2nd Review
PRCCP20240569
Jan 2025

Stormwater Site Plan – Frontage Improvements

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230752.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2024

Stormwater Site Plan – Frontage Improvements

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230752.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2024

12/17/2024

I hereby state that this Stormwater Site Plan for the East Town Crossing Frontage project has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Table of Contents

Appendices

Appendix A

Exhibits

1.0 Project Overview

1.1 Purpose and Scope

This Stormwater Site Plan accompanies the frontage improvement plans for E Pioneer and Shaw Road E associated with the on-site improvements for the East Town Crossing project. Frontage improvements are located along parcels 0420351026, 0420351029, 0420351030, 0420264021, 0420264053, 0420264054, and 0420264012 for an area of 1.09 acres. Refer to Appendix A, Figure A-1 for a Vicinity Map.

Included under this cover are the design and analysis of the treatment and conveyance facilities proposed as part of the site improvements. This report will demonstrate that the stormwater design for this project will meet the requirements of the 2019 Department of Ecology (DOE) *Stormwater Management Manual for Western Washington* (*SMMWW*), as adopted by the City of Puyallup.

1.2 Existing Conditions Summary

1.2.1 Existing Site Features

The existing area is approximately 1.09 acres and is a mixture of vegetation, sidewalk, and roadside channel. Within the parcels themselves, a network of dirt and gravel access roads connect E Pioneer, Shaw Rd E, and the commercial property to the south. In the southwest parcels, there is an existing residential structure and a vacant residential lot. The majority of the landcover is made up of tall grass, shrubs, and a few trees.

Along Pioneer, a channel and series of culverts runs alongside the road before connecting into a pipe running west under Shaw Ed E, and then north across Pioneer into another channel.

Along Shaw Rd E, existing curb, gutter, and catch basins convey water to the north where stormwater is treated in wetpools.

A topographical survey of the project was prepared by Abbey Road Group. that shows existing site conditions. See Appendix A, Exhibit A-2 for the Existing Conditions Map.

1.2.2 Soils

The National Resources Conservation Service (NRCS) classifies the onsite soils as Briscot Loam in the northern two-thirds of the site and Puyallup fine sandy loam in the lower third of the site. Appendix A, Exhibit A-4 provides the NRCS soil map. Briscot Loam is classified as hydrologic soil group B/D with poorly draining characteristics. Puyallup fine sandy loam is classified as hydrologic soil group A with well-draining characteristics.

Krazan & Associates, Inc prepared a geotechnical report for the site. On March 4, 2021, two large-scale pilot infiltration tests were completed. Based on the results presented in the Geotechnical Report, it was determined that the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Migizi Group, Inc., confirmed in their Project Infiltration Letter, dated August 25, 2023 (provided as Appendix B, Exhibit B-1) that Krazan & Associates, Inc.'s findings result in a calculated 0 inches per hour infiltration rate. Thus, in opposition of the NRCS report, the entire site is not recommended for any infiltration due to the presence of unfavorable soils.

See Appendix B, Exhibit B-1 for the Krazan & Associates, Inc. Geotechnical Engineering Report and Appendix B-2 for the Migizi Group Geotechnical Letter.

1.3 Proposed Conditions Summary

The proposed improvements include storm conveyance, grading, paving, and road widening. Frontage improvements along Shaw Road E are limited to installation of a sidewalk and the replacement of a catch basin with a Catch Basin StormFilter. Frontage improvements along Pioneer include road widening, curb and gutter, planting strip, and an 8 ft sidewalk. Stormwater will be collected at the curb line in combination inlets and conveyed to a line of dispersion trenches. The polluted stormwater will be treated over compost amended vegetated filter strips (CAVFS) to provide enhanced treatment.

See Appendix A, Exhibit A-3, for the Developed Conditions Map.

2.0 Offsite Analysis Report

2.1 Upstream Analysis

The channel along Pioneer receives stormwater from a stream running through the site, from the detention pond located on the site, runoff from the road, and the extension of the existing road side ditch that extends east of the project site.

Shaw Rd E contains an existing conveyance system that runs north and past the extents of the proposed improvements.

2.2 Downstream Analysis

In existing conditions, the stormwater in the channel along the southside of Pioneer passes through multiple culverts along the property frontage before being split into two separate piped systems which ultimately discharge to the roadside channel on the north side of Pioneer. The first piped system consists of two pipes adjacent to each other, 12-in and 18-in ductile iron, which crosses Pioneer just east of the intersection. The CB's connected to these pipes are located within the travel lane with the CB connected to the 18-in pipe currently buried under pavement. The other CB is visible with a solid lid. The second pipe system crosses Shaw Road westerly before turning northwest in a buried structure and discharging to the Pioneer north channel on the west side of Shaw Road. This channel runs along the roadside before it intersects with another culvert directing water to Deer Creek and the Puyallup River.

Stormwater within the bounds of Shaw Rd E is currently being conveyed to the north and west side of the Shaw-Pioneer intersection where a large wetpond treats stormwater.

3.0 Permanent Stormwater Control Plan

This project is a new development that includes more than 5,000 square feet of impervious surfaces; therefore, all Minimum Requirements (MR) apply to this project. Refer to Appendix A, Exhibit A-5 for the Flow Chart for Determining Requirements for New Development.

Flow control for the offsite improvements have already been met via the onsite storm system accounting for the frontage work as bypass and can be viewed under permit PRCCP20230970. Water quality will be address as follows.

The existing channel along Pioneer will be relocated for the required road widening, this is discussed under a separate cover. Stormwater will be collected in combination inlets that convey water to dispersion trenched which will spread the concentrated flow into sheet flow. Stormwater will then be treated via CAVFS to satisfy the enhanced treatment requirement triggered by the fish-bearing stream. Stormwater ultimately discharges to the relocated stream.

Along Shaw Road E, the catch basin directly north of the driveway will be replaced with a concrete StormFilter. This version of the StormFilter can be placed directly against the face of the curb as to not impact the travel lane.

Refer to the Water Quality Calculations (Appendix D, Exhibit D-1 & D-2) for the StormFilter and CAVFS.

4.0 Summary of Minimum Requirements

4.1 MR 1 – Preparation of Stormwater Site Plans

This report and project plans have been prepared to provide justification of the water quality and flow control design proposed for this project.

4.2 MR 2 - Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (CSWPPP) has been prepared to satisfy MR 2 and is included as Appendix E of this report.

4.3 MR 3 – Source Control of Pollution

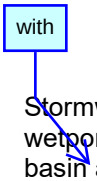
The proposed project is required to provide source control of pollution. Following are proposed measures to be implemented as part of the civil plans.

- All discharges to the city storm system require City of Puyallup approval.
- All pollutants, including waste materials and demolition debris created onsite during construction, shall be handled and disposed of in a manner that does not cause contamination of surface water.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles that may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures such as drip pans.
- Concrete Handling (BMP C151) shall be used to prevent or treat contamination of surface water runoff by pH modifying sources.

The CSWPPP provides details on the control of pollution during construction.

4.4 MR 4 – Preservation of Natural Drainage Systems and Outfalls

Existing stormwater conditions direct water in the channel along the southside of Pioneer. This stormwater passes through multiple culverts along the property frontage before being split into two separate piped systems which ultimately discharge to the roadside channel on the north side of Pioneer. Under a separate cover (Permit PRGR20240491), this project proposes to relocate the channel, while maintaining the existing piped connection which travels under Pioneer. The work under this cover proposes to maintain the flow path of stormwater runoff generated by the south half of Pioneer by discharging to the channel.



Stormwater on Shaw Road E collected in catch basins and conveyed north to an existing wetpond that was constructed during the Shaw Road CIP. Work under this cover replaces a catch basin a water quality device and maintains the existing flow paths.

4.5 MR 5 – Onsite Stormwater Control

Onsite stormwater management Best Management Practices (BMPs) are not practical for the site due to native site soils, which have no infiltrative properties. With that in mind, per the Flow Chart for Determining MR #5 Requirements, refer to Appendix A, Exhibit A-6, List #2 of the List Approach is required. Below is a summary of the findings of List #2, refer to Appendix A, Exhibit A-7 for the Infeasibility Checklists.

Surface Type: Lawn and Landscaped Areas:
Chosen BMP: T5.13: Post-Construction Soil Quality and Depth.

Surface Type: Other Hard Surfaces:
All options on the List Approach are infeasible, runoff will be directed toward either a StormFilter catch basin (for Shaw Road E) or CAVFS (for enhanced treatment along E Pioneer).

4.6 MR 6 – Runoff Treatment

Over 5,000 square feet of pollution-generating surface (PGIS) will be added as part of these improvements; therefore, water quality treatment will be provided.

A StormFilter was sized using the peak 15-minute flow rate from WWHM and the DOE GULD standard specification of 7.5 gpm per 18” cartridge. Pollution generating surfaces from the proposed Shaw Rd E driveway and existing road surface that isn’t currently treated will be directed to the StormFilter.

The CAVFS were sized using WWHM and the 2019 SWMMWW. Pollution generating surfaces from the proposed E Pioneer driveway, portions of the road widening, and existing road surface that isn’t currently treated will be directed to the CAVFS.

Refer to Appendix D, Exhibits D-1 & D-2 for the Water Quality Calculations for frontage improvements and a copy of the GULD standards.

4.7 MR 7 – Flow Control

Frontage improvements were included as bypass for the East Town Crossing onsite system. Refer to the Phase 1 SSP for calculations and basin maps under Permit PRCCP20230970.

See appendix D, exhibit D-3 for sizing capacity calculations for the box culvert within the enhanced stream that connects to the existing city storm conveyance system.

4.8 MR 8 – Wetland Protection

It is to the best of our knowledge that no wetlands exist on or adjacent to the site that would be impacted by the proposed site development.

Refer to Appendix A, Exhibit A-8, A-9, and A-10 for the FEMA Map, FEMA Letter of Map Revision, and Flood Plain Memo.

4.9 MR 9 – Operation and Maintenance

See Appendix C for a copy of the Operations and Maintenance Manual. This manual shall be readily available for inspection by the City of Puyallup. The maintenance and operations of improvements within the ROW shall be the responsibility of the City of Puyallup.

5.0 Wells and Septic Systems

The Department of Ecology (DOE) Well Report Map does not identify any wells present on the site. Any wells located will be decommissioned following the Tacoma-Pierce County Health Department (TPCHD) removal regulations.

6.0 Fuel Tanks

To our knowledge, there are no existing fuel tanks on the site. If located during construction, the fuel tanks will be abandoned according to TPCHD and DOE standards.

7.0 Construction Stormwater Pollution Prevention Plan

A Temporary Erosion Control Plan is included with the plan set, and a CSWPPP for the project is included as Appendix E of this report.

NTF-not attached to submitted storm report. Provided under separate submittal line item.

8.0 Special Reports and Studies

A Geotechnical Report was prepared by Krazen & Associates, Inc., dated April 11, 2019. Refer to Appendix B-1. In addition, a letter from Migizi Group is included as Appendix B-2.

A Stream Restoration and Mitigation Plan was prepared by Soundview Consultants, dated September 2023. Refer to Appendix B-4.

The stream relocation and frontage improvements included regrading within the existing 100-year floodplain. As a result of the regrading additional storage volume was provided, refer to flood plain memo appendix A-10.

9.0 Other Permits

A State Environmental Policy Act (SEPA) Checklist has been completed for this project. At the time of writing, a Clear, Fill, and Grade Permit was readied for issuance as Permit # PRGR-2023-0972. Coverage under DOE's Construction Stormwater General Permit must be obtained.

Washington Department of Fish and Wildlife HPA permit has been applied for and approved for this project as Permit # 2024-6-20+01.

10.0 Operations and Maintenance Manual

Refer to Appendix C for the Maintenance Standards for the proposed drainage facilities and the Maintenance Checklist for the finished project site.

A Stormwater Maintenance Agreement will be recorded at the time of Occupancy in accordance with City Standards.

11.0 Conclusion

Based on our understanding and the attached documentation, we believe the proposed improvements conform to City of Puyallup and Washington State Department of Ecology standards. We conclude that this project, as proposed, will not have adverse impacts to the site or the downstream drainage system.

This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry.

AHBL, Inc.

Christopher Watt
Project Engineer

CJW/ZCP

November 2024
Q:\2023\2230752\10_CIV\NON_CAD\REPORTS\SSP - Frontage Memo\20240401 Rpt (SSP) Frontage 2230752.docx

Appendix A

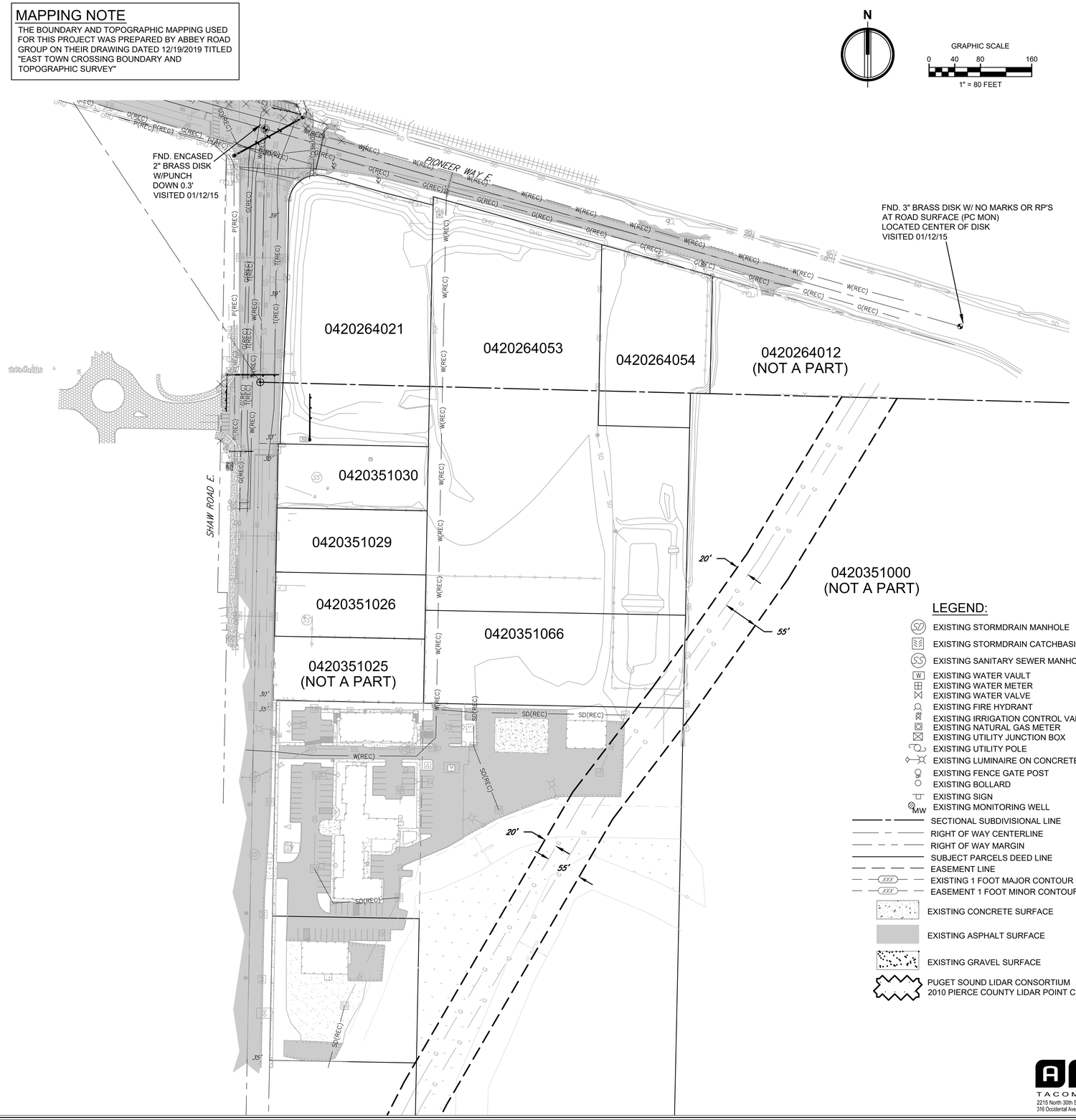
Exhibits

AHBL
2215 North 30th Street,
Suite 300,
Tacoma, WA 98403
253.383.2422 TEL
253.383.2572 FAX

VICINITY MAP	2230752
EAST TOWN CROSSING	FIGURE 1

MAPPING NOTE

THE BOUNDARY AND TOPOGRAPHIC MAPPING USED FOR THIS PROJECT WAS PREPARED BY ABBEY ROAD GROUP ON THEIR DRAWING DATED 12/19/2019 TITLED "EAST TOWN CROSSING BOUNDARY AND TOPOGRAPHIC SURVEY"



LEGEND:

- EXISTING STORMDRAIN MANHOLE
- EXISTING STORMDRAIN CATCHBASIN
- EXISTING SANITARY SEWER MANHOLE
- EXISTING WATER VAULT
- EXISTING WATER METER
- EXISTING WATER VALVE
- EXISTING FIRE HYDRANT
- EXISTING IRRIGATION CONTROL VALVE
- EXISTING NATURAL GAS METER
- EXISTING UTILITY JUNCTION BOX
- EXISTING UTILITY POLE
- EXISTING LUMINAIRE ON CONCRETE BASE
- EXISTING FENCE GATE POST
- EXISTING BOLLARD
- EXISTING SIGN
- EXISTING MONITORING WELL
- SECTIONAL SUBDIVISIONAL LINE
- RIGHT OF WAY CENTERLINE
- RIGHT OF WAY MARGIN
- SUBJECT PARCELS DEED LINE
- EASEMENT LINE
- EXISTING 1 FOOT MAJOR CONTOUR INTERVAL
- EASEMENT 1 FOOT MINOR CONTOUR INTERVAL
- EXISTING CONCRETE SURFACE
- EXISTING ASPHALT SURFACE
- EXISTING GRAVEL SURFACE
- PUGET SOUND LIDAR CONSORTIUM 2010 PIERCE COUNTY LIDAR POINT CLOUD DATA

SURVEYOR'S NOTES

1. **HORIZONTAL DATUM:** BASIS OF BEARING AND SURVEY DATA PER WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE.

