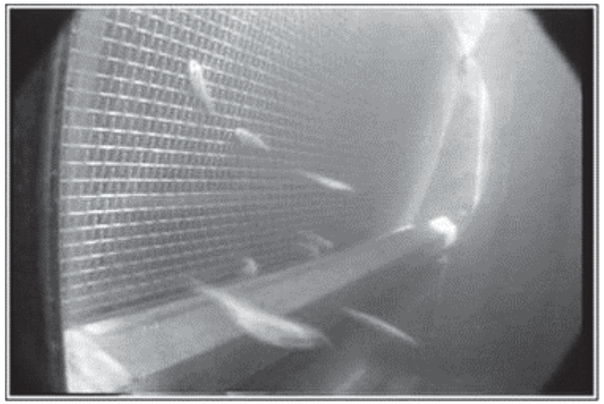


Figure 1 - Fish screens could be required at bypass inlets

Brugger's Bog possible floodplain storage and habitat improvement areas - NW area

Seattle City Light Easement - open water facilities highly discouraged

Existing playground

Existing bridge

Wetland 'A'

Ballinger Creek

25th Ave NE Flood Reduction project approximate limits of conveyance system improvements

Brugger's Bog possible floodplain storage and habitat improvement areas - SE area

BALLINGER WAY NE

23RD AVE NE

25TH AVE NE

NE 195TH PL

NE 195TH ST

Steel 66"

19800 19851 19833 19831 19842 19834 19827 19830 19820 19576 19570 19562 19552 19540 19547 19534 19526 19527 19524 19545 19547 19533 19524 19500 2545 2500 19530 2610 2136 19517 19516 19508 19519 19507 19504 2141 2133 2518 19230

0 50 100 200 Feet

25th Ave NE Flood Reduction Project
Site Plan Existing Conditions

Buffers shown are existing stream buffers only; wetland buffers not shown for clarity

CITY OF SHORELINE

N W E S

Floodplain Storage Site(s) within Brugger's Bog Park would be a possible complement to all options in order to provide attenuation of peak flows and minimize size of other system improvements and downstream impacts. Two primary areas are being considered for potential floodplain storage sites: within the southeast corner of the park northeast of existing Wetland "A"; and within the northwestern quadrant of the park alongside existing channel in an area presently overgrown with invasive blackberry. In addition to providing storage volume, floodplain storage sites would (1) avoid adverse impacts to existing critical areas and significant trees, (2) restore native vegetation, and (3) function as a park improvement/amenity. For Alternative 1 only, these areas may also contain anadromous fish habitat and gravel supply.

Buggers Bog Park Floodplain storage

Item No.	Description	Unit	Quantity	Unit Price	Total Cost	Comments
4	Stream Excavation	CY	2444	$ 40	$ 97,778	220 by 60 by ave 5' deep
5	Stream Planting and Restoration	SY	1467	$ 100	$ 146,667	220 by 60
	Subtotal				$ 244,444	
	Items Estimated by % of Subtotal					
9	Mobilization	10%			$ 24,444	
10	TESC including temp diversions	15%			$ 36,667	
12	Dewatering	10%			$ 24,444	
13	Construction Survey and As-builting	5%			$ 12,222	
14	Removal of Structures and Obstructions	5%			$ 12,222	
15	Miscellaneous Small Bid Items	20%			$ 68,444	
	Subtotal Construction				$ 422,889	
	Construction Contingency	40%			$ 169,156	
	Planning Level Construction Cost (rounded nearest $10k)				$ 590,000	
	Additional Items					
	Construction Engineering & Administration	15%			$ 88,500	
	Permitting and Design + City Staff time	20%			$ 118,000	
	Design contingency	15%			$ 88,500	
	Property Easement Acquisition	SF	4000	$ 5	$ 20,000	
	Additional Items Subtotal				$ 315,000	
	Conceptual Level Cost Estimate				$ 905,000	

Figure 1 - Possible concept similar to Brugger's Bog improvements

Appendix F.2
Coordination With Seattle Public Utilities

Giseburt, Michael S

From: Hwang, Paj <Paj.Hwang@seattle.gov>
Sent: Tuesday, September 20, 2016 1:35 PM
To: Giseburt, Michael S
Cc: John Featherstone (jfeatherstone@shorelinewa.gov); Pennock, Brooke; Weber, Mary B; Mantchev, Eugene; Schwartz, Isabella
Subject: RE: City of Shoreline - Culvert Replacement at NE 195th Street Under SPU's Tolt River Pipeline
Attachments: Optional Culvert Section Under SPU 66-inch Water Line.pdf; Final Survey 20150291-Shoreline 25th-State Plane-Model.pdf

Hi Michael
The SPU team was able to review the project today. In response to your questions:
-SPU is concerned that the proposed steel plate would corrode over time and could present future issues as it would be supporting the pipeline, backfill over pipeline, and traffic loading. We prefer that the box culvert top slab be concrete w/ min. 6" separation between the bottom of our water line to top of box culvert.
-To eliminate any voids, SPU desires CDF backfill between the exist. 66" pipe and new culvert.
-Yes, SPU would request temp. support stamped drawings and detailed construction sequencing and will be onsite for all construction impacting our water mains.
-During construction, we would also be concerned about loading over our pipeline from machinery. Generally, we would want to know the largest wheel load over our pipelines and do not want any point loads (from crane outriggers) on our pipeline. Stamped structural calcs may be required to ensure that the heaviest load does not impact our pipeline. Alternatively, stamped structural calcs may be required to ensure that any proposed mitigation (i.e. steel sheets) will be adequate to protect SPU lines.
-We would also want to know about any excessive vibrations anticipated with this construction. I don't believe there will be any that impact our pipeline, but just putting it out there early if there will be.

Feel free to give me a call with any questions. Thanks,
-Paj

Paj Hwang, P.E.
Senior Civil Engineer | Cathodic Protection Program
Engineering & Technical Services Division
Project Delivery & Engineering Branch | Seattle Public Utilities
PO Box 34018 | Seattle, WA 98124-4018
Tel (206) 386-4198 | Email: Paj.Hwang@seattle.gov
City of Seattle
http://www.seattle.gov/util/

From: Giseburt, Michael S [mailto:MGiseburt@louisberger.com]
Sent: Wednesday, September 07, 2016 2:32 PM
To: Pennock, Brooke <Brooke.Pennock@seattle.gov>
Cc: John Featherstone <jfeatherstone@shorelinewa.gov>; Weber, Mary B <MWeber@louisberger.com>
Subject: City of Shoreline - Culvert Replacement at NE 195th Street Under SPU's Tolt River Pipeline

Brook, this is a follow up to the City of Shoreline's 25th Avenue NE Flood Reduction Project. As you recall the City is planning to replace the existing culvert underneath NE 195th Street just east of Ballinger Way, and will cross below the 66" Tolt River Pipeline. The culvert is actually located in Lake Forest Park jurisdiction (with the corporate limits being on

the north edge of the NE 195th Street right-of-way), but the City of Shoreline is leading the project because the existing culvert is undersized and contributes to upstream flooding within the City of Shoreline.

We are assisting the City of Shoreline with the preparation of a pre-design report for the culvert replacement project. The existing culvert is a 24"x36" corrugated metal arch (CMP) which is set directly below the 66" line. We had the 66" line potholed (which was observed by SPU) and found the depth below grade surface was 38". There does not appear to be any clearance between the 66" pipe and the culvert. When the culvert is replaced, it will have to be replaced with a fish passable culvert to meet the Washington State Department of Fish and Wildlife requirements. We've determined that an approximate 10'x4' box culvert will be required, which will also need to be partially filled with fish friendly spawning gravels.

I've attached a .pdf of our base map survey for background information. The existing culvert is roughly half filled in with sediment and the downstream channel has sediment build up (see skematic of existing NE 195th St profile below) that is higher than the soffit of the culvert. There is also an existing gabion headwall around the culvert and wall along the east side of Ballinger Way downstream of the culvert which is very poor condition.

We have obtained a copy of SPU's requirements for crossing the pipeline (Standards for Utilities Installed in Proximity of Seattle Public Utilities Transmission Pipelines, June 2006). In this document, it states that the separation should be a minimum of 24-inches for all facilities installed under the pipelines. This would be extremely problematic for the City of Shoreline. Providing a 24-in separation, plus adding the thickness of a box culvert top slab, plus providing approximately 3 vertical feet of open culvert would require the stream grade be lowered about 4-5 feet below the existing stream grade. This would also undermine the downstream gabion wall. As a result we and the City of Shoreline would like to get your feedback on an optional design to minimize the separation between the 66" pipe and new culvert. Getting your input now during preliminary design is important for the City to know what to expect for permitting and the re-grading of the stream. Attached is a sketch of an optional design that utilizes a concrete box culvert with a steel plate top for the portion of the culvert directly under the 66" pipeline. This is a preliminary schematic to get SPU's feedback.

After the predesign report, we would move to preliminary and final design and prepare drawings for SPU's review and approval. For construction, we envision that the construction Contractor would shore the excavation and provide temporary support of the 66" pipe to place the new culvert. As a part of the construction documents, we would require the Contractor's engineer to provide stamped calculations for the temporary support and detailed construction sequencing. We assumed SPU representatives would be want to be on-site during construction.

The information we would like to get from SPU is:

- Would such an approach be acceptable to SPU?
- What would be the minimum allowable separation between the 66" line and the new culvert? (We've shown 8-inches on a preliminary basis, but if SPU would allow anything less than this that would be even better)
- What bedding material would SPU want between the 66" pipe and the new culvert?
- Are there other concerns about the new crossing and besides the design and temporary supporting calculations, what else would the City of Shoreline need to provide to obtain approval?

I originally received your name from Michael Brennan, but not positive if you are the one to review this type of request. Please let me know if this should be sent to someone else at SPU.

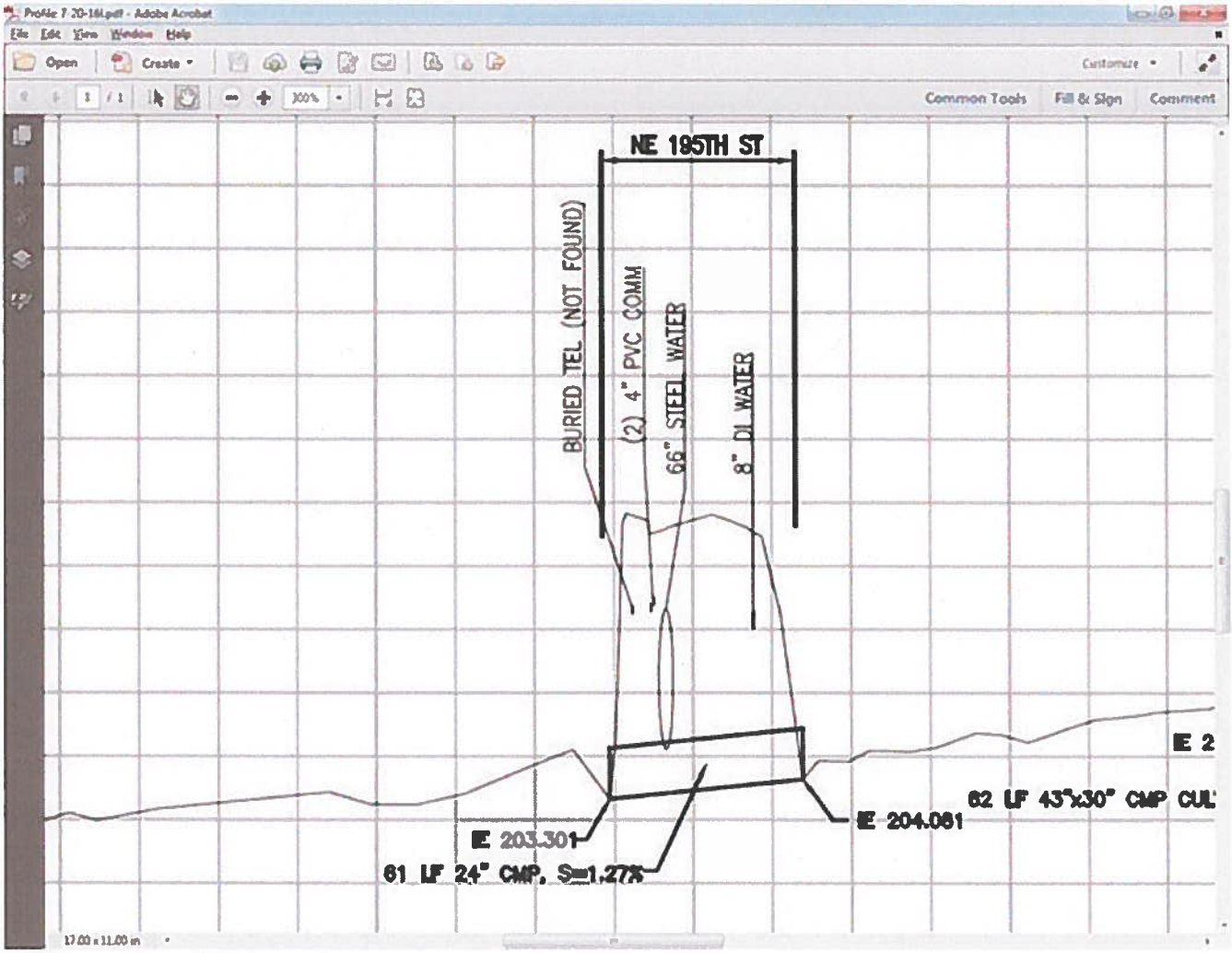


Figure 1- Existing profile NE 195th Street (looking west)