2. **BASIS OF BEARING:** HELD S 01° 21' 28" W OBSERVED ALONG THE EAST LINE OF THE NORTHEAST QUARTER OF SEC. 35, T. 20 N. R. 4 E. BETWEEN THE NORTHEAST CORNER OF THE NORTHEAST QUARTER MONUMENT AND THE SOUTHEAST CORNER OF THE NORTHEAST QUARTER MONUMENT OF THE SAID SECTION AS SHOWN HEREON.

3. **VERTICAL DATUM:** NAVD88
AS DEFINED BY THE NATIONAL GEODETIC SURVEY (NGS)
PROJECT BENCHMARK:
DESIGNATION: 21 010
PID: DL2774

PUBLISHED ELEVATION: 75.70 FEET (NAVD 88)
DESCRIPTION: ENCASED STEEL ROD LOCATED IN EASTERLY GRAVEL SHOULDER AT THE INTERSECTION OF PIONEER WAY AND 134TH AVE. E.

4. ALL UTILITY LOCATES HAVE BEEN DETERMINED BY SURFACE LOCATION ONLY EITHER BY PHYSICAL STRUCTURES OR PAINT MARKINGS
AS DETERMINED BY UNDERGROUND + UTILITY LOCATE, INC. AND/OR UTILITY COMPANY. GAS PIPE LOCATION WITH IN THE PROPERTY DETERMINED BY MAP PROVIDE BY PUGET SOUND ENERGY, INC. ACTUAL UNDERGROUND LOCATION MAY VARY. EXISTING UTILITIES AS SHOWN MAY NOT BE THE SAME AFTER THIS DATE AS MAJOR CONSTRUCTION IS IN PROGRESS.

5. REFERENCE SURVEYS:
   1. 200303315001
   2. SP 9303315001
   3. ROS 8210040207

6. METHOD OF SURVEYING WAS:
   1. CONVENTIONAL TRAVERSE USING A TOPCON 800A TOTAL STATION.
   2. MONUMENTS FOUND MARCH 2008

TOPOGRAPHIC NOTE

THE EXISTING CULTURAL AND TOPOGRAPHICAL DATA SHOWN ON THESE DRAWINGS HAS BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, MCINNIS ENGINEERING CANNOT ENSURE ACCURACY AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THAT INFORMATION OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO THESE DRAWINGS AS A RESULT.

SITE INFORMATION

PARCEL: 0420264021,
0420264054, 0420264053,
0420351066, 0420351030,
0420351029, 0420351026
ADDRESS: 2902 E PIONEER
PUYALLUP, WA 98372
ZONING: CG AND MF

SURVEYOR

ABBEY ROAD GROUP
CONTACT: LARRY WALKER
2102 E MAIN AVE, SUITE 109
PUYALLUP, WA 98372
OFFICE: 253-435-3699

AHBL
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

EXISTING CONDITIONS MAP

EAST TOWN CROSSING

A-2

N

GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

BLDG H

BLDG G

BLDG T.I.

BLDG T.I.

BLDG D

BLDG C

BLDG B

BLDG E

BLDG F

BLDG A

CLUB HOUSE

MATCHLINE SEE RIGHT

MATCHLINE SEE LEFT

DEVELOPED CONDITIONS MAP	A-3
EAST TOWN CROSSING	

AHBL
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

SHAW RD

4,200 SF TO STORMFILTER

BLDG H

BLDG G

BLDG T.I.

BLDG T.I.

PIONEER

PIONEER WAY E

CLUB HOUSE

BLDG D

BLDG C

BLDG B

BLDG E

BLDG F

BLDG A

12,000 SF TO CAVFS

4,000 SF THAT WILL BE TREATED UNDER TREATMENT TRADE

DISPERSION TRENCH AND CAVFS

DISPERSION TRENCH AND CAVFS

4,000 NEW PGIS THAT WILL NOT BE TREATED UNDER TREATMENT TRADE

N

GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

AHBL

TACOMA · SEATTLE

2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL

316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

DEVELOPED CONDITIONS BASIN MAP

EAST TOWN CROSSING

A-3a

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Pierce County Area, Washington

October 26, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

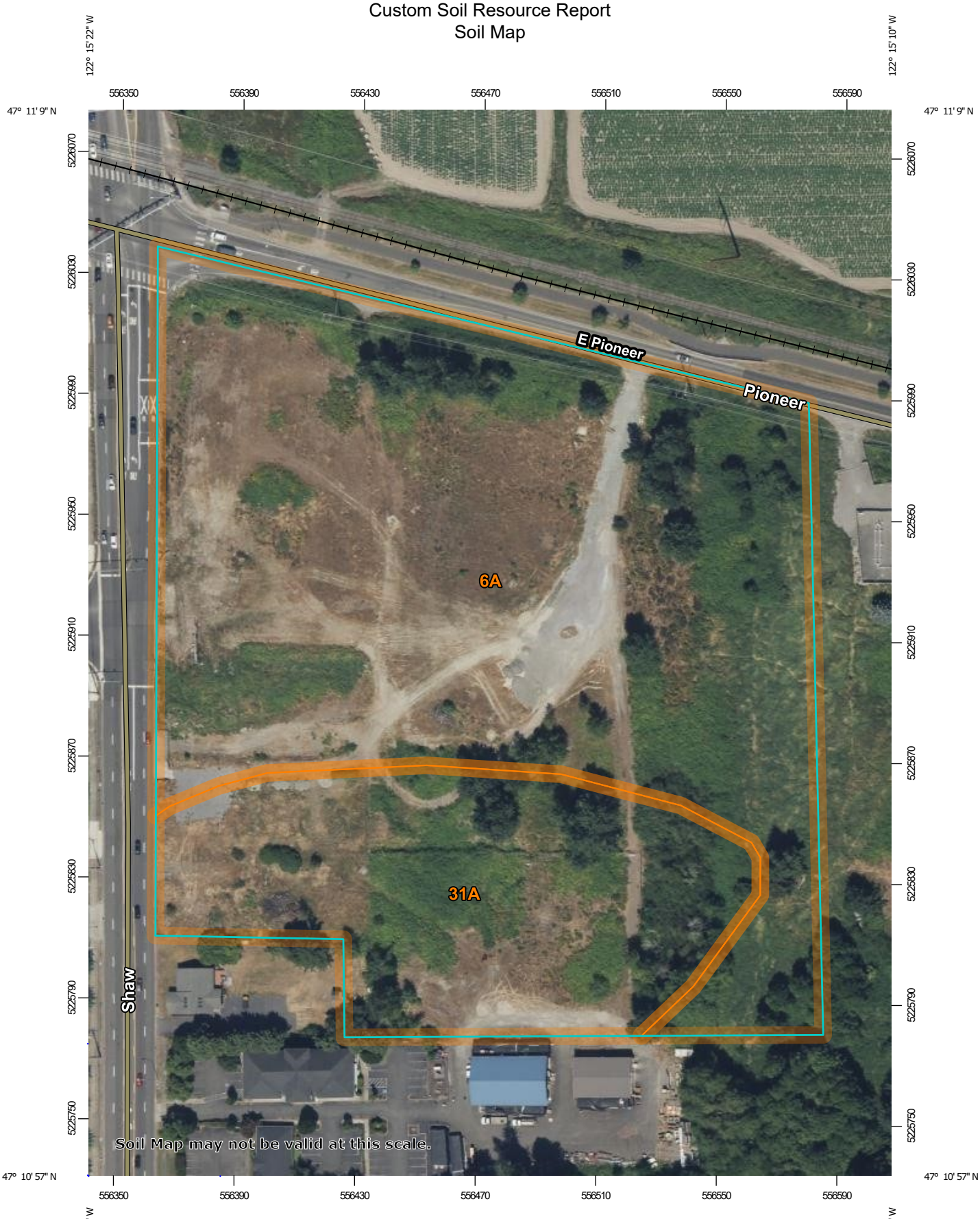
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,720 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 19, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 31, 2022—Aug 8, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	8.8	72.1%
31A	Puyallup fine sandy loam	3.4	27.9%
Totals for Area of Interest		**12.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Pierce County Area, Washington

6A—Briscot loam

Map Unit Setting

National map unit symbol: 2hrc
Elevation: 20 to 250 feet
Mean annual precipitation: 30 to 55 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 160 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Briscot, drained, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Briscot, Drained

Setting

Landform: Flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 11 inches: loam
H2 - 11 to 38 inches: stratified fine sand to silt loam
H3 - 38 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 35 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: F002XA007WA - Puget Lowlands Wet Forest
Forage suitability group: Seasonally Wet Soils (G002XN202WA)
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

Minor Components

Briscot, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

31A—Puyallup fine sandy loam

Map Unit Setting

National map unit symbol: 2hq9
Elevation: 0 to 390 feet
Mean annual precipitation: 35 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 170 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Puyallup and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Puyallup

Setting

Landform: Terraces, flood plains
Parent material: Alluvium

Typical profile

H1 - 0 to 13 inches: ashy fine sandy loam
H2 - 13 to 29 inches: loamy fine sand
H3 - 29 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 48 to 79 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F002XA008WA - Puget Lowlands Riparian Forest
Forage suitability group: Droughty Soils (G002XN402WA)
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Minor Components

Briscot, undrained

Percent of map unit: 2 percent

Landform: Depressions
Other vegetative classification: Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

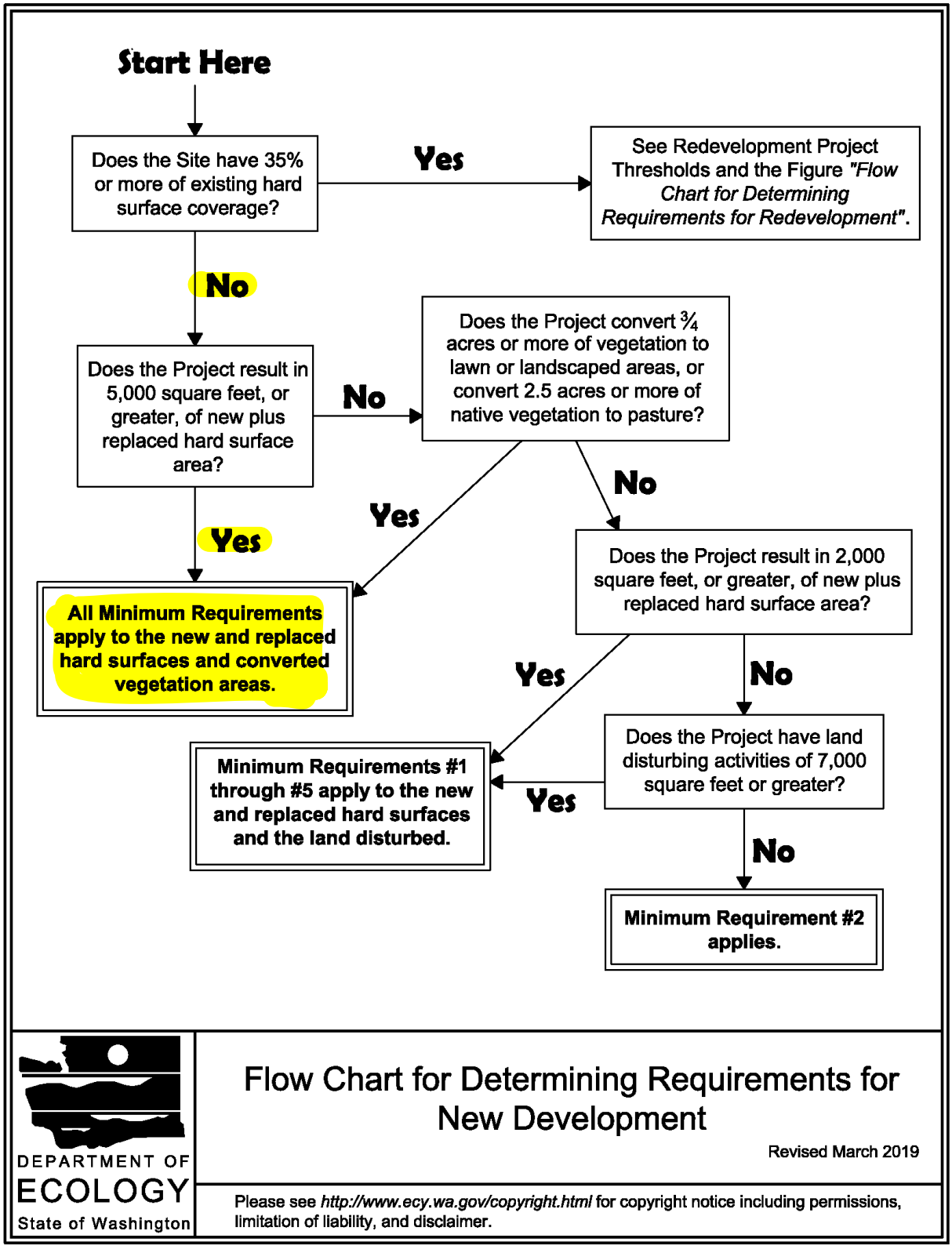
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

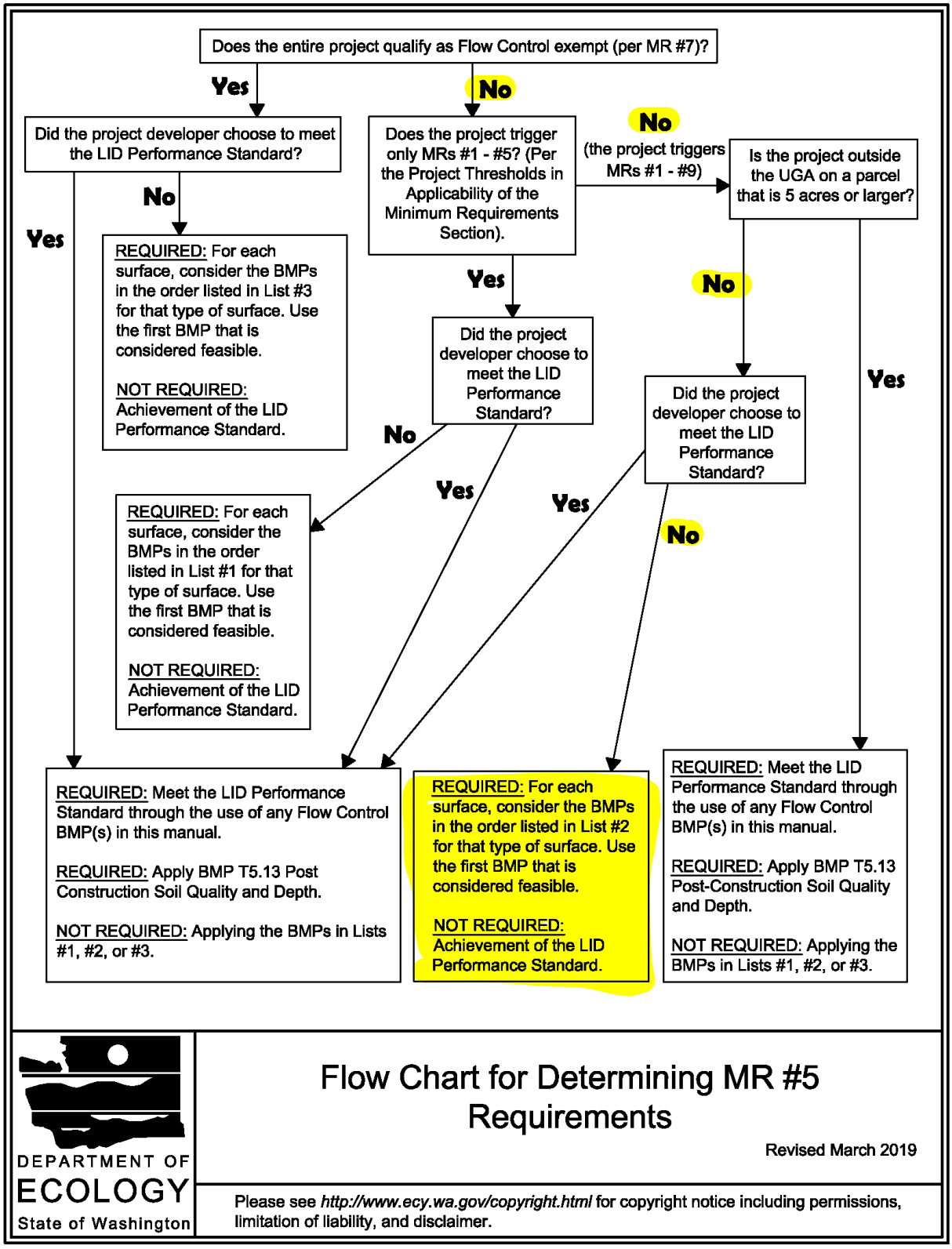
APPENDIX A-5

Figure I-3.1: Flow Chart for Determining Requirements for New Development



APPENDIX A-6

Figure I-3.3: Flow Chart for Determining MR #5 Requirements



Appendix A-7:

Surface Type: Lawn and Landscaped Areas

Infeasibility Checklist BMP T5.13 Post Construction Soil Quality and Depth				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-2 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	**Can the soil amendments be placed on slopes less than 33%?**	☒	☐	☐
2	**Will installing sheet flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (2a-2e).**	☐	☒	☐
2a	**Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act**	☐		
2b	**Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts**	☐		
2c	**Public health and safety standards**	☐		
2d	**Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way**	☐		
2e	**Critical Area Preservation Ordinance**	☐		

Surface Type: Roofs

Infeasibility Checklist BMP T5.30 Full Dispersion				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-9 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	Can the flow spreader and dispersion areas be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the flow spreader and dispersion areas be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the dispersion areas be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the dispersion areas be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the dispersion area be located outside of critical areas, critical area buffers, streams, or lakes?	☐	☐	☐

6	Can the flow spreader and dispersion area maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
8	Will installing a full dispersion system cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (8a-8e).	☐	☐	☐
8a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
8b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
8c	Public health and safety standards	☐		
8d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
8e	Critical Area Preservation Ordinance	☐		
9	Can the design standards in BMP T5.30 be met?	☐	☐	☐
9a	Describe the design standard that cannot be met:			
Questions #10 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
10	Will the use of a full dispersion cause erosion or flooding problems onsite or on adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist
BMP T5.10A Downspout Full Infiltration

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-7 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the infiltration trench or drywell be placed 10 feet or more from any building structure?	☐	☐	☐
2	Can the infiltration trench or drywell be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the infiltration trench or drywell be placed 50 feet or more from the top of any slope 20% or greater?	☐	☐	☐
4	Can the infiltration trench or drywell be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the infiltration trench or drywell meet setback requirements from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Will installing an infiltration trench or drywell cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (6a-6e).	☐	☐	☐
6a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
6b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		

6c	Public health and safety standards		☐	
6d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way		☐	
6e	Critical Area Preservation Ordinance		☐	
7	Can the design standards in BMP T5.10A be met?	☐	☐	☐
7a	Describe the design standards that cannot be met:			
Questions #8-10 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
8	Was the soil classified as being clay, sandy clay, clay loam, silty clay loam, sandy clay loam, or silt according to the USDA Textural Soil Triangle? (An answer of yes means this BMP is not feasible).	☐	☒	☐
9	Is the depth from proposed final grade to the seasonal high groundwater table or other impermeable layer equal to or greater than 3 feet?	☐	☒	☐
10	Is the depth from the bottom of the infiltration trench or drywell to the seasonal high groundwater table equal to or greater than 1 foot?	☐	☒	☐

Infeasibility Checklist
BMP T5.14 Rain Gardens

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-18 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.

Question Number	Question	Yes	No	NA
1	**Can the rain garden be placed 10 feet or more from any building structure?**	☐	☒	☐
2	Can the rain garden be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the rain garden be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the rain garden be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the rain garden be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
6	Can the rain garden be located greater than 100 feet from an underground storage tank whose capacity including tank and underground connecting pipe is 1100 gallons or more?	☐	☐	☐
7	Can the rain garden be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the rain garden be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the rain garden be located greater than 100 feet from drinking water well or a spring used for drinking water supply?	☐	☐	☐

10	Can the rain garden be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the rain garden be located on slopes less than 8%?	☐	☐	☐
12	Is the rain garden compatible with the surrounding drainage system (e.g., project drains to an existing stormwater system whose elevation precludes proper connection to a rain garden)?	☐	☐	☐
13	For properties with known soil or groundwater contamination, can the rain garden be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
14	For properties with known soil or groundwater contamination, can the rain garden be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐
15	For properties with known soil or groundwater contamination, can the rain garden be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
16	For properties with known soil or groundwater contamination, can the rain garden be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
17	For rain gardens that are constructed with imported compost materials, can the rain garden be located greater than ¼ mile from a phosphorus-sensitive waterbody? (Does not apply to discharges to Wapato Lake).	☐	☐	☐
18	Will installing a rain garden cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (18a-18e).	☐	☐	☐
18a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
18b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
18c	Public health and safety standards	☐		
18d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
18e	Critical Area Preservation Ordinance	☐		
Questions #19-20 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
19	Is the depth from the lowest level of the rain garden soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 1 foot?	☐	☒	☐
20	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
Questions 21-28 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
21	Will the proposed rain garden location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
22	Will the proposed rain garden location allow for a safe overflow pathway to the City stormwater system or a private stormwater system?	☐	☐	☐
23	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐

24	Is the project located in an area whose groundwater drains into an erosion hazard or landslide hazard area? (An answer of yes means the BMP is infeasible).	☐	☐	☐
25	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
26	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
27	Is there lack of usable space onsite for rain gardens at redevelopment sites? (An answer of yes means the BMP is infeasible).	☐	☐	☐
28	For public road projects, is there insufficient space within the ROW to install a rain garden? (An answer of yes means this BMP is infeasible).	☐	☐	☐

Infeasibility Checklist
BMP T7.30 Bioretention

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach

Questions #1-18 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.

Question Number	Question	Yes	No	NA
1	**Can the bioretention facility be placed 10 feet or more from any building structure?**	☐	☒	☐
2	Can the bioretention facility be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the bioretention facility be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the bioretention facility be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the bioretention facility be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
6	Can the bioretention facility be located greater than 100 feet from an underground storage tank whose capacity including tank and underground connecting pipe is 1100 gallons or more?	☐	☐	☐
7	Can the bioretention facility be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the bioretention facility be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the bioretention facility be located greater than 100 feet from drinking water well or a spring used for drinking water supply?	☐	☐	☐
10	Can the bioretention facility be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the bioretention facility be located on slopes less than 8%?	☐	☐	☐
12	Is the bioretention facility compatible with the surrounding drainage system (e.g., project drains to an existing stormwater system whose elevation precludes proper connection to the bioretention facility)?	☐	☐	☐
13	For properties with known soil or groundwater contamination, can the bioretention facility be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
14	For properties with known soil or groundwater contamination, can the bioretention facility be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐

15	For properties with known soil or groundwater contamination, can the bioretention facility be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
16	For properties with known soil or groundwater contamination, can the bioretention facility be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
17	For bioretention facilities that are constructed with imported compost materials, can the bioretention facility be located greater than ¼ mile from a phosphorus-sensitive waterbody? (Does not apply to discharges to Wapato Lake).	☐	☐	☐
18	Will installing a bioretention facility cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (18a-18e).	☐	☐	☐
18a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
18b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
18c	Public health and safety standards	☐		
18d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
18e	Critical Area Preservation Ordinance	☐		
Questions #19-21 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
19	Is the depth from the lowest level of the bioretention soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 1 foot? This applies only if the contributing area to the bioretention facility has less than 5,000 square feet of pollution-generating impervious surface, and less than 10,000 square feet of impervious surface, and less than ¾ acre pervious surface.	☐	☒	☐
20	Is the depth from the lowest level of the bioretention soil mix or any underlying gravel layer to the seasonal high groundwater table or other impermeable layer equal to or greater than 3 feet? This applies only if the contributing area to the bioretention facility has: 5,000 square feet or greater of pollution-generating impervious surface, or 10,000 square feet or greater of impervious surface, or more ¾ acre pervious surface AND the bioretention facility cannot be broken down into amounts smaller than those listed above.	☐	☒	☐
21	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
Questions 22-29 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
22	Will the proposed bioretention facility location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
23	Will the proposed bioretention facility location allow for a safe overflow pathway to the City stormwater system or a private stormwater system?	☐	☐	☐
24	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐
25	Is the project located in an area whose groundwater drains into an erosion hazard or landslide hazard area? (An answer of yes means the BMP is infeasible).	☐	☐	☐
26	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐

27	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
28	Is there lack of usable space onsite for bioretention facilities at redevelopment sites? (An answer of yes means the BMP is infeasible).	☐	☐	☐
29	For public road projects, is there insufficient space within the ROW to install a bioretention facility? (An answer of yes means this BMP is infeasible).	☐	☐	☐

Infeasibility Checklist
BMP T5.10B Downspout Dispersion

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-10 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the dispersion trench or splashblocks be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the dispersion trench or splashblocks be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the dispersion trench or splashblocks be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the dispersion trench or splashblocks be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the dispersion trench or splashblock maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to maintain or construct a vegetated flowpath of at least 25 feet from the outlet of a dispersion trench and any property line, structure, stream, wetland, other infiltration or dispersion system, or impervious surface?	☐	☒	☐
7	Is it possible to maintain or construct a vegetated flowpath of at least 50 feet from the outlet of a dispersion trench and any slope greater than 15%?	☐	☐	☐
8	Is it possible to maintain or construct a vegetated flowpath of at least 50 feet from the outlet of splashblock and any property line, structure, slope over 15%, stream, wetland, other infiltration or dispersion system, or impervious surface?	☐	☐	☐
9	Will installing a dispersion trench or splashblocks cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (9a-9e).	☐	☐	☐
9a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
9b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
9c	Public health and safety standards	☐		
9d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
9e	Critical Area Preservation Ordinance	☐		
10	Can the design standards in BMP T5.10B be met?	☐	☐	☐
10a	Describe the design standard that cannot be met:			

Questions #11 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).

11	Will the use of a dispersion trench or splashblocks cause erosion or flooding problems onsite or on adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist
BMP T5.10C: Perforated Stub-out Connections

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-7 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the perforated stub-out connection be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the perforated stub-out connection be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the perforated stub-out connection be placed 50 feet or more from the top of any slope 20% or greater?	☐	☐	☐
4	Can the perforated stub-out connection be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the perforated stub-out connection meet setback requirements from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Will installing a perforated stub-out connection cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (6a-6e).	☐	☐	☐
6a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
6b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
6c	Public health and safety standards	☐		
6d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
6e	Critical Area Preservation Ordinance	☐		
7	Can the design standards in BMP T5.10C be met?	☐	☐	☐
7a	Describe the design standard that cannot be met:			

Questions #8 relates to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.

8	Is the depth from the bottom of the perforated stub-out connection to the seasonal high groundwater table equal to or greater than 1 foot?	☐	☒	☐

Surface Type: Other Hard Surfaces

Infeasibility Checklist
BMP T5.15 Permeable Pavement

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-24 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries. Citation of the following do not need site-specific written recommendations from a

Washington State Licensed Professional Engineer or Washington State Licensed Professional Geologist though some criteria may require professional services to determine if the infeasibility criteria apply.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	**Can the permeable pavement be placed 10 feet or more from any building structure?**	☐	☐	☐
2	Can the permeable pavement be placed 5 feet or more from any other structure or property line?	☐	☐	☐
3	Can the permeable pavement be placed 50 feet or more from the top of any slope greater than 20%?	☐	☐	☐
4	Can the permeable pavement be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the permeable pavement be located outside of designated erosion or landslide hazard areas?	☐	☐	☐
7	Can the permeable pavement be located greater than 10 feet from an underground storage tank (tank used for petroleum product, chemical, or liquid hazardous waste storage) whose capacity including tank and underground connecting pipe is 1100 gallons or less?	☐	☐	☐
8	Can the permeable pavement be located greater than 100 feet of a closed or active landfill?	☐	☐	☐
9	Can the permeable pavement be located greater than 100 feet from drinking water well or a spring used for drinking water supply if the permeable pavement is (or has run-on from) a pollution-generating hard surface?	☐	☐	☐
10	Can the permeable pavement be placed 10 feet or more from small on-site sewage disposal drainfields? (For large on-site sewage disposal setbacks see WAC Chapter 246-727B).	☐	☐	☐
11	Can the permeable pavement be constructed such that the subgrade is less than 6%?	☐	☐	☐
12	Can the permeable pavement be constructed such that the wearing course is less than 6% (after reasonable attempts have been made to design the grade)?	☐	☐	☐
13	Is the location for permeable pavement a multi-level parking garage, above a culvert, or a bridge? An answer of yes means the BMP is not feasible.	☐	☐	☐
14	Does the road receive more than very low traffic volumes? (Roads with a projected average daily traffic volume of 400 vehicles or less). This infeasibility criterion cannot be used for sidewalks or non-traffic bearing surfaces. An answer of yes means the BMP is not feasible.	☐	☐	☐
15	Does the road receive more than very low truck traffic? (Roads not subject to through truck traffic but may receive up to weekly use by utility trucks, daily school bus use, and multiple daily use by pick-up trucks, mail/parcel delivery trucks, and maintenance vehicles.). This infeasibility criterion cannot be used for sidewalks or non-traffic bearing surfaces. An answer of yes means the BMP is not feasible.	☐	☐	☐
16	Does the area typically generate high concentrations of oil due to high traffic turnover or frequent transfer of oil? (See SWMM for additional guidance.) An answer of yes means the BMP is not feasible.	☐	☐	☐
17	Can the permeable pavement be located outside of areas with industrial activity as identified in 40 CFR 122.26(b)14?	☐	☐	☐
18	Can permeable pavement be located outside of areas where the risk of concentrated pollutant spills is likely such as gas stations, truck stops, and industrial chemical storage areas?	☐	☐	☐
19	Can permeable pavement be located outside of areas likely to have long-term excessive sediment deposition after construction?	☐	☐	☐
20	For properties with known soil or groundwater contamination, can the permeable pavement be located greater than 100 feet from an area known to have deep soil contamination?	☐	☐	☐
21	For properties with known soil or groundwater contamination, can the permeable pavement be located such that infiltration will not increase or change the direction of the migration of pollutants in the groundwater? (Based upon groundwater modeling).	☐	☐	☐