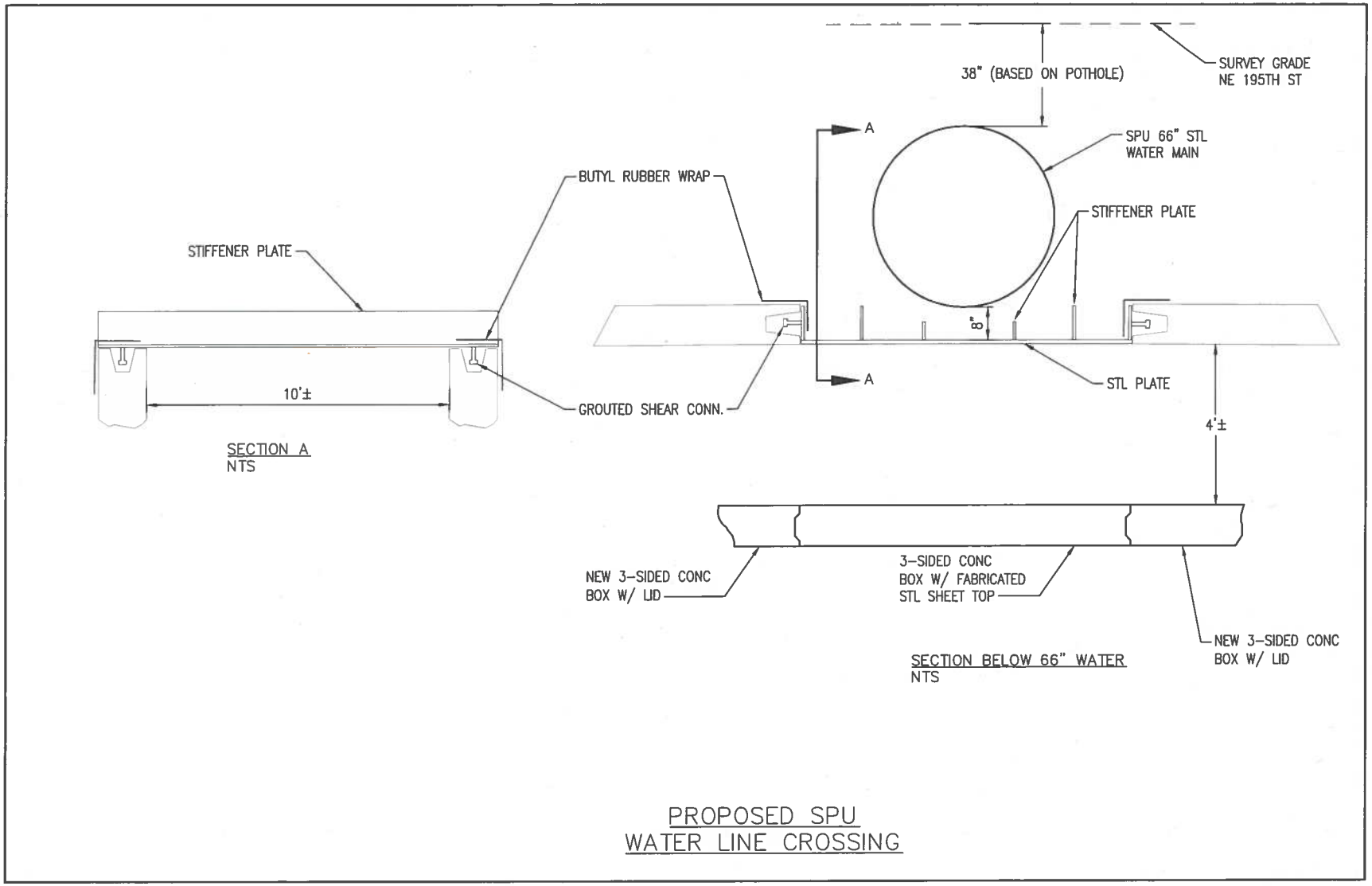
Thank you very much for your consideration and input.

Please contact me if you have any questions.

Mike Giseburt
Senior Project Manager | Water Services

direct +1.206.453.1549
mobile +1.206.556.5906
email mgiseburt@louisberger.com
web louisberger.com

Louis Berger
520 Pike Street, Suite 1005 | Seattle | Washington | USA | 98101
Learn more at louisberger.com/water.



PROPOSED SPU
WATER LINE CROSSING

Appendix F.3
Coordination with City of Shoreline Planning Department

CITY OF SHORELINE

Planning & Community Development

17500 Midvale Avenue North
Shoreline, WA 98133
(206) 801-2500 ♦ Fax (206) 801-2788

October 28, 2016

John Featherstone, Engineer II Surface Water
Shoreline Public Works Department
17500 Midvale Ave N
Shoreline, WA 98133

Re: Pre-application meeting #202189 for flood reduction project on 25th Ave NE.

Dear John:

Thank you for attending the pre-application meeting on September 27, 2016 to discuss the alternative concepts for the flood reduction proposals on 25th Ave NE. The following is a summary of the issues discussed. This summary is not intended to represent a review of the plans submitted to date. You are responsible for compliance with the codes upon submittal of a formal application. Please let us know if you have any additional questions.

Codes and Regulations:
Shoreline Municipal Code (SMC)
Shoreline Comprehensive Plan (SCP)
City of Shoreline Engineering Development Manual
2012 Department of Ecology Stormwater Management Manual for Western Washington

SHORELINE DEVELOPMENT CODE AND COMPREHENSIVE PLAN
Paul Cohen (206) 801-2551

1. The three project options involve flood control in environmentally Critical Areas of wetlands and streams that parallels 25th Ave NE and include both City R-o-W and private property. These options may involve the cooperation of these property owners – the Shoreline School District (Aldercrest), City of Shoreline (Brugger's Bog Park and utility yard). City of Lake Forest Park, and private property at 2500 NE 195th Pl. and 2518 NE 195th St.
2. Your project will require a CASUP approval because it is public agency or utility proposing work in a Type S or Type F anadromous stream under SMC 20.80.276 (D)(1). Under the CASUP criteria.

SMC 20.30.333 Critical area special use permit (Type C action).
A. Purpose. The purpose of the critical areas special use permit is to allow development by a public agency or public utility when the strict application of the critical areas standards

would otherwise unreasonably prohibit the provision of public services. This type of permit does not apply to flood hazard areas or within the shoreline jurisdiction.

B. Decision Criteria. A critical areas special use permit shall be granted by the City only if the utility or public agency applicant demonstrates that:

1. The application of the critical areas regulations, Chapter 20.80 SMC, Critical Areas, would unreasonably restrict the ability of the public agency or utility to provide services to the public;

2. There is no other practical alternative to the proposal by the public agency or utility which would cause less impact on the critical area;

3. The proposed development does not create a health or safety hazard on or off the development site, will not be materially detrimental to the property or improvements in the vicinity;

4. This special use permit process shall not allow the use of the following critical areas for regional retention/detention facilities except where the Hearing Examiner makes a finding that the facility is necessary to protect public health and safety or repair damaged natural resources:

a. Type S or Type F anadromous streams or buffers;

b. Category I wetlands or buffers with plant associations of infrequent occurrence; or

c. Category I or II wetlands or buffers which provide critical or outstanding habitat for herons, raptors or State or Federal designated endangered or threatened species unless clearly demonstrated by the applicant, using best available science, that there will be no impact on such habitat;

5. Any alterations permitted to the critical area are mitigated in accordance with SMC 20.80.082 and relevant mitigation standards for the impacted critical area(s);

6. Consistent with SMC 20.80.050, Alteration of critical areas, the proposal attempts to protect the existing critical area functions and values consistent with the best available science and attempts to mitigate adversely impacted critical area functions and values to the fullest extent possible; and

7. The proposal is consistent with other applicable regulations and standards.

C. Permit Conditions. The Director may condition the proposed activity as necessary to mitigate the impacts to critical areas and to conform to the standards required by Chapter 20.80 SMC, Critical Areas.

SHORELINE SURFACE WATER DESIGN AND ENGINEERING
Kevin Kinsella (206) 801-2428

Drainage requirements:

1. All surface water design has to meet the 2012 Stormwater Management Manual for Western Washington (DOE), and the City of Shoreline Engineering Development Manual.
2. The City will be looking for low impact development (LID) stormwater mitigation for the project.
3. A SWPPP and drainage report, meeting the requirements of the 2012 Stormwater Management Manual for Western Washington (DOE), and the City of Shoreline Engineering Development Manual, may be required.
4. Depending on the total land disturbance created by the project, a NPDES permit may be required.

Frontage Improvements:

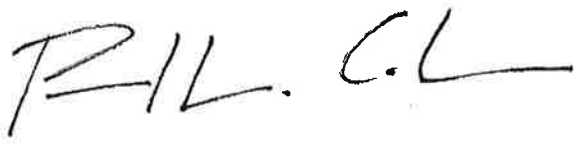
5. The Engineering Development Manual street matrix specifies street improvements on 25th Ave NE, between NE 195th and NE 200th, consisting of a 13' travel lane, 6" curb, 5' amenity zone, and an 8' sidewalk on the west half; and 11' travel lane, 8' parking, 6" curb, 5' amenity zone, and an 8' sidewalk on the east half.

Resources:

6. 2012 Engineering Development Manual: http://www.shorelinewa.gov/index.aspx?page=251.
7. Stormwater Management Manual for Western Washington – 2012: http://www.ecy.wa.gov/programs/wq/stormwater/manual.html
8. LID Manual 2012 – Low Impact Development Technical Guidance Manual for Puget Sound: http://www.psp.wa.gov/gov/downloads/LID/LID manual 2005.pdf.

NOTE: This information is time sensitive and subject to change. A pre-application meeting does not vest this proposal under the current code, nor does it constitute full review of submitted material. If more than a year has passed since this meeting and an application has not been submitted, a new meeting may be required to satisfy SMC 20.30.080.

Sincerely,



Paul Cohen,
Project Manager

cc: File #202189

25th Avenue NE Flood Reduction Project

Meeting Summary Minutes - DRAFT

Meeting Date: September 27, 2016 (9 am – 10:30)
Meeting Location: City of Shoreline City Hall – Conference Room 107

Attendees:

Paul Cohen, City of Shoreline
Juniper Nammi, City of Shoreline
Kevin Kinsella, City of Shoreline
John Featherstone, City of Shoreline
Shelby Petro, Herrera Environmental Consultants

Purpose of Meeting: *To engage in the City of Shoreline pre-application process for the 25th Avenue NE Flood Reduction City CIP Project. The project team set up the pre-application at this time specifically in order to receive input on potential new buffers for critical areas to be voluntarily restored under this project, daylighted stream channels in particular.*

Summary of Discussion Items:

1) CASUP: Project will require a Critical Area Special Use Permit (CASUP), the application for which should be made around 30-60% design level (same time as SEPA). This will allow the reviewers to comment and re-design to occur as needed. The application will go through a hearing examiner which will result in a staff report. There is a targeted 120-day processing timeframe.
2) SEPA: Joint Shoreline – Lake Forest Park (LFP) review could possibly be done for critical areas and SEPA documentation. More discussion with COS and LFP would be necessary to combine other reviews under a Memorandum of Understanding (MOU). However, this would not necessarily make the review process easier and so it may be more straightforward to keep the formal processes for these two cities separate.
3) North Maintenance Facility:

a) If the 25th Ave NE project daylights Ballinger Creek before the North Maintenance Facility (NMF) is constructed (or, more accurately, if 25th Ave NE vesting permits are vested prior to NMF vesting permits), then the new critical area (stream) buffer will extend onto the NMF property. The owner (City/Public Works) would have to agree to have the creek buffer on the NMF property, and NMF project would then have to apply for a CASUP and request a buffer reduction.
b) However, if the NMF constructs (permits are vested) before the daylighting of the creek, daylighting the creek should have no effect on the configuration of the already-redeveloped site.
c) If construction schedules are similar for both projects, then the projects could do a joint CASUP. Permitting the two projects would be simplest if the NMF constructs their project before daylighting Ballinger Creek along 25th Ave NE.

4) Daylighted Creek Buffers: this is an important issue as the width of post-daylighting stream buffers could greatly impact the project team's ability to daylight the creek within the right-of-way and at other locations, and both City Council and permitting agencies (such as Tribes, Dept of Fish and Wildlife, and Army Corps of Engineers) have expressed a strong interest that any stream conveyance improvement projects will need to daylight the creek to the maximum extent feasible.
   a) Because the project is a volunteer daylighting project, a critical area buffer reduction can be requested through the CASUP. The buffer reduction amount will be a negotiation by which the applicant requests a reduction (providing justification) and the COS will respond with a counter reduction width or accept the request.
   b) The buffer reduction request could incorporate limiting buffers to front yard setbacks and areas where there is existing vegetation, so as to not impact neighboring properties.
   c) Where applicable, the applicant can make a case that there is a functional isolation in areas where there is 8 feet or more break in vegetation in the buffer (SMC 20.80.200.D.7). Doing so may eliminate the need to request permission from private property owners to allow a critical area buffer on their property.
5) Voluntary daylighting is self-mitigating (SMC 20.30.333) because the proposed project is leaving the stream in the same or better condition after implementation of the project. No mitigation for buffer reduction would be necessary.
6) If any wetlands / floodplain storage facilities are designed to meet the criteria of "stormwater detention facilities", then there are no COS buffer requirements.
7) An Engineering Deviation application would be necessary for any stream daylighting within the R-o-W as there is no allowance for daylighted channel width within the EDM street matrix.