22	For properties with known soil or groundwater contamination, can the permeable pavement be located in an area that does not have contaminated surface soils that are proposed to remain in place?	☐	☐	☐
23	For properties with known soil or groundwater contamination, can the permeable pavement be located in areas not prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?	☐	☐	☐
24	Will installing permeable pavement cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (24a-24e).	☐	☐	☐
24a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
24b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
24c	Public health and safety standards	☐		
24d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
24e	Critical Area Preservation Ordinance	☐		
Questions #25-28 relate to infeasibility criteria that are based upon subsurface characteristics and require a soils report to determine infeasibility.				
25	Is the depth from the lowest layer designed as part of the permeable pavement section to the seasonal high groundwater elevation, bedrock, or other impermeable layer equal to or greater than 1 foot?	☐	☐	☐
26	For pollution generating pervious pavement surfaces, can the soil suitability criteria for treatment be met? (See SWMM – BMP T5.15)	☐	☐	☐
27	Was the soil classified as having a measured native soil saturated hydraulic conductivity of 0.3 in/hour or more?	☐	☒	☐
28	Is the existing impervious surface that will be replaced non-polluting generating and located over an outwash soil with a saturated hydraulic conductivity of 4 inches/hour or greater?	☐	☐	☐
Questions 29-40 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
29	Will the proposed permeable pavement location threaten the safety or reliability of preexisting underground utilities, preexisting underground storage tanks, preexisting structures, or preexisting road or parking lot surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
30	Will infiltrating and ponded water compromise existing adjacent impervious pavements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
31	Are there reasonable concerns about erosion, slope failure, or downgradient flooding due to infiltration? (An answer of yes means the BMP is infeasible).	☐	☐	☐
32	Can the permeable pavement be located outside area whose groundwater drains into an erosion hazard or landslide hazard area?	☐	☐	☐
33	Will infiltrating water threaten existing below grade basements? (An answer of yes means the BMP is infeasible).	☐	☐	☐
34	Will infiltrating water threaten shoreline structures such as bulkheads? (An answer of yes means the BMP is infeasible).	☐	☐	☐
35	Can permeable pavement be located away from the bottom of steep, erosion prone areas that are likely to erode sediment?	☐	☐	☐
36	Can permeable pavement be located away from fill soils that can become unstable when saturated?	☐	☐	☐
37	Will permeable pavement construction on steep slopes cause erosion and structural failure? (An answer of yes means the BMP is infeasible).	☐	☐	☐

38	Will permeable pavement construction on steep slopes cause runoff velocities that preclude adequate infiltration at the pavement surfaces? (An answer of yes means the BMP is infeasible).	☐	☐	☐
39	Can permeable pavement provide sufficient strength to support the anticipated loads?	☐	☐	☐
40	Are underlying soils suitable for supporting traffic loads when saturated?	☐	☒	☐

Infeasibility Checklist
BMP T5.12: Sheet Flow Dispersion

It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.

Questions #1-9 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.

Question Number	Question	Yes	No	NA
1	Can the sheet flow dispersions system be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the sheet flow dispersion system be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the sheet flow dispersion system be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the sheet flow dispersion system be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the sheet flow dispersion system maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to provide a vegetated flowpath width of 10 feet or greater for up to 20 feet of width of paved or impervious surface?	☐	☒	☐
7	For paved or impervious surfaces widths 20 feet or greater, is it possible to provide a vegetated flowpath width of 20 feet or greater (additional 10 feet of width must be added for each increment of 20 feet or more in width)?	☐	☒	☐
8	Will installing sheet flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (8a-8e).	☐	☐	☐
8a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
8b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
8c	Public health and safety standards	☐		
8d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
8e	Critical Area Preservation Ordinance	☐		
9	Can the design standards in BMP T5.12 be met?	☐	☐	☐
9a	Describe the design standard that cannot be met:			
Questions #10 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
10	Will the use of sheet flow dispersion cause erosion or flooding problems onsite or an adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

Infeasibility Checklist BMP T5.11: Concentrated Flow Dispersion				
It is not necessary to answer all questions when determining if a BMP is feasible for Minimum Requirement #5 – The List Approach. Unless otherwise noted, a single answer of No means the BMP is considered infeasible for meeting Minimum Requirement #5 – The List Approach.				
Questions #1-8 relate to infeasibility criteria that are based on conditions such as topography and distances to predetermined boundaries and certain design criteria.				
Question Number	**Question**	**Yes**	**No**	**NA**
1	Can the concentrated flow dispersion system be placed 10 feet or more from any building structure?	☐	☒	☐
2	Can the concentrated flow dispersion system be placed 5 feet or more from any other structure or property line?	☐	☒	☐
3	Can the concentrated flow dispersion system be placed 50 feet or more from the top of any slope 15% or greater?	☐	☐	☐
4	Can the concentrated flow dispersion system be placed 50 feet or more from geologically hazardous areas?	☐	☐	☐
5	Can the concentrated flow dispersion system maintain setbacks from Onsite Sewage Systems per WAC 246-272A-0210?	☐	☐	☐
6	Is it possible to maintain or construct a vegetated flowpath of at least 25 feet from the discharge location and any property line, structure, slope greater than 15%, surface water, or other hard surface?	☐	☒	☐
7	Will installing concentrated flow dispersion cause conflicts with any of the following? (An answer of yes means this BMP is infeasible.) Place a checkmark next to the applicable item (7a-7e).	☐	☐	☐
7a	Requirements of the Historic Preservation Laws and Archeology Laws, Federal Superfund or Washington State Model Toxics Control Act, Federal Aviation Administration requirements for airports, or Americans with Disability Act	☐		
7b	Special zoning district design criteria adopted and being implemented through any City of Puyallup planning efforts	☐		
7c	Public health and safety standards	☐		
7d	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	☐		
7e	Critical Area Preservation Ordinance	☐		
8	Can the design standards in BMP T5.11 be met?	☐	☐	☐
8a	Describe the design standard that cannot be met:			
Questions #9 require evaluation of site specific conditions and a written recommendation from an appropriate Washington State Licensed Professional (e.g., Professional Engineer, Professional Geologist, Professional Hydrogeologist).				
9	Will the use of concentrated flow dispersion cause erosion or flooding problems onsite or an adjacent properties? (An answer of yes means this BMP is not feasible).	☐	☐	☐

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Pierce County GIS, WA DNR, WSDOT, USFWS, Washington State Department of Ecology, and Puget Sound Regional Council. This information was compiled at scales of 1:1,200 to 1:24,000 during the time period 1996-2012.

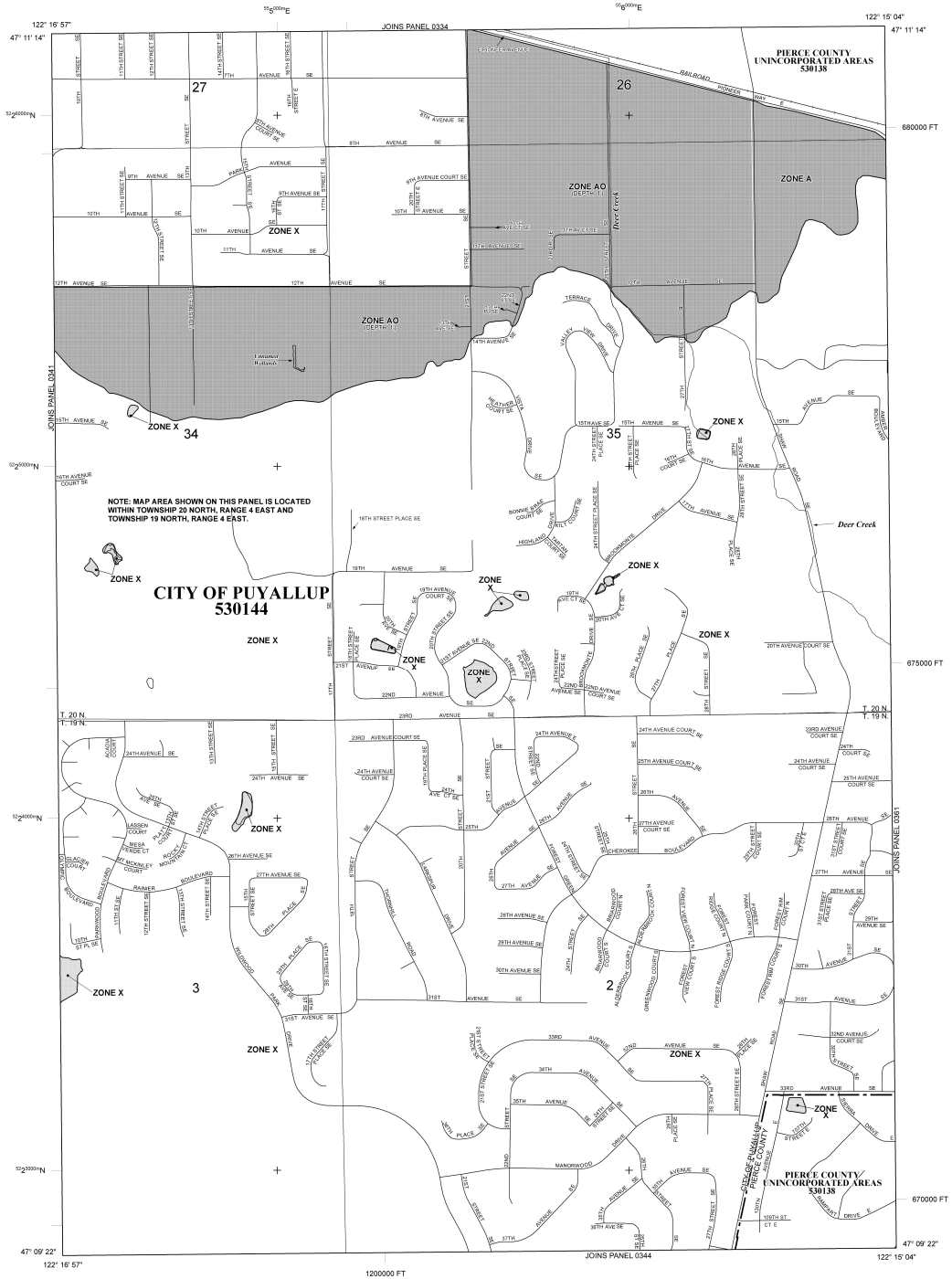
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 Base Flood Elevation line and value; elevation in feet*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A Cross section line
- 23 — 23 Transect line
- Culvert
- Bridge
- 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4989000m N 1000-meter Universal Transverse Mercator grid values, zone 10
- DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
March 7, 2017

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0342E

FIRM

FLOOD INSURANCE RATE MAP

PIERCE COUNTY, WASHINGTON AND INCORPORATED AREAS

PANEL 342 OF 1375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PIERCE COUNTY	530138	0342	E
PUYALLUP, CITY OF	530144	0342	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53053C0342E

EFFECTIVE DATE
MARCH 7, 2017

Federal Emergency Management Agency

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Puyallup Pierce County Washington	CHANNELIZATION CULVERT DETENTION BASIN	HYDROLOGIC ANALYSIS 1D HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 530144		
IDENTIFIER	06-171 East Town Crossing	APPROXIMATE LATITUDE & LONGITUDE: 47.184, -122.254 SOURCE: Other DATUM: WGS 84	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 53053C0342E DATE: March 7, 2017 TYPE: FIRM NO.: 53053C0361E DATE: March 7, 2017	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: March 7, 2017 PROFILE(S): 363P, 365P(NEW), AND 366P(NEW) SUMMARY OF DISCHARGES TABLE: 2

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map

FLOODING SOURCE(S) & REVISED REACH(ES) See Page 2 for Additional Flooding Sources

Deer Creek - Pioneer - From just downstream of E Pioneer Ave & Shaw Road E to approximately 1,520 feet upstream of E Pioneer Ave & Shaw Road E
Pioneer South Creek - From just downstream of E Pioneer Ave & Shaw Road E to approximately 1,530 feet upstream of E Pioneer Ave & Shaw Road E

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Deer Creek – Pioneer	No BFEs*	BFEs	YES	NONE
	Zone X (unshaded)	Zone AE	YES	NONE
Pioneer South Creek	No BFEs	BFEs	YES	NONE
	Zone A	Zone AE	YES	NONE

* BFEs - Base (1-percent-annual-chance) Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER FLOODING SOURCES AFFECTED BY THIS REVISION

FLOODING SOURCE(S) & REVISED REACH(ES)

Pioneer South Creek Tributary - From confluence with Pioneer South Creek to approximately 1,860 feet upstream of confluence with Pioneer South Creek

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Pioneer South Creek Tributary	No BFEs*	BFEs	YES	NONE
	Zone A	Zone AE	YES	YES

* BFEs - Base (1-percent-annual-chance) Flood Elevations

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Kristen Meyers
Director, Mitigation Division
Federal Emergency Management Agency, Region X
Federal Regional Center
130 228th Street, Southwest
Bothell, WA 98021-8627
(425) 487-4543

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp

LOCAL NEWSPAPER

Name: *The News Tribune*

Dates: May 4, 2022 and May 11, 2022

Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

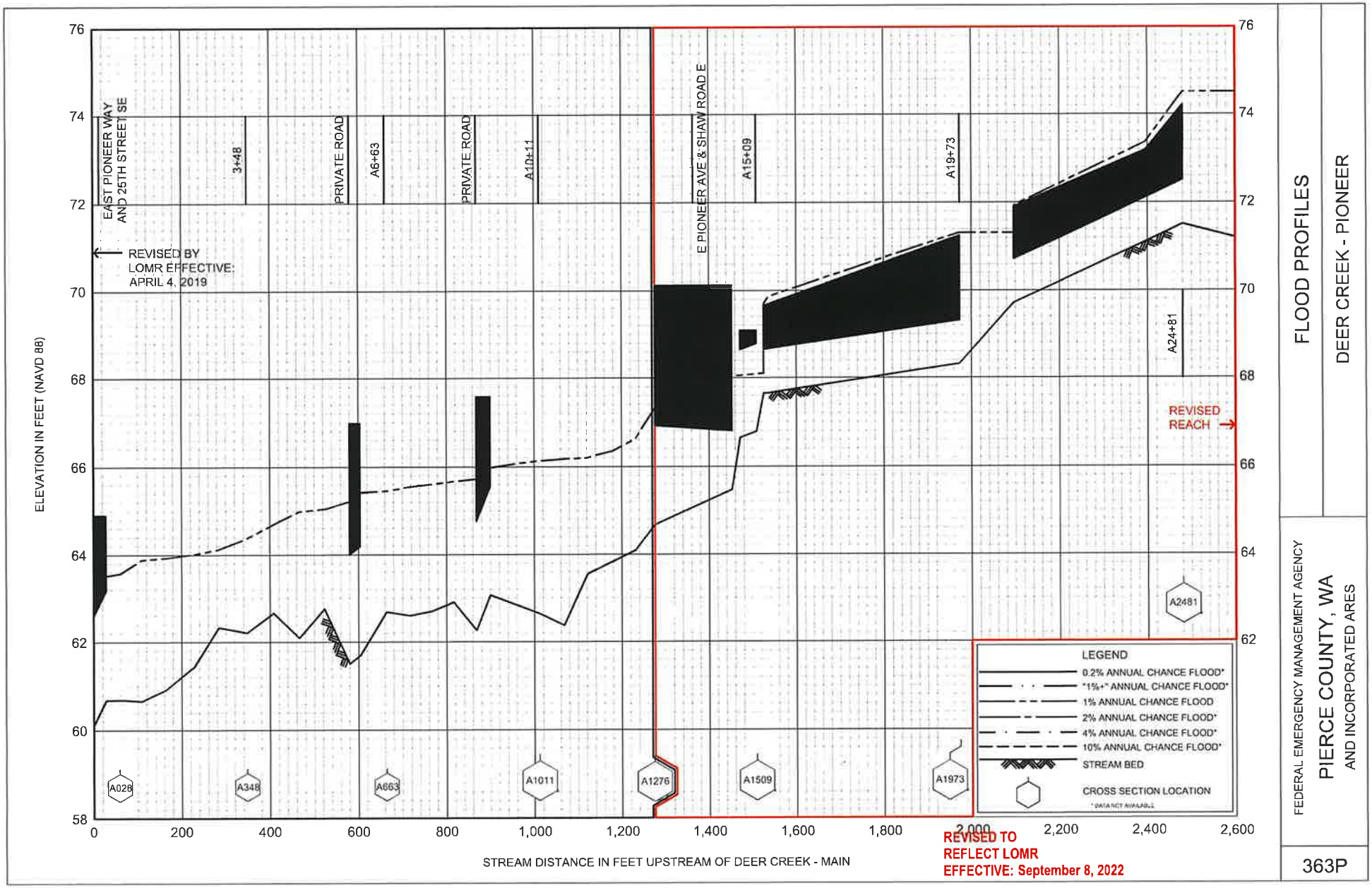
REVISED TO
REFLECT LOMR
EFFECTIVE: April 4,
2019