Appendix F.4
Coordination with City of Lake Forest Park

25th Avenue NE Flood Reduction Project

Meeting Summary Minutes

Meeting Date: October 13, 2016 (10 am – 11:30)
Meeting Location: City of Lake Forest Park City Hall

Attendees:

Neil Jensen, City of Lake Forest Park – City Engineer
Aaron Halverson, City of Lake Forest Park - Environmental Programs Manager
Ande Flower, City of Lake Forest Park - Principal Planner
John Featherstone, City of Shoreline
Mike Giseburt, Louis Berger
Shelby Petro, Herrera Environmental Consultants (via phone)

Purpose of Meeting: *To update City of Lake Forest Park on current project status and collect feedback on key issues. A copy of the agenda is attached at the end of these minutes.*

Summary of Discussion Items:

1) General comments:
   a) Results of electrofishing for WSDOT gabion wall repair project at NE 195th St: a couple of cutthroat trout and a Coho were found in the small channel segment upstream of 195th. Fish size was unconfirmed, possibly ranging from 3-8 inches
   b) LFP suggested Shoreline should coordinate with the Snoqualmie tribe. **Action: Neil will provide contact information to John.** For a recent Lake Forest Park project (McAleer culvert at NE 178th St), the Snoqualmie tribe appeared to be mostly interested in potential artifact recovery (cultural resources).

2) LFP Permitting/Planning/Critical Areas:
   a) New critical areas regulations to be released in December. **Action: Ande to provide copy of draft updates to Mike.**
   b) Under the proposed rules, the stream and culvert improvements which could potentially be done under the 25th Ave NE Flood Reduction Project would be

permitted through a process that starts with Public Agency Utility Exception (PAUE), which includes a public hearing. PAUE is submitted at the same time as SEPA, typically at 60% design level.

c) Ande was open to the idea of the project team submitting a single "blanket" SEPA application which covers the whole project area and is organized to present required information of interest to separate jurisdictions. This would potentially allow for separate reviews by both City of Shoreline and City of Lake Forest Park. Threshold decision will be made by each jurisdiction separately.
d) Critical areas include trees – we will need an arborist report with an inventory of significant trees. **Action: Ande will send information about tree requirements**. Ande also noted that City has an arborist if we want to use them.
e) Major Sensitive area work permit – to include narrative, 60% design, tree inventory report by arborist
f) Tree removal permit is submitted around same time as PAUE and SEPA
g) Other permits including ROW, clearing/grading permits should be submitted at 90% design.
h) The City had a similar daylighting project recently. **Action: Ande to provide the hearing examiner and staff report for the PUAE from the other LFP project with daylighting creek**
i) If realigning creek, it could require property approval of the buffer change. However, most of this property is already encumbered by existing wetland and stream buffers (which may also be increasing when LFP updates their critical area code), so it may be that the buffer impact would be effectively insignificant from shifting Ballinger Creek by a relatively small amount. If the project team cannot get property owner approval of buffer change, an option would be to keep the existing buffer (or as modified by the new regulations) and provide buffer enhancement (such as planting) as mitigation for not increasing the buffer width.
j) New surface water easement south of NE 195th Street, if needed, would likely be obtained by City of Lake Forest Park with associated costs paid from the City of Shoreline 25th Ave NE project budget. Lake Forest Park noted that for a similar recent stream project (Lyon Creek Flood Mitigation Project), they needed to use eminent domain to obtain easements. Due to issues with the failed gabion wall and existing stream location immediately along the wall, the narrow width of available right-of-way eastward of the failed wall, and the likely need to deepen the channel, it currently appears fairly likely that the project team could need to obtain an easement at this location.

3) Downstream mitigation:
   a) John reviewed map of downstream culverts with the idea of potential mitigation opportunities to enhance fish passage along Ballinger Creek upstream of the confluence with Lyon Creek. Culverts noted on the map included two Ballinger Way NE culverts, Forest Park Drive, and 30th Ave NE (unimproved ROW).
   b) LFP does not have any current plans to improve any of the culverts between the Lyon Creek confluence and NE 195th Street (6-10 year outlook). Currently planned culvert improvements are limited to the main stem Lyon Creek.
   c) Aaron mentioned the culvert at the 30th Ave NE unimproved ROW (pedestrian trail) is a fish passage barrier, and may be a good fit for a potential mitigation opportunity (if offsite mitigation required for the project). This culvert is 48-inch diameter CMP with an unusual design (referred to as stacked cut culvert) and an erosion issue at the downstream end. Improvements would not need to accommodate the various project needs associated with replacing a culvert crossing an active roadway (e.g., added cost of pavement/sidewalk restoration, temporary traffic control, fewer utility conflicts, etc.). There is also upstream armoring (concrete thrown into channel) that could be removed and restored. LFP did not think there was too much storage (providing flood attenuation) upstream of this culvert.
   d) The culvert at Forest Park Drive is undersized, causing some nuisance (yard) flooding upstream.
   e) LFP noted that Ballinger Creek flows through a large wetland area on LFP property southwest of the LFP maintenance yard at 19201 Ballinger Way NE.

4) Stakeholder engagement within Lake Forest Park
   a) Lake Forest Park Stewardship Foundation (LFPSF) – LFP confirmed that LFPSF would be good to contact regarding this project, and thought that a representative from LFP should be on hand should Shoreline attend an LFPSF meeting as project outreach. Neil offered to be main point person to coordinate for this, thought that himself, Frank, or Aaron could attend.
   b) Aaron offered that Tom Murdock of the local Adopt-A-Stream Foundation would be worth contacting as a potential advocate for the project.
   c) LFP could think of no other major stakeholders within LFP that Shoreline should coordinate with for the 25th Ave NE project.

AGENDA

Thursday, October 13, 2016
10:00-11:45am Lake Forest Park City Hall - 17425 Ballinger Way NE

Purpose:
The 25th Ave NE Flood Reduction Project is developing conceptual design alternatives and seeking feedback from key stakeholders as part of this process.