REVISED TO
REFLECT LOMR
EFFECTIVE: September 8, 2022

Table 2 – Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
DEBRA JANE CREEK					
At Mouth	1.3	45	62	69	85
At Confluence with Bonney Lake Outflow	0.8	26	34	38	48
At Upstream End of Debra Jane Lake	0.1	9	12	14	17
DEER CREEK					
At the BNSF Railroad crossing near E. Pioneer Way and 23rd Street SE	2.4	N/A	N/A	220	N/A
DEER CREEK - PIONEER					
Upstream of Shaw Road E	0.8	N/A	N/A	11	N/A
PIONEER SOUTH CREEK					
Upstream of Shaw Road E	1.7	N/A	N/A	35	N/A
PIONEER SOUTH CREEK TRIBUTARY					
At confluence with Pioneer South Creek	0.2	N/A	N/A	3	N/A

Revised Data



FLOOD PROFILES

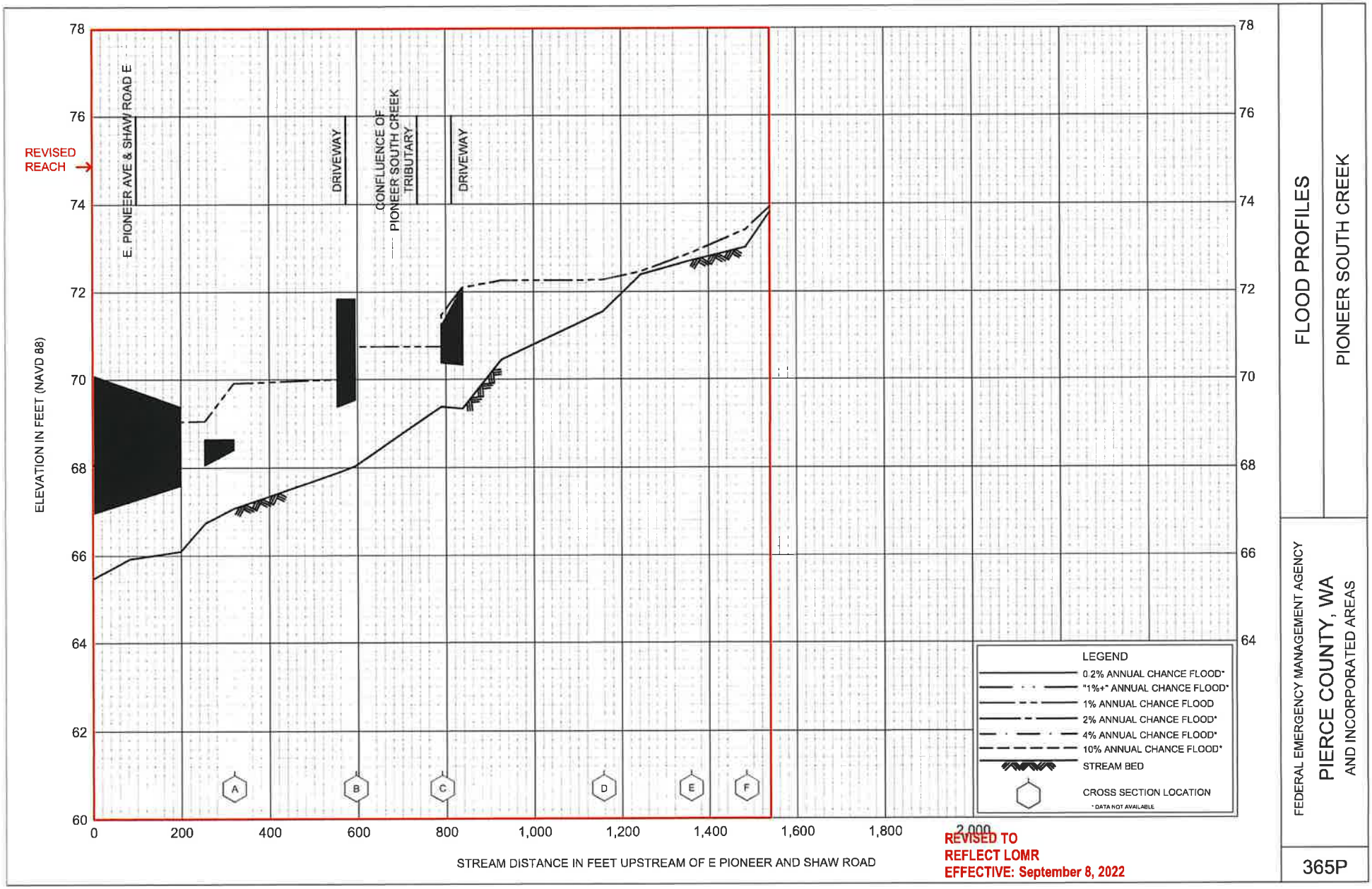
DEER CREEK - PIONEER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PIERCE COUNTY, WA

AND INCORPORATED ARES

363P



REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

FLOOD PROFILES

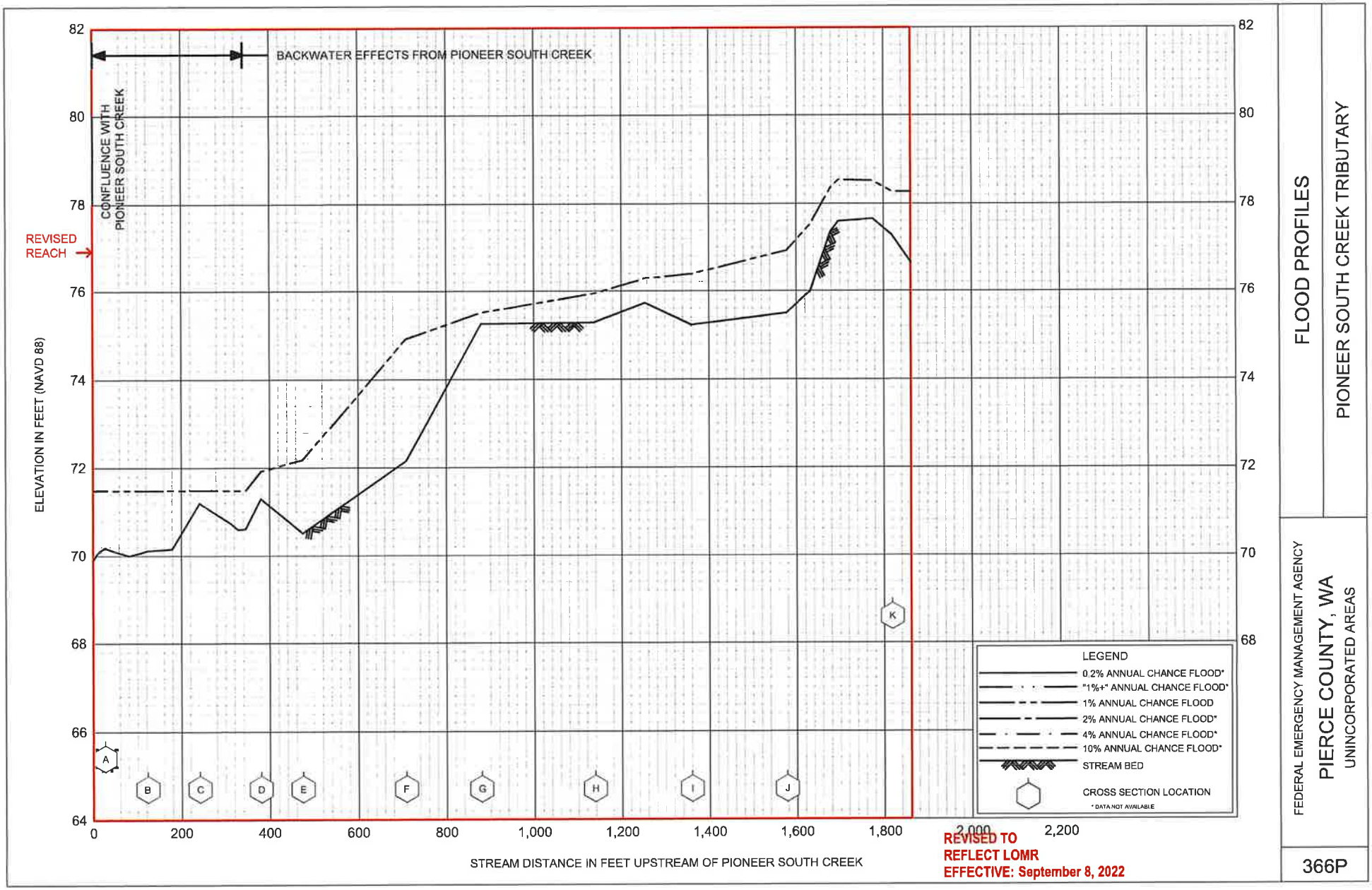
PIONEER SOUTH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

PIERCE COUNTY, WA

AND INCORPORATED AREAS

365P



REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

FLOOD PROFILES

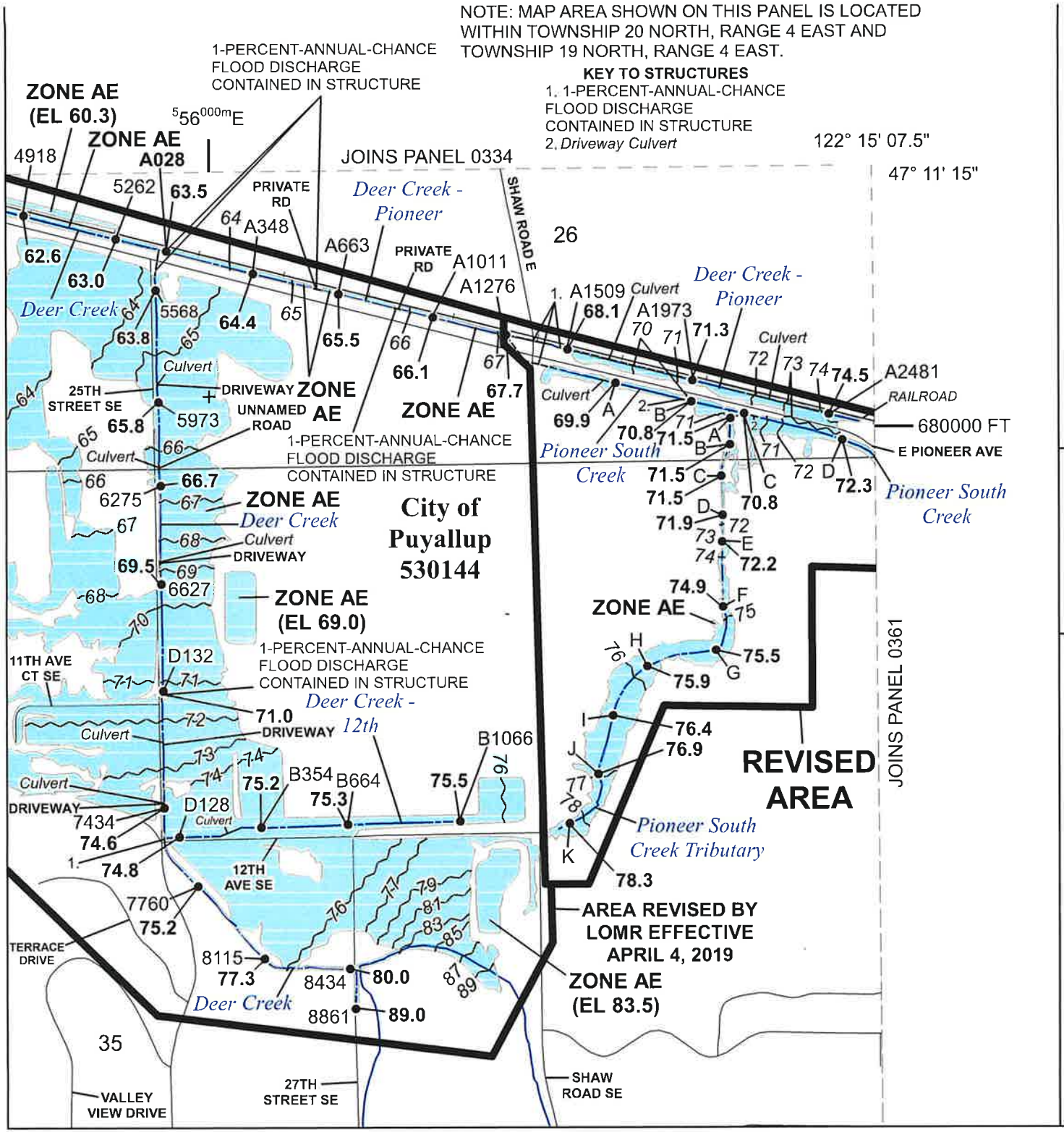
PIONEER SOUTH CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

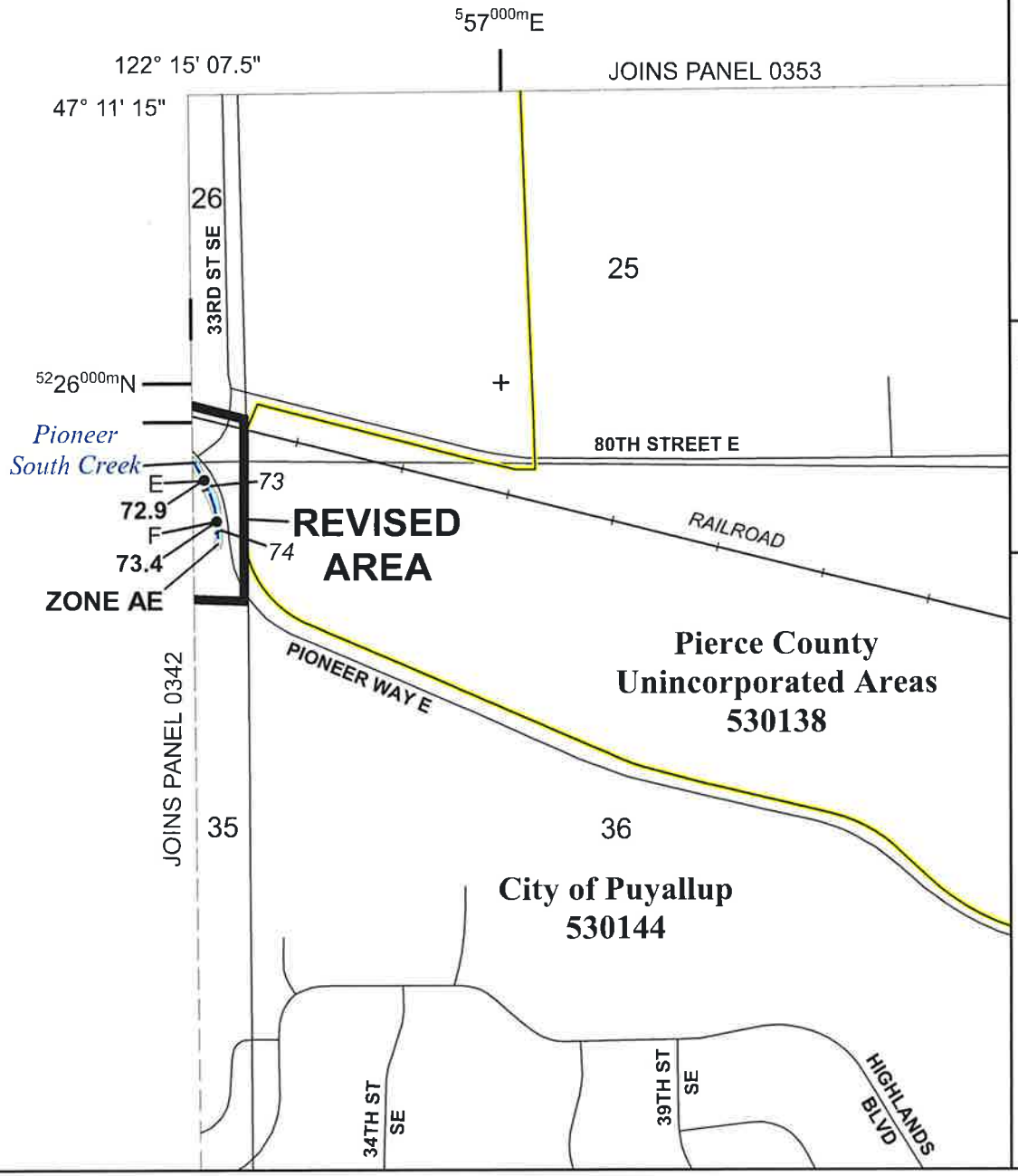
PIERCE COUNTY, WA

UNINCORPORATED AREAS

366P


NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 20 NORTH, RANGE 4 EAST AND TOWNSHIP 19 NORTH, RANGE 4 EAST.
KEY TO STRUCTURES
1. 1-PERCENT-ANNUAL-CHANCE FLOOD DISCHARGE CONTAINED IN STRUCTURE
2. Driveway Culvert
1-PERCENT-ANNUAL-CHANCE FLOOD DISCHARGE CONTAINED IN STRUCTURE
ZONE AE (EL 60.3)
ZONE AE A028
5560000mE
122° 15' 07.5"
47° 11' 15"
JOINS PANEL 0334
PRIVATE RD
SHAW ROAD E
26
Deer Creek - Pioneer
Deer Creek
Pioneer South Creek
Pioneer South Creek Tributary
Deer Creek - 12th
25TH STREET SE
UNNAMED ROAD
DRIVEWAY
Culvert
RAILROAD
A2481
680000 FT
E PIONEER AVE
City of Puyallup 530144
ZONE AE
ZONE AE (EL 69.0)
ZONE AE (EL 83.5)
11TH AVE CT SE
12TH AVE SE
TERRACE DRIVE
VALLEY VIEW DRIVE
27TH STREET SE
SHAW ROAD SE
JOINS PANEL 0361
REVISED AREA
AREA REVISED BY LOMR EFFECTIVE APRIL 4, 2019
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee See Notes. Zone X
SCALE
Map Projection: NAD 1983 UTM Zone 10N; Western Hemisphere; Vertical Datum: NAVD 88
1 inch = 500 feet 1:6,000
0 250 500 1,000 Feet
0 75 150 300 Meters
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
PIERCE COUNTY, WASHINGTON and Incorporated Areas
PANEL 342 OF 1375
Panel Contains:
COMMUNITY NUMBER PANEL SUFFIX
PIERCE COUNTY 530138 0342 E
PUYALLUP, CITY OF 530144 0342 E
REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022
VERSION NUMBER 2.1.3.0
MAP NUMBER 53053C0342E
EFFECTIVE DATE MARCH 7, 2017
FEMA
National Flood Insurance Program

MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 19 NORTH, RANGE 4 EAST, TOWNSHIP 19 NORTH, RANGE 5 EAST, TOWNSHIP 20 NORTH, RANGE 4 EAST, AND TOWNSHIP 20 NORTH, RANGE 5 EAST.



SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, 499
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee See Notes. Zone X

SCALE

N

Map Projection:
NAD 1983 UTM Zone 10N;
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PIERCE COUNTY, WASHINGTON
and Incorporated Areas

PANEL 361 OF 1375

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
PIERCE COUNTY	530138	0361	E
PUYALLUP, CITY OF	530144	0361	E
SUMNER, CITY OF	530147	0361	E

REVISED TO REFLECT LOMR EFFECTIVE: September 8, 2022

VERSION NUMBER
2.1.3.0

MAP NUMBER
53053C0361E

EFFECTIVE DATE
MARCH 7, 2017

BLDG H

BLDG G

BLDG T.I.

BLDG T.I.

BLDG D

BLDG C

BLDG B

BLDG E

CLUB HOUSE

BLDG F

BLDG A

FEMA FLOODPLAIN
SITE VOLUME: 533 CU YD

Verify leader location (noted floodplain is beyond project limits). [Storm Report; Pg 59 of 273]

STREAM VOLUME: 567 CU YD

FEMA FLOODPLAIN
SITE VOLUME: 533 CU YD

N

GRAPHIC SCALE

0 20 40 80

1" = 40 FEET

AHBL

2215 North 30th Street,
Suite 300,
Tacoma, WA 98403
253.383.2422 TEL
253.383.2572 FAX

EAST TOWN CROSSING

FLOODPLAIN COMPENSATORY CALCS

2230752.10

DATE: 11/25/2024

A-10

PROJECT MEMO

TO:	File	**DATE:**	November 25, 2024
FROM:	Christopher Watt Tacoma - (253) 383-2422	**PROJECT NO.:**	2230752.10
		PROJECT NAME:	East Town Crossing
SUBJECT:	Floodplain Compensatory Storage Calculations		

Summary:

The East Town Crossing project proposes road widening and fill within a regulated floodplain, as well as the grading of a stream. Due to this work, compensatory storage calculations are required. This memo is intended to prove that the proposed grading within the floodplain increases the total storage volume and is thus in compliance with PMC 21.07.

Calculation:

Existing Storage Volume:
An earthwork volume was created in order to determine the amount of fill (water volume) between the existing grades and the flood elevations provided in the LOMR dated September 8, 2022. This determined the minimum required storage volume of the finished grading:

Cut volume (unadjusted)	402.23 Cu. Yd.
Fill volume (unadjusted)	533.64 Cu. Yd.
Net volume (unadjusted)	131.41 Cu. Yd.<Fill>

Final Storage Volume:
An earthwork volume was created attempting to match the existing storage volume for the finished stream grading.

Cut volume (unadjusted)	5811.13 Cu. Yd.
Fill volume (unadjusted)	567.91 Cu. Yd.
Net volume (unadjusted)	5243.22 Cu. Yd.<Cut>

Both the existing LOMR boundary and the equivalent area in the final grading can be seen in the map below.

Conclusion:

An equivalent storage volume can be encapsulated by the proposed stream relocation, thus meeting the requirements of PMC 21.07.

CJW/

c: Todd Sawin, AHBL

\\ahbl.com\data\Projects\2022\2220304\10_CIV\NON_CAD\REPORTS\Memos (PDD)\20230511 Parking Memo.docx

Appendix B

B-1……...Geotechnical Report by Krazan & Associates, Inc., dated April 11, 2019

B-2……...Project Infiltration Feasibility Letter by Migizi Group, dated August 25, 2023

B-3……...Water Table Monitoring Information by Abbey Road Group, dated January 17, 2023.

B-4……...Stream Restoration and Mitigation Plan by Soundview Consultants, dated March 2024

APPENDIX B-1

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

April 11, 2019

KA Project No. 062-19005

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Mr. Gil Hulsmann

Email: Gil.Hulsmann@AbbeyRoadGroup.com
Tel: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan

Theresa R. Nunan
Project Engineer

TRN:MR

GEOTECHNICAL ENGINEERING INVESTIGATION
EAST TOWN CROSSING
PARCEL NOS. 0420264053, 0420264054, 0420351066
SE CORNER OF E. SHAW ROAD & E. PIONEER WAY
PUYALLUP, WASHINGTON

PROJECT NO. 062-19005
APRIL 11, 2019

Prepared for:

ABBEY ROAD GROUP LAND DEVELOPMENT
SERVICES COMPANY, LLC
ATTN: MR. GIL HULSMANN
PO BOX 1224
PUYALLUP, WA 98371

Prepared by:

KRAZAN & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING DIVISION
825 CENTER STREET, STE A
TACOMA, WASHINGTON 98409
(253) 939-2500

TABLE OF CONTENTS

April 11, 2019 KA Project No. 062-19005

GEOTECHNICAL ENGINEERING INVESTIGATION
EAST TOWN CROSSING
PARCEL NOS. 0420264053, 0420264054, 0420351066
SE CORNER OF EAST SHAW ROAD AND EAST PIONEER WAY
PUYALLUP, WASHINGTON

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed East Town Crossing project located near the southeast corner of East Shaw Road and East Pioneer Way in Puyallup, Washington, as shown on the Vicinity Map in Figure 1. Discussions regarding site conditions are presented in this report, together with conclusions and recommendations pertaining to site preparation, excavations, structural fill, utility trench backfill, drainage and landscaping, erosion control, foundations, concrete floor slabs and exterior flatwork, lateral earth pressures, and pavement.

A Site Plan showing the approximate exploratory boring and monitoring well locations is presented following the text of this report in Figure 2. Appendix A includes USCS Soil Classification information, as well as a description of the field investigation, exploratory boring logs, and the laboratory testing results. Appendix B contains a guide to aid in the development of earthwork specifications. Pavement design guidelines are presented in Appendix C. The recommendations in the main text of the report have precedence over the more general specifications in the appendices.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the subsurface soil and groundwater conditions at the site, to develop geotechnical engineering recommendations for use in design of specific construction elements, and to provide criteria for site preparation and earthwork construction.

Our scope of services was performed in general accordance with our proposal for this project, dated January 25, 2019 (Proposal Number G19001WAT) and included the following:

- Exploration of the subsurface soil and groundwater conditions by conducting approximately three (3) geotechnical borings and installing two (2) groundwater level monitoring wells using a subcontracted drill rig;
- Provide a site plan showing the geotechnical boring and monitoring well locations;

- Provide comprehensive boring and monitoring well logs, including soil stratification and classification, and groundwater levels where applicable;
- Recommended foundation type for the proposed structures;
- Allowable foundation bearing pressure, anticipated settlements (both total and differential), coefficient of horizontal friction for footing design, and frost penetration depth;
- Recommendations for seismic design considerations including site coefficient and ground acceleration based on the 2015 IBC;
- Recommendations for structural fill materials, placement, and compaction;
- Recommendations for suitability of on-site soils as structural fill;
- Recommendations for temporary excavations;
- Recommendations for site drainage and erosion control;
- Recommendations for flexible and rigid pavements, as well as permeable pavement.

PROPOSED CONSTRUCTION

Based on the Overall Site Plan prepared by Abbey Road Group Land Development Services, dated December 12, 2018, we understand that the proposed development will include construction of six residential structures (designated Buildings A through E) and a club house/office building. Site drainage systems will include a subsurface stormwater system located in the southern portion of the property, and a rain garden along the northern and eastern edges of the site. We have not been provided with details regarding construction of the subsurface stormwater system. The planned development will also include utility installation, and paved parking areas and driveways. For the purpose of our analyses, we have assumed that the residential buildings and club house will be 1- to 2-story structures with a slab-on-grade floor system. We have also assumed only minor grading up to 1 foot of cut or fill will be required to establish planned elevations for the site.

SITE LOCATION AND DESCRIPTION

The site consists of three undeveloped parcels encompassing approximately 7 acres of land located south and east of the intersection of Shaw Road with East Pioneer Way. The site is bordered to the north by East Pioneer Way, to the south by commercial property, to the east by undeveloped land and a creek, and to the west by undeveloped land and abandoned residences. The site is roughly rectangular in shape and relatively level at approximately Elevation 72 to 74 feet. A dirt road runs north-south through the center of the site, and also extends from the center of the site westward towards Shaw Road. An existing storm pond is located in the southeast corner of the site, with the bottom at Elevation 69

feet. A wetland that has been field verified by others is located within the western central edge of the site. A creek runs along the eastern boundary of the site.

Most of the property is covered with seasonal vegetation, brambles, and a few trees located within the central portion of the site. Some trash and an abandoned trailer are located in the north central portion of the site. The southern portion of the site is currently being used by the adjacent business for container storage.

We understand that past construction activities for the undeveloped parcel to the west of the site that borders Shaw Road and East Pioneer Way consisted of the placement of fill material to raise the existing grades, based on the Geotechnical Evaluation and Additional Recommendations report prepared by Krazan & Associates, dated March 13, 2007. Those fill activities did not extend into this site.

GEOLOGIC SETTING

The site lies within the central Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances and retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and nonglacial sediments.

The Washington Division of Geology and Earth Resources, Geologic Map of the South Half of the Tacoma Quadrangle, Washington (Open File Report 87-3) indicates that the property is located in an area that is predominantly underlain by recent alluvium deposited by the Puyallup River. The recent alluvium consists of interbedded silt, sandy silt, silty sand, sand, gravel, local areas of peat and clay. The finer material represents overbank material and local lacustrine deposits, and the coarser materials most likely represent deposits in abandoned channels of the Puyallup River.

FIELD INVESTIGATION

A field investigation consisting of three (3) exploratory soil borings and installation of two (2) monitoring wells was completed to evaluate the subsurface soil and groundwater conditions at the project location. The soil borings were completed on March 11, 2019 by a Krazan subcontractor utilizing a hollow stem auger drill rig. The soil borings were advanced to depths ranging from 21.5 to 38.5 feet below the existing ground surface (bgs). A geotechnical engineer from Krazan and Associates was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the explorations.

Representative samples of the subsurface soils encountered in the borings were collected and sealed in plastic bags. These samples were transported to our laboratory for further examination and testing. The

soils encountered in the exploratory borings were continuously examined and visually classified in accordance with the Unified Soil Classification System (USCS).

SOIL PROFILE AND SUBSURFACE CONDITIONS

The geotechnical subsurface exploration for this project consisted of soil borings and monitoring wells advanced to depths of approximately 21.5 to 38.5 feet bgs. The locations of the soil borings and monitoring wells are shown on the Site Plan in Figure 2.

Beneath 5 to 8 inches of surficial topsoil, the borings encountered alluvial soils to their explored depths. The topsoil was underlain by 4.5 to 7 feet of brown silty sand (SM) and poorly graded sand (SP) with relative densities in the loose to medium dense range. The sand soils were underlain by a 3-foot thick stratum of interbedded sandy silt (ML) that exhibited medium stiff to stiff consistencies and silty sand (SM) soils with relative densities in the loose to medium dense range.

Boring B-1 encountered a layer of silty clay and clayey silt beneath the sandy silt and silty sands from 7.5 to 11.0 feet bgs. The silty clay (CL) and clayey silt (ML) exhibited a very soft consistency with a Standard Penetration Test (SPT) resistance (N-value) of 1/12 inches and a moisture content of 51 percent.

The clayey silt in boring B-1 and the silty sand/sandy silt stratum in borings B-2 and B-3 were underlain by silty sand, sand, and gravel soils with varying silt contents to the termination depths of 21.5, 38.5, and 21.5 feet bgs, respectively. These granular soils exhibited relative densities in the loose to very dense range with N-values ranging from 8 to 60/8" blows per foot.

Gradation and Atterberg Limits tests were conducted on representative samples of the soils for classification purposes and for determination of engineering properties. The gradation and Atterberg Limits results are graphically depicted in Appendix A. For additional information about the soils encountered, please refer to the boring logs in Appendix A.

Monitoring Wells: Two monitoring wells, designated W-1 and W-2, were installed at the site on March 11, 2019 using a subcontracted driller and track mounted drill rig. Monitoring well W-1 was installed within borehole B-1. The boreholes for monitoring wells W-1 and W-2 were advanced to a depth of 21.5 feet and 20 feet below the existing ground surface, respectively, using 4¼-inch diameter hollow stem augers. A 10-foot long section of slotted PVC pipe attached to a 10-foot section of solid PVC pipe was inserted into the borehole, and the annular space between the pipe and the augers was backfilled with filter sand to a depth of 8 feet bgs followed by bentonite chips to the ground surface. A metal well cap was then installed over the pipe and cemented in-place to protect the well from unauthorized access. The installation log for monitoring wells W-1 and W-2 are included in Appendix A.