Attendees:
Neil Jensen, City of Lake Forest Park
Aaron Halverson, City of Lake Forest Park
Ande Flower, City of Lake Forest Park
John Featherstone, City of Shoreline
Mike Giseburt, Louis Berger
Shelby Petro, Herrera

Desired Outcome:
Update City of Lake Forest Park on current project status and collect feedback on key issues

Discussion Items:

1. Project updates (information to be presented)
    a. Tasks currently completed and/or underway
        i. H&H Modeling results
    b. Coordination with WSDOT NE 195th St gabion wall repair, including for cleaning and CCTV inspection of NE 195th St culvert
    c. Description of conceptual alternatives, with emphasis on work and impacts within LFP, including:
        i. NE 195th St culvert
            1. interface with WSDOT design
            2. Interactions with SPU regarding Tolt pipeline
        ii. Channel d/s of NE 195th culvert
            1. Estimated length, profile, section of improvements
            2. WSDOT failed gabion wall complications
            3. Possible need for new easement(s)
            4. Possible impacts to Wetland B
            5. Ballinger Way NE crossing culvert
            6. Erosion complaints received from property owners at 19235 Ballinger Way NE during ROE process
        iii. Expected post-project peak flow impacts downstream of project area
    d. Overview of near-term stakeholder outreach plan
2. Questions/topics for discussion (information to be requested)

a. LFP permitting/regulatory requirements
    i. What permits may be required from Public Works? Planning?
    ii. Any potential changes in requirements due to pending Critical Areas Ordinance update?
    iii. Any interest in doing a Shoreline-LFP MOU, particularly for SEPA review, and maybe also for critical areas?
    iv. If Ballinger Creek alignment downstream of NE 195th St is shifted away from gabion wall, would updated buffers need to be considered and could there be any issues with obtaining permission to do so?
    v. How were buffering and critical area permitting issues handled for the LFP Lyon Creek project daylighting?
b. Downstream impacts
    i. Discussion of LFP's plans for any fish passage restoration efforts along Lyon and Ballinger Creeks
    ii. Discussion of any potential project mitigation sites within LFP, particularly with regard to fish passage mitigation
    iii. Any particular downstream locations of concern (flooding/erosion/failing infrastructure/etc)?
c. Discussion of easement acquisition need, process, etc. for channel downstream of NE 195th St. Title reports have shown no surface water easements for 2525 and 2609 NE 195th St.
d. Feedback on stakeholder outreach plan
    i. LFP desired involvement for various stakeholder contacts including meetings, calls, emails, etc.
    ii. What (public/private) stakeholders specific to LFP should be contacted? Who/how/when/why…
    iii. Anything/anyone we missed?
e. General feedback
    i. NE 195th St culvert
    ii. SPU coordination regarding Tolt pipeline
    iii. Advice on utility coordination within LFP. NE 195th St culvert crosses:
        1. Sewer (LFP)
        2. Water (North City WD)
        3. Water (SPU)
        4. Comm
    iv. Any other questions, comments, concerns, advice.