GROUNDWATER

Groundwater was encountered during the drilling operations at a depth of about 7 to 8 feet below the existing ground surface. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, climatic conditions, as well as other factors. Therefore, water levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

GEOLOGIC HAZARDS

Erosion Concern/Hazard

The Natural Resources Conservation Services (NRCS) map for Pierce County Area, Washington, classifies the site area as Briscot loam. The NRCS classifies the Briscot loam as Hydrologic Soil Group B/D with low potential for erosion in a disturbed state.

It has been our experience that soil erosion can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, i.e., silt fences, hay bales, mulching, control ditches or diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The 2015 International Building Code (IBC), Section 1613.3.2, refers to Chapter 20 of ASCE-7 for Site Class Definitions. It is our opinion that the overall soil profile corresponds to Site Class D as defined by Table 20.3-1 "Site Class Definitions," according to the 2010 ASCE-7 Standard. Site Class D applies to a "stiff soil" profile. The seismic site class is based on a soil profile extending to a depth of 100 feet. The soil borings on this site extended to a maximum depth of 38.5 feet and this seismic site class designation is based on the assumption that similar soil conditions continue below the depth explored.

We referred to the U.S. Geological Survey (USGS) Earthquake Hazards Program Website and 2012/2015 IBC to obtain values for S_S, S_{MS}, S_{DS}, S_1, S_{M1}, S_{D1}, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The seismic design parameters for this site are as follows:

Seismic Design Parameters
(Reference: 2015 IBC Section 1613.3.2, ASCE, and USGS)

Seismic Item	Value
Site Coefficient F_a	1.003
S_s	1.243 g
S_{MS}	1.247 g
S_{DS}	0.831 g
Site Coefficient F_v	1.524
S_1	0.476 g
S_{M1}	0.726 g
S_{D1}	0.484 g

Additional seismic considerations include liquefaction potential and amplification of ground motions by loose/soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. Soil liquefaction is a state where soil particles lose contact with each other and become suspended in a viscous fluid. This suspension of the soil grains results in a complete loss of strength as the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events.

We have reviewed "Liquefaction Susceptibility Map of Pierce County, Washington" by Stephen P. Palmer et al., (WA DNR, 2004). The map indicates that the site area is located in a zone of high liquefaction susceptibility. At the request of our client, we have conducted a site-specific liquefaction analysis for this project.

To evaluate the liquefaction potential of the site, we analyzed the following factors:

1) Soil type
2) Groundwater depth
3) Relative soil density
4) Initial confining pressure
5) Maximum anticipated intensity and duration of ground shaking

Liquefaction Analysis: The commercially available liquefaction analysis software, LiquefyPro from CivilTech, was used to evaluate the liquefaction potential and the possible liquefaction induced settlement for the site soil and groundwater conditions based on our explorations. The analysis was performed using the information from the soil test boring and laboratory gradation analyses. Maximum

Considered Earthquake (MCE) was selected in accordance with the 2015 International Building Code (IBC) Chapter 16 and the U.S. Geological Survey (USGS) Earthquake Hazards Program website. For this analysis, a maximum earthquake magnitude of 7.11 and peak horizontal ground surface acceleration of 0.5g were used. Our analysis assumed a groundwater depth of 7.0 feet during the earthquake.

The maximum liquefaction induced settlement for this type of seismic event is estimated to be on the order of about 2 inches. The differential settlements are estimated to be on the order of about 1-inch.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the planned improvements at this site are feasible, provided that the geotechnical engineering recommendations presented in this report are included in the project design. Based on our explorations, it is our opinion that conventional spread foundations supported on medium dense/stiff or firmer native soil, or on structural fill extending to the medium dense/stiff or firmer native soil would be appropriate for the new buildings.

We recommend that organic topsoil, undocumented fill, and loose/soft soils be stripped to expose the underlying medium dense/stiff or firmer native soil. Footings should extend through any organic or loose soil and be founded on the underlying medium dense or firmer native soil, or structural fill extending to the competent native soils.

Exploration boring B-1 was drilled in the northern portion of the site, in the area of the planned rain garden between Pioneer Way and the Club House and Residential Building E. Boring B-1 encountered a layer of very soft silty clay between 7.5 and 11 feet below the existing ground surface. These materials are not considered suitable to support foundations and will need to be removed where they are encountered. Test pits should be conducted prior to the construction phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 (drilled within the eastern and southern portions of the site) and monitoring well W-2 (installed within the central portion of the site) encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs, respectively; however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

The soils encountered on this site are considered moisture-sensitive and will be easily disturbed and difficult to compact when wet. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during wet weather, additional expenses and delays

should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls to protect exposed subgrades and construction traffic areas.

Site Preparation

General site clearing should include removal of any undocumented fill, organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas. Additional recommendations for preparation of specific areas are provided in **the Foundations, Pavement Design** and **Exterior Flatwork** subsections of this report.

The soils that will be encountered during site development are considered extremely moisture-sensitive and may disturb easily in wet conditions. The prepared subgrade should be protected from construction traffic and surface water should be diverted around prepared subgrade. We recommend that the site be developed only during extended periods of dry weather.

During wet weather conditions, subgrade stability problems and grading difficulties may develop due to excess moisture, disturbance of sensitive soils and/or the presence of perched groundwater. Construction during the extended periods of wet weather could result in the need to remove wet disturbed soils if they cannot be suitably compacted due to elevated moisture contents. The onsite soils have significant silt content in the explored areas and are moisture sensitive, and can be easily disturbed when wet. If over-excavation is necessary, it should be confirmed through continuous monitoring and testing by a qualified geotechnical engineer or geologist. Soils that have become unstable may require drying to near their optimal moisture content before compaction is feasible. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry, warm weather (typically during the summer months). If the soils cannot be dried back to a workable moisture condition, remedial measures may be required. General project site winterization should consist of the placement of aggregate base and the protection of exposed soils during the construction phase. It should be understood that even if Best Management Practices (BMP's) for wintertime soil protection are implemented and followed there is a significant chance that moisture disturbed soil mitigation work will still be required.

Any buried structures encountered during construction should be properly removed and backfilled. Excavations, depressions, or soft and pliant areas extending below the planned finish subgrade levels should be excavated to expose firm undisturbed soil, and backfilled with structural fill. In general, any septic tanks, underground storage tanks, debris pits, cesspools, or similar structures should be completely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as reeommended by the geotechnical engineer. The resulting excavations should be backfilled with structural fill.

We understand that backfilling of the wetland in the central western edge of the site that has been field identified by others will be permitted for construction of the paved parking area and subsurface storm system. We also understand that proposed Residential Building C will be constructed within the area currently occupied by an existing storm pond. Our field explorations were not specifically conducted within either of these areas. Any organic, silt or clay soils, or accumulations of sediment, encountered within the wetland area or the existing storm pond should be removed down to firm undisturbed soil, and backfilled with structural fill to the planned finish grades.

A representative of our firm should be present during all site clearing and grading operations to observe, test and evaluate earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The geotechnical engineer may reject any material that does not meet compaction and stability requirements. Further recommendations, contained in this report, are predicated upon the assumption that earthwork construction will conform to the recommendations set forth in this section and in the Structural Fill section below.

Temporary Excavations

The onsite soils have variable cohesion strengths, therefore the safe angles to which these materials may be cut for temporary excavations is limited, as the soils may be prone to caving and slope failures in temporary excavations. Temporary excavations in the loose to medium dense native soils should be sloped no steeper than 2H:1V (horizontal to vertical) where room permits.

All temporary cuts should be in accordance with Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. The temporary slope cuts should be visually inspected daily by a qualified person during construction work activities and the results of the inspections should be included in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and minimizing slope erosion during construction. The temporary cut slopes should be covered with plastic sheeting to help minimize erosion during wet weather and the slopes should be closely monitored until the permanent retaining systems are complete. Materials should not be stored and equipment operated within 10 feet of the top of any temporary cut slope.

A Krazan & Associates geologist or geotechnical engineer should observe, at least periodically, the temporary cut slopes during the excavation work. The reasoning for this is that all soil conditions may not be fully delineated by the limited sampling of the site from the geotechnical explorations. In the case of temporary slope cuts, the existing soil conditions may not be fully revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of the temporary slope will need to be evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed smoothly and required deadlines can be met. If any variations or undesirable conditions are

encountered during construction, Krazan & Associates should be notified so that supplemental recommendations can be made.

Structural Fill

Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the Site Preparation subsection of this report prior to beginning fill placement.

Best Management Practices (BMP's) should be followed when considering the suitability of the existing materials for use as structural fill. The on-site soils are generally considered suitable for re-use as structural fill, provided the soil is free of organic material and debris, and it is within ± 2 percent of the optimum moisture content. If the native soils are stockpiled for later use as structural fill, the stockpiles should be covered to protect the soil from wet weather conditions. We recommend that a representative of Krazan & Associates be on site during the excavation work to determine which soils are suitable for use as structural fill.

Imported, all weather structural fill material should consist of well-graded gravel or a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). All structural fill material should be submitted for approval to the geotechnical engineer at least 48 hours prior to delivery to the site.

Fill soils should be placed in horizontal lifts not exceeding 8 inches in thickness prior to compaction, moisture-conditioned as necessary (moisture content of soil shall not vary by more than ±2 percent of optimum moisture), and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM D1557 Test Method. In-place density tests should be performed on all structural fill to document proper moisture content and adequate compaction. Additional lifts should not be placed if the previous lift did not meet the compaction requirements or if soil conditions are not considered stable.

Foundations

Our exploratory borings encountered loose to medium dense granular soils underlain by a 3-foot thick stratum of interbedded sandy silt and silty sand, followed by loose to very dense granular alluvial soils to the explored depths. Boring B-1, drilled at the proposed rain garden area in the northern end of the site, encountered a 3.5-foot thick layer of very soft silty clay at a depth of 7.5 feet bgs.

The very soft clay encountered in Boring B-1 between 7.5 and 11 feet below the existing ground surface is not considered suitable to support foundations and will need to be removed where it is encountered.

Further exploration of this area with test pits should be conducted during the planning phase to determine the aerial extent (i.e. lateral extent and depth) of this very soft clay layer. If the additional test pit exploration reveals that the soft clay layer extends into the footprint of the Clubhouse or Residential Building E, or any of the other structures, additional foundation recommendations will be necessary to address the effect of the very soft clays. If the very soft clay is encountered in building areas, a deep foundation system may be required for support of the structure(s).

Borings B-2 and B-3 and monitoring well W-2, drilled within the eastern, southern, and central portions of the site, encountered medium dense/stiff native soils at depths of approximately 5 and 7 feet bgs. however, deeper layers of loose/soft soils may be encountered in unexplored areas of the site.

Pending the findings of further explorations in the northern portion of the site, the proposed structures may be supported on a shallow foundation system. Where loose/soft soils are encountered at the planned footing elevations, the subgrade should be over-excavated to expose suitable bearing soil. The foundation excavations should be evaluated by Krazan & Associates prior to structural fill placement to verify that the foundations will bear on suitable material.

Building foundations should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Footing widths should be based on the anticipated loads and allowable soil bearing pressure, and should conform to current International Building Code (IBC) guidelines. Water should not be allowed to accumulate in foundation excavations. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing capacity of 2,000 pounds per square foot (psf) may be used for foundation design for this project. A representative of Krazan and Associates should evaluate the foundation bearing soil prior to footing form construction.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.35 acting between the bases of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 150 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglecting the upper 12 inches). The allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A 1/3 increase in the above values may be used for short duration wind and seismic loads.

For foundations constructed as recommended, the total static settlement is not expected to exceed 1-inch. Differential settlement, along a 20-foot exterior wall footing, or between adjoining column footings should be less than ½ inch. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils become flooded or saturated. It should be noted that the estimated settlement provided herewith is a

static settlement and does not include liquefaction induced settlement. Static settlement is induced by the applied dead load from the structures.

Up to 2 inches of total settlement and 1 inch of differential settlement could occur during and/or following a seismic event. The foundation elements, i.e. spread and wall footings, could be structurally tied together to create a stiffer structure. It should be noted that this measure would not mitigate the anticipated seismic settlement; however, it may reduce the damage associated with the anticipated seismic settlement, particularly the effects of differential settlement on a structure.

Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed structures, should not be permitted to flood and or saturate foundation subgrade soils. To prevent the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter rigid perforated PVC pipe, sloped to drain, with perforations placed near the bottom and enveloped in all directions by washed rock and wrapped with filter fabric to limit the migration of silt and clay into the drain.

Lateral Earth Pressures and Retaining Walls

We understand that a below grade stormwater vault is planned for this project. We have developed criteria for the design of retaining or below grade walls for the stormwater vault. Our design parameters are based on retention of the native soils. The parameters are also based on level, well-drained wall backfill conditions. Walls may be designed as "restrained" retaining walls based on "at-rest" earth pressures, plus any surcharge on top of the walls as described below, if the walls are braced to restrain movement and/or movement is not acceptable. Unrestrained walls may be designed based on "active" earth pressure, if the walls are not part of the buildings and some movement of the retaining walls is acceptable. Acceptable lateral movement equal to at least 0.2 percent of the wall height would warrant the use of "active" earth pressure values for design. We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 38 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls or loads imposed by construction equipment, foundations, back slopes or roadways (surcharge loads). Groundwater was encountered in each of the borings at 7 to 8 feet below the ground surface. Portions of the vault that will extend below the groundwater level will need to be designed to resist hydrostatic pressures and buoyant forces. Equivalent fluid densities for buoyant soil pressure under yielding conditions would be 20 pcf and 30 pcf for nonyielding conditions. The allowable buoyant passive pressure would be 100 pcf with a factor of safety of 2.0.

Floor Slabs and Exterior Flatwork

Before the placement of concrete floors or pavements on the site, or before any floor supporting fill is placed, the loose soils and undocumented fill must be removed to expose medium dense or firmer undisturbed native soil. The subgrade should then be proof-rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of yielding soils should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirements of structural fill. Fill soils should be placed in horizontal lifts not exceeding 8 inches loose thickness, moisture-conditioned as necessary, (moisture content of soil shall not vary by more than ±2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557.

Floor slabs may be designed using a modulus of subgrade reaction value of k = 200 pounds per cubic inch (pci) for slabs supported on medium dense or firmer native soils or on structural fill extending to medium dense or firmer native soil.

In areas where it is desired to reduce floor dampness, such as areas covered with moisture sensitive floor coverings, we recommend that concrete slab-on-grade floors be underlain by a water vapor retarder system. According to ASTM guidelines, the water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 4-inches of compacted clean (less than 5 percent passing the U.S. Standard No. 200 Sieve), open-graded angular rock of ¾-inch maximum size. The vapor retarder sheeting should be protected from puncture damage.

It is recommended that the utility trenches within the building pads be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the drainage and irrigation adjacent to the buildings is recommended. Grading should establish drainage away from the structures and this drainage pattern should be maintained. Water should not be allowed to collect adjacent to the structures. Excessive irrigation within landscaped areas adjacent to the structure should not be allowed to occur. In addition, ventilation of the structure may be prudent to reduce the accumulation of interior moisture.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to minimize the transportation of sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented and these measures should be in general accordance with local regulations. As a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features of the site:

1) Phase the soil, foundation, utility and other work, requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be undertaken during the wet season (generally October through April), but it should also be known that this may increase the overall cost of the project.

2) All site work should be completed and stabilized as quickly as possible.

3) Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.

4) Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited, other filtration methods will need to be incorporated.

Groundwater Influence on Structures and Earthwork Construction

The soil borings were checked for the presence of groundwater during exploratory operations. Groundwater was encountered in all of our borings at approximately 7 to 8 feet bgs. It should be recognized that groundwater elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, groundwater levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

If groundwater is encountered during construction, we should observe the conditions to determine if dewatering will be needed. Design of temporary dewatering systems to remove groundwater should be the responsibility of the contractor. If earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated. These soils may "pump," and the materials may not respond to densification techniques. Typical remedial measures include: disking and aerating the soil during dry weather; mixing the soil with drier materials; removing and replacing the soil with an approved fill material. A qualified geotechnical engineering firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Drainage

The ground surface should slope away from building pads and pavement areas, toward appropriate drop inlets or other surface drainage devices. It is recommended that adjacent exterior grades be sloped a

minimum of 2 percent for a minimum distance of 5 feet away from structures. Roof drains should be tightlined away from foundations. Roof drains should not be connected to the footing drains.

Pavement areas should be inclined at a minimum of 1 percent and drainage gradients should be maintained to carry all surface water to collection facilities and suitable outlets. These grades should be maintained for the life of the project.

Specific recommendations for and design of storm water disposal systems or septic disposal systems are beyond the scope of our services and should be prepared by other consultants that are familiar with design and discharge requirements.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be minimized; cyclic wetting and drying of excavation side slopes should be avoided.

All utility trench backfill should consist of suitable on-site material or imported granular material. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Pavement Design

Based on our explorations, the near surface soils at the site are interpreted as loose to medium dense silty sand and sand soils to depths of approximately 4.5 to 7.0 feet bgs. Due to the loose nature of the anticipated pavement subgrade soils, we recommend that subgrade modification techniques be considered. Subgrade modification typically includes the over-excavation of unsuitable materials, the placement of a geotextile fabric at the bottom of the over-excavated area, and then the placement of structural fill, with the structural fill consisting of clean crushed rock, rock spalls, or Controlled Density Fill (CDF). We recommend the use of a high-strength geotextile separation fabric, such as Mirafi 600X

or equivalent, for the geotextile. Subgrade modification such as this is intended to disperse surcharge loads and therefore aid in pavement performance.

Where loose soils are encountered in the pavement subgrade, we recommend over-excavation of the loose soil to at least 12 inches below the planned pavement subgrade elevation. The exposed grade after the over-excavation should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. We recommend that a high-strength geotextile separation fabric, such as Mirafi 600X or equivalent, then be placed over the compacted soil. After the fabric is placed, the area should be filled to the planned slab subgrade elevation with structural fill. The structural fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In-place density tests should be performed to verify proper moisture content and adequate compaction.

In areas where the pavement subgrade soil consists of firm and unyielding native soils, a proof roll of the pavement subgrade soil may be performed in lieu of the compaction and in-place density tests. It should be noted that subgrade soils that have relatively high silt contents may be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Traffic loads were not provided, however, based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (delivery and fire trucks). Pavement design life of 20 years was assumed for our analysis. Recommendations for an asphaltic concrete flexible pavement section and Portland Cement Concrete (PCC) rigid pavement section are provided in Tables 1 and 2 below.

Table 1: ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

Asphaltic Concrete	Aggregate Base	Compacted Subgrade**
3.0 in.	6.0 in.	12.0 in.

Table 2: PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT
4000 psi with FIBER MESH

Min. PCC Depth	Aggregate Base	Compacted Subgrade**
6.0 in.	4.0 in.	12.0 in.

*** A proof roll may be performed in lieu of in-place density tests*

The asphaltic concrete depth listed in Table 1 for the flexible pavement section should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) ½-inch Hot Mix Asphalt (HMA). The pavement specification in Appendix C provides additional recommendations, including aggregate base material.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our services as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. We should also be present during the construction of stormwater management system to evaluate the soils. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor. Furthermore, Krazan & Associates is not responsible for the contractor's procedures, methods, scheduling or management of the work site.

LIMITATIONS

Geotechnical engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences improves. Although your site was analyzed using the most appropriate current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to improvements in the field of geotechnical engineering, physical changes in the site either due to excavation or fill placement, new agency regulations or possible changes in the proposed structure after the time of completion of the soils report may require the soils report to be professionally reviewed. In light of this, the owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. Our report, design conclusions and interpretations should not be construed as a warranty of the subsurface conditions. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The findings and conclusions of this report can be affected by the passage of time, such as seasonal weather conditions, manmade influences, such as construction on or adjacent to the site, natural events such as earthquakes, slope instability, flooding, or groundwater fluctuations. If any variations or undesirable conditions are encountered during construction, the geotechnical engineer should be notified so that supplemental recommendations can be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The geotechnical engineer should be notified of any changes so that the recommendations can be reviewed and reevaluated.

Misinterpretations of this report by other design team members can result in project delays and cost overruns. These risks can be reduced by having Krazan & Associates, Inc. involved with the design teams' meetings and discussions after submitting the report. Krazan & Associates, Inc. should also be retained for reviewing pertinent elements of the design team's plans and specifications. Contractors can also misinterpret this report. To reduce this, risk Krazan & Associates. Inc. should participate in pre-bid and preconstruction meetings, and provide construction observations during the site work.

This report is a geotechnical engineering investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands. Any statements or absence of statements, in this report or on any soils log regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessments.

The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments. We emphasize that this report is valid for this project as outlined above, and should not be used for any other site. Our report is prepared for the exclusive use of our client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

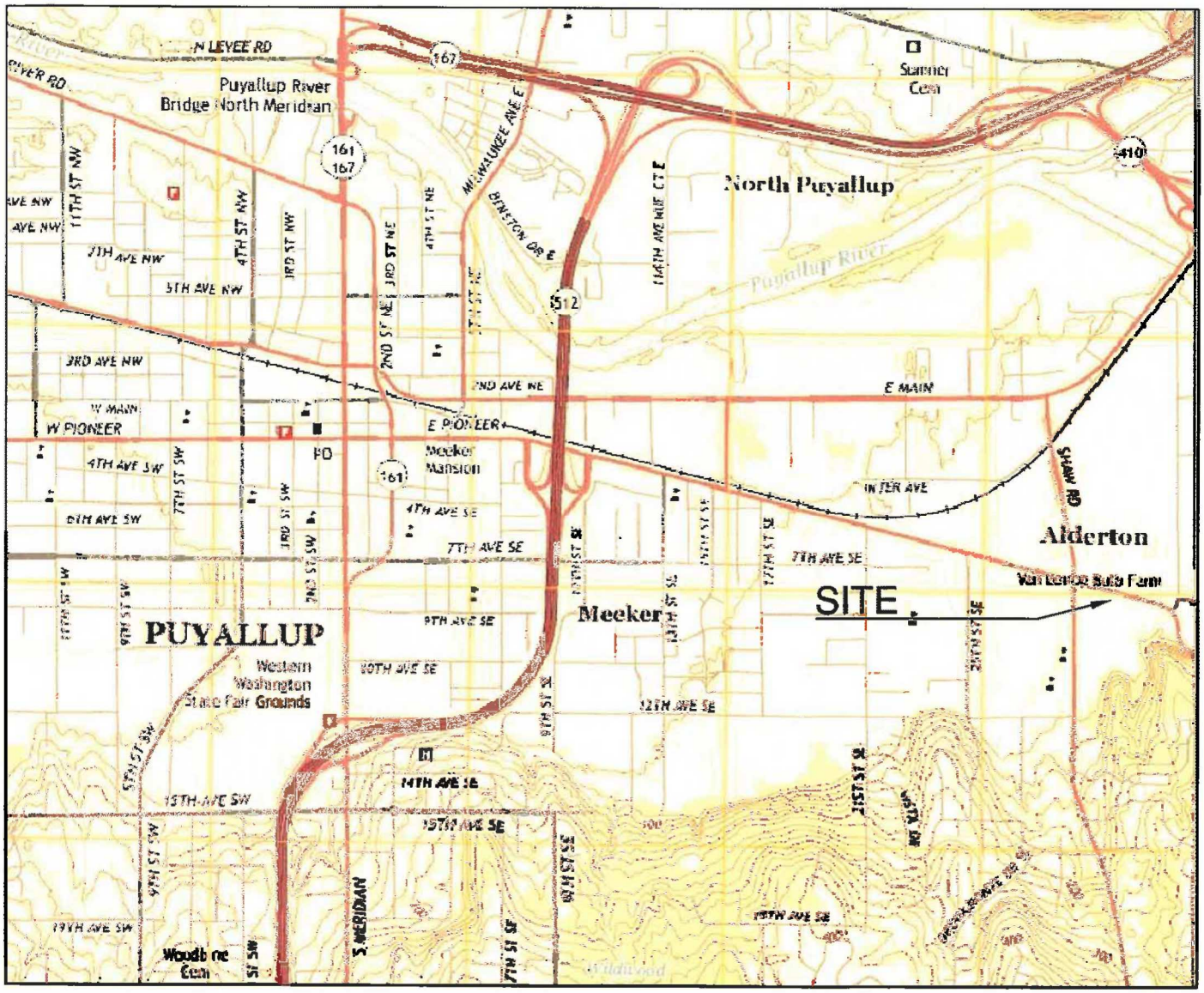
04/11/19

Theresa R. Nunan

Michael D. Rundquist, P.E.
Senior Project Manager

Theresa R. Nunan
Project Engineer

TRN:MDR

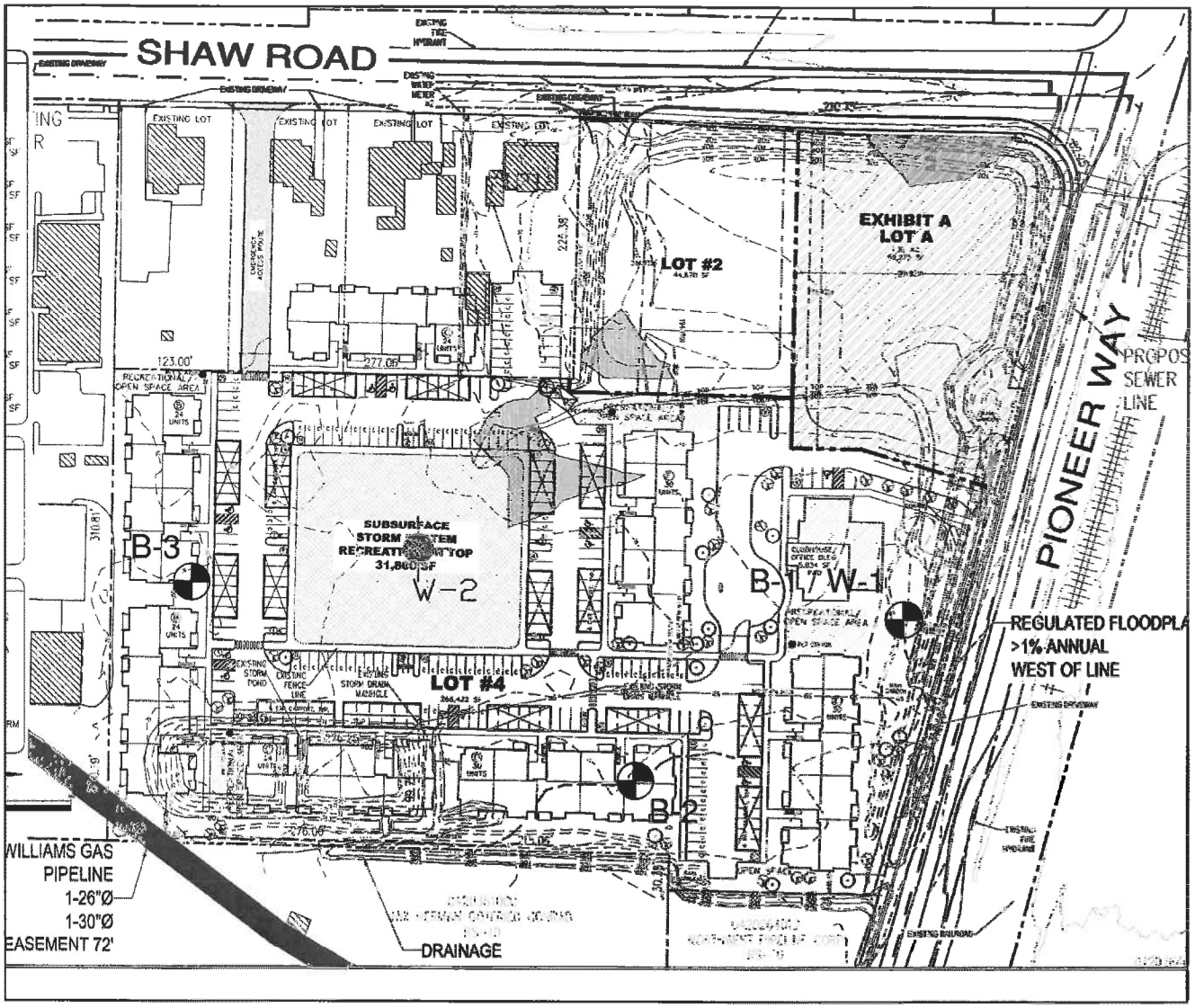


Reference: USGS topographic map website, Puyallup, WA, dated 2017.

N

Vicinity Map

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale



LEGEND

- B-1 Number and Approximate Location of Borings
- W-1 Approximate Location of Monitoring Well

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 2
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: April 2019
Krazan & ASSOCIATES, INC.	Not to Scale

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploration program. Exploratory borings and monitoring wells were drilled and sampled for subsurface exploration at this site. The soil explorations reached depths of approximately 38.5 feet below the existing ground surface. The approximate exploratory boring locations are shown on the Site Plan (Figure 2). The logs of the soil explorations and monitoring wells are presented in this appendix. The depths shown on the attached logs are from the existing ground surface at the time of our exploration.

The drilled borings were advanced using a subcontracted drilling rig. Soil samples were obtained by using the Standard Penetration Test (SPT) as described in ASTM Test Method D1586. The Standard Penetration Test and sampling method consists of driving a standard 2-inch outside-diameter, split barrel sampler into the subsoil with a 140-pound hammer free falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the Standard Penetration Resistance, or N-value. The blow count is presented graphically on the boring logs in this appendix. The resistance, or "N" value, provides a measure of the relative density of granular soils or of the relative consistency of cohesive soils.

The soils encountered were logged in the field during the exploration and are described in general accordance with the Unified Soil Classification System (USCS). All samples were returned to our laboratory for evaluation.

Laboratory Testing

The laboratory testing program was developed primarily to determine the index properties of the soils. Test results were used for soil classification and as criteria for determining the engineering suitability of the surface and subsurface materials encountered.

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	**Project Number:** 062-19007	**Client:** Abbey Road Group	**Boring No.**	**B-1**
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			**Drilling Company:** Geologic Drill Partners	
Project Manager: Theresa Nunan	**Date** **Started:** 3.11.2019		**Equipment:** Track Bobcat	
Field Engineer: Theresa Nunan	**Completed:** 3.11.2019		**Drilling Method:** Hollow Stem Augers	
Notes: Monitoring Well W-1 installed in borehole.	**Backfilled:** 3.11.2019		**Hammer Type:** 140-lb. Manual	
Ground Surface Elevation: 72 +/- feet MSL	**Groundwater Depth:** 8 feet	**Groundwater Elev.:**	**Total Depth of Boring:** 21.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
		SPT	1-1	1 6 9	15		Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 6 to 8-inch thick stiff sandy clay layers, medium dense, moist	
							Brownsih Grey Poorly Graded SAND (SP), fine grained, medium dense, moist	
	5	SPT	1-2A 1-2B	4 5 5	10		Alternating 4 to 12-inch thick layers of brown Sandy SILT (ML) and Silty SAND (SM), medium stiff/loose, moist to wet	% Si/Cl = 78.5 % MC = 35.4
		SPT	1-3A 1-3B	1 1/12"	1/12"		Dark Brownish Grey Silty CLAY (CL) with marsh grass, seams of peat and thin roots, very soft, wet - - - Becomes Clayey SILT (ML), with fine sand and thin roots, very soft	LL = 35 PI = 1 % F. Sa = 19.8 % Si/Cl = 79.1 % MC = 51.2
	10	SPT	1-4	1 2 6	8		Dark Grey/Black Silty SAND (SM), fine to medium grained, loose, wet	
	15	SPT	1-5	5 4 4	8		- - - Same	
	20	SPT	1-6	4 12 12	24		- - - Becomes Poorly Graded SAND (SP-SM) with Silt, fine to medium grained, medium dense, wet	
	25						**End of Boring at 21.5 Feet**	

Krazan & ASSOCIATES, INC.

Project: East Town Crossing	**Project Number:** 062-19007	**Client:** Abbey Roac Group	**Boring No.**	**B-2**
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			**Drilling Company:** Geologic Drill Partners	
Project Manager: Theresa Nunan	**Date** **Started:** 3.11.2019		**Equipment