Appendix G
Summary of Potential Grant Programs

Grant Name	Funding Source (Agency)	Amount	Grant Description	Level of Effort	Application Requirements	Application Open Period	Due Date	Source (Link)	Notes	Applicability
Flood Reduction Grants	King County Flood Control District	Up to $3.32 million; no cap; match encouraged by not required (typical award $11,000 - $400,000)	Targets medium and small local flood reduction projects including projects where the control of stormwater will have a direct benefit in reducing flooding.	Grant Application Process: - Application submitted to King County Water and Land Resources Division staff - Applicants will be contacted to set up site visits or phone interviews with technical experts - Selection team will develop a list of recommended projects for funding to submit to the Flood Control District Board of Supervisors	Application components: - Project objectives - Proposal - Project team qualifications - Readiness to proceed	RFP issued in spring (as early as March) 2017	Application due April/May 2017	http://www.kingcountyfloodcontrol.org/default.aspx?ID=62	Ineligible projects include those that: are eligible for WRIA funds; transfer flooding problems up or downstream; adversely impact habitat or water quality; provide compensatory mitigation under a regulatory requirement.	High - Project meets criteria of program and has already received grand funding.
Pre-Disaster Mitigation Grant	Federal Emergency Management Agency (FEMA)	variable, $150,000 to $4 million; only funds up to 75% of costs and must be paired with non-Federal sources	The PDM Program is designed to assist applicants in implementing a sustained pre-disaster natural hazard mitigation program. Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters, most effective when implemented under a comprehensive, long-term mitigation plan.	Online application through Mitigation eGrants system on the FEMA Grants Portal. Applications must be tracked by applicants through the FEMA portal - no notifications sent to applicants. Application requires high level of effort, including a cost-benefit analysis.	Online application, Project information, Cost Benefit Analysis.	March	June	https://www.fema.gov/pre-disaster-mitigation-grant-program	LFP received one of these grants for their Lyon Creek flood mitigation project, and the WA EMD which manages this grant on the state level was interested in our project as a potential funding candidate. Further research needed on this grant to determine if it would be worth the time and cost for the application process as well as the (what I'm assuming is) a fairly arduous grant management task. May require subcontracting with a specialist consultant to do the BCA (benefit cost analysis) portion of the grant application.	High - Project meets criteria of program, WA EMD was interested in the project as a potential funding candidate in early 2016.
Sub-Regional Opportunity Fund	King County Flood Control District	Variable	The Sub-Regional Opportunity Fund can be used for flood control, stormwater control, and cooperative watershed management projects. Salmon habitat protection projects must be linked to the construction of a flood or stormwater project.	Submit application form to Kim Harper at kim.harper@kingcounty.gov	Application form It is encouraged to contact King County to discuss project ideas prior to submitting the application.	NA	October (variable)	http://www.kingcountyfloodcontrol.org/default.aspx?ID=57	The project must be completed within two years after the commencement date of the project. This fund can be used as a match for other grants, including the ESRP, SRFB, WWRP, and Ecology Water Quality Grants.	High - Stormwater and flood focused funding. The project is already using City of Shoreline SROF funding.
Centennial Grants	Washington Department of Ecology (Ecology)	Variable with 25% match grant limits that vary based on project type; maximum amount for cash only match is $500,000 with in-kind contributions is $250,000	The Centennial program provides grants for water quality infrastructure and nonpoint source pollution projects to improve and protect water quality. Eligible infrastructure projects are limited to wastewater treatment construction projects for financially distressed communities. Eligible nonpoint projects include stream restoration and buffers, on-site septic repair and replacement, education and outreach, and other eligible nonpoint activities. Annual Water Quality combined application process: one application can be submitted for Centennial Grants, 319 grants, or CWSRF loans	Online application through EAGL	Online forms	August (annually)	October (annually)	http://www.ecy.wa.gov/programs/wq/funding/fundprgms/Cent/oppCent.html	Consider project similarities to Padden Creek daylighting project (which was paired with an Ecology loan). Deadline for 2017 application is unknown, check back in June (Patricia Brommer 360-407-6566)	Medium - Grant targets water quality improvement projects. Nonpoint projects include stream restoration.
Five Star & Urban Waters Restoration Programs	National Fish and Wildlife Foundation (and others)	$20,000 to $50,000, with 100% non-federal match required	Projects focused on improving water quality, watersheds, and the species and habitats they support. Funding priorities for this program include on-the-ground wetland, riparian, in-stream, and/or coastal habitat restoration; education and training activities; measurable ecological, education, and community benefits; and partnerships to achieve ecological and educational outcomes.	Online application through Easygrants	Proposal components: - Narrative - Board of Trustees or Directors - Financial documents - Statement of litigation - GAAP Audited Financial Statements - IRS Form 990 - Applicant data sheet - Metrics - Budget - Matching contributions - Permits and/or approvals - (Optional) conceptual or engineered plans - (Optional) letters of support - (Optional) project site maps	RFP issued in November 2016	Proposal due late January/early February 2017	http://www.nfwf.org/fivestar/Pages/2016RFP.aspx		Moderate - Restoration project elements may be eligible; however the grant targets water quality improvement, which isn't a key element of this project; small dollar amount.
Salmon Recovery Grants	WA State Recreation and Conservation Office Salmon Recovery Funding Board (SRFB)	Variable, with 15% match req., and no grant cap (except design-only projects, limited to $200,000)	Projects that protect existing, high quality habitats for salmon, and restore degraded habitat to increase overall habitat health and biological productivity. Typical projects include replacing fish barriers, replanting stream banks, removing dikes and levees, installing LWD, and buying pristine habitat.	Grant Application Process (3 months): - Submit application to lead entity - Lead entities may request technical review of proposals before the application deadline; applicants must coordinate with the lead entity to obtain this review - Submit online application through PRISM - 3 Phase project evaluation: local entity evaluates and ranks applications in its area; the SRF Board reviews all projects for eligibility; the SRF Board's Scientific Review Panel evaluates each project proposal for technical merits and identifies specific concerns regarding the salmon benefits and certainty of success	Applicants must demonstrate how their projects address the goals and actions defined in the regional recovery plans or lead entity strategies. Check with local entity for specific proposal/application requirements.	February (variable date)	August (variable date)	http://www.rco.wa.gov/grants/salmon.shtml		Moderate - Project alternatives include daylighting Ballinger Creek and creating fish passage and habitat.
Section 319 Grants	Washington Department of Ecology (Ecology)	Variable with 25% match and cap of $250,000 for any combination match or $500,000 with cash only match	Typical water quality projects include agricultural BMPs; education and stewardship; water quality monitoring; lake water quality monitoring; riparian and wetlands habitat restoration and enhancement; stream restoration; TMDL plan development and implementation; and wellhead protection. Annual Water Quality combined application process: one application can be submitted for Centennial Grants, 319 grants, or CWSRF loans.	Online application through EAGL	Online forms	September 1, 2017	November (variable, first week of Nov), 2017	http://www.ecy.wa.gov/programs/wq/funding/opportunities319.html		Moderate - Grant targets water quality improvement projects, which the project would achieve.
Stormwater Financial Assistance	Washington Department of Ecology (Ecology)	$5 million, per community; 25% match required	Projects that address existing pollution problems and provide a high level of water quality benefit.	Online application through EAGL	Online forms	August 1 (annually)	2nd week of October (annually)	http://www.ecy.wa.gov/programs/wq/funding/FundPrgms/Stormwater/oppSW.html		Moderate- Grant targets water quality improvement projects, which the project would achieve.
Watershed Planning Implementation and Flow Achievement Grants	Washington Department of Ecology (Ecology)	Variable	Projects that increase flows below the project site; improve instream and riparian zone conditions (such as enhancing fish passage or habitat); reorganizing or concentrating points of diversion; establishing water banks, water exchanges, or pursing trust water opportunities; improving public water supply or irrigation district infrastructure that leads to water savings; purchasing and installing meters, stream gages, or groundwater monitoring equipment when water savings and/or efficiencies can be expected.	Online application through EAGL	Online forms	February 1, 2017	April 30, 2017	http://www.ecy.wa.gov/programs/wr/funding/fo-wspifa.html		Moderate - Project meets most criteria of program.
Cooperative Watershed Management Grant Program	WRIA 8 Salmon Recovery Council and King County Flood Control District	Varies annually; 2016 funds were approx $1.6 million; matching funds not required	Habitat restoration and acquisition projects, monitoring activities, and outreach and education programs located within the King County portion of WRIA 8.	Email application materials to jason.wilkinson@kingcounty.gov	Project sponsors submit an application form, budget worksheet, and relevent WRIA 8 supplemental application form with supplemental materials	January	March	http://www.govlink.org/watersheds/8/funding/default.aspx		Low - Restoration project elements may be eligible; however WRIA 8's focus is on Chinook, which are not in Ballinger Creek.
Bring Back the Natives/ More Fish	National Fish and Wildlife Foundation (NFWF)	$50,000 to $100,000+, with 100% non-federal match required	Program funding priorities focus on projects that produce measurable outcomes for native fish species of conservation concern. Because the leading factors in native fish species decline are habitat alteration, climate change, and invasive species, projects that address these threats are of particular interest. In the Pacific Northwest, projects should focus on benefiting Western native trout and char (including CA Golden trout; Eagle Lake Rainbow trout; Lahontan, Rio Grande, Yellowstone, Colorado, and Westslope Cuttrhoat trout; Bull trout, Apache trout, and Gila trout) and West Coast salmon and steelhead (especially Oregon Coastal Coho; Southern OR/Northern CA Coast Coho; Central CA Coast Coho; Central CA Coast Steelhead; and South-Central CA Coast Steelhead) through restoring habitat connectivity; restoring riparian, instream habitat, and water quality; invasive species management; and innovation and game changing research.	Online application through Easygrants	Proposal components: - Narrative - Board of Trustees or Directors - Financial documents - Statement of litigation - Budget - Matching contributions - Permits and/or approvals - (Optional) photos - (Optional) letters of support - (Optional) project site maps	June (annually)	July (annually)	http://www.nfwf.org/bbn/Pages/home.aspx	Projects must start within 6 months of grant award, or can be back-dated up to one year prior to the proposal due date to seek reimbursement for costs already incurred or to capture matching contributions.	Low - Grant doesn't target fish species that are found within the project area.

Estuary and Salmon Restoration Program (ESRP)	WA Dept. of Fish and Wildlife (WDFW) WA State Recreation and Conservation Office	Variable, with 33% match req.	Program created to support the emerging priorities of the Puget Sound Nearshore Ecosystem Restoration Program. Typical projects include nearshore restoration and protection activities that restore natural ecosystem processes and functions, including protection of nearshore and wetland habitat, restoration of salmon habitat and estuaries, removing or breaching dikes, removing bulkheads, feasibility and design, and decommissioning roads and removing fill.	Grant Application Process: - RFP Published - Register for pre-application site visit - Pre-application site visit: in-person site visits with members of the ESRP team (optional, but highly recommended) - Proposals submitted via HWS/Nearshore Data Site and PRISM - Presentations by sponsors to technical evaluation team - Ranked project list and funding recommendations are published and submitted to Washington Legislature	Proposal components: - Full proposal budget worksheet - Visual scope of work - Landowner acknowledgement - Full proposal narrative - Additional supporting documents - PRISM Online Application Wizard/Contract System - In-Person Presentation	Next RFP issued in spring 2018	Application due in late summer (August) 2018	http://www.rco.wa.gov/grants/esrp.shtml http://www.pugetsoundnearshore.org/esrp/grants.html	Annual and Biennial Competitions. Odd-year investments open to new and portfolio projects. Even-year investments pending funding availibility for only portfolio projects.	Low - Grant focuses on nearshore restoration.
Flood Control Assistance Account Program (FCAAP)	Washington Department of Ecology (Ecology)	$500,000 per county; 25% match in non-state funds	Washington Legislature established the Flood Control Assistance Account Program to assist local jurisdictions in comprehensive planning and flood control maintenance efforts. Projects include planning, maintenance projects, feasibility studies, match for federal projects, and emergency projects.	Online application through EAGL	Online forms	NA	NA	http://www.ecy.wa.gov/programs/sea/grants/fcaap/index.html	Due to state budget reductions, Ecology will be unable to offer Flood Control Assistance Account Program (FCAAP) grants through June 30, 2017. There are still limited funds available on an as-needed basis.	Low - The project would be eligible, if the grant is funded again; however, the program has been unfunded for quite some time.
Land and Water Conservation Fund (LWCF)	WA State Recreation and Conservation Office	Variable, with 50% match req. and $500,000 cap	Funds awarded to preserve and develop outdoor recreation resources, including parks, trails, and wildlife lands. Typical projects include land acquisition and development or renovation, such as renovating community parks, building new parks and trails, protecting wildlife habitat, and building athletic fields.	Grant Application Process (6 months): - Submit online application through PRISM - Make an in-person presentation - Applications and presentations are reviewed and scored by a panel - The ranked list is presented to the Recreation and Conservation Funding Board - The board approves a ranked list of projects and sends them to the National Park Service for final funding approval	Online forms In-person presentation	March (variable date)	May (variable date)	http://www.rco.wa.gov/grants/lwcf.shtml		Low - Project would need to emphasize public access, parks, and recreational benefits in elements in Bruggers Bog Park and/or North Maintenance Facility site.
National Fish Passage Program	US Fish and Wildlife Service (USFWS)	Variable	A fish passage project is any activity that improves the ability of fish or other aquatic species to move by reconnecting habitat that has been fragmented by barriers.	Proposals must be submitted to a Fish and Wildlife Conservation Office Biologist to be formally considered for funding.	To begin the application process, contact the Regional Fish Passage Coordinator (Dan Shively) or the local Fish and Wildlife Conservation Office. Service Biologists will discuss the project and help ensure it is a good fit for the NFPP. Subsequent information on proposal and application requirements will be provided if the project is determined to be a good fit.	Proposals accepted year round; funding cycle beings in August	following spring	https://www.fws.gov/fisheries/whatwedo/NFPP/nfpp.html	(Susan Wells 703-358-2523)	Low - Program seems to target larger systems and ESA fish species. Would be worth discussing more with USFWS biologist.
Trout and Salmon Foundation	Private funding and donations	Up to $10,000 with matching	Provide matching up to $10,000 for an individual project that aids in the restoration or improvement of any trout stream, salmon fishery, and/or ambient stream conditions through research, education, publication, and physical stream restoration which will result in improved fish reproduction, fish growth and survival, or expansion of the trout/salmon fisheries by way of offering financial assistance for specific projects.	Submit a detailed funding request to troutandsalmonfoundation@gmail.com or by mail to Trout and Salmon Foundation, 4801 South Lawndale Avenue, Chicago, IL 60632	Proposal components: - Name and contact info for organization - A brief history of the organization - A detailed statement describing the project - An itemized of labor, equipment, and materials - A budget - The amount of funds being requested - An executive summary - Acknowledgement of the Trout & Salmon Foundation's support in any public relations statements related to the project	NA	August 1, 2017	https://www.troutandsalmonfoundation.org/apply-now/	The Foundation has limited resources and places higher priority on projects that physically restore or enhance streams and fisheries habitat.	Low - Project would need to demonstrate and emphasize fish habitat for target species; small dollar amount.
Washington Wildlife and Recreation Program (WWRP)	Washington State Recreation and Conservation Office	Local agencies must provide 50% match; $25,000 cap on riparian protection, $1 million cap on park projects, no cap on other categories; $55 million awarded biennially	Funding for a broad range of land protection and outdoor recreation project, including park acquisition and development, habtiat conservation, farmland preservation, and construction of outdoor recreation facilities. Categories include: critical habtiat, local parks, natural areas, riparian protection, trails, urban wildlife habtiat, other.	18 month evaulation process. Online application, in-person presentation, applications ranked by Recreation and Conservation Funding Board, list of top projects goes to Governor's Office and then Legislature for approval.	Application requirements vary based on project type/category. Presentation and presentation materials required.	Variable based on project type (see online schedule)	Variable based on project type (see online schedule)	http://www.rco.wa.gov/grants/wwrp.shtml	LWCF grant application for the Hidden Lake Dam Removal project, which seemed like a reasonable, if unconventional, candidate funding ultimately did not score especially well.	Low - Project would need to emphasize public access, parks, and recreational benefits in elements in Bruggers Bog Park and/or North Maintenance Facility site.

NOTES:

John 11/3/16: Grant attractiveness will weigh somewhat into the alternatives evaluation – for instance due to the fish habitat angle, something like Alternative 3 (daylighting on NMF, or the mirrored version on SSD property across the street) could potentially be pursue some of that funding. This is not as likely for the other alternatives – although there may be a somewhat more tenuous argument to be made for improvements at NE 195th St and downstream of there.

John 11/3/16: One upside of the recently-confirmed presence of anadromous species (tentatively ID'ed as cutthroat and Coho) located upstream of NE 195th St is that perhaps that can be used as leverage for some of this fish-related funding. It would be interesting to "test the waters" for those grant progams to see if our project would be a good fit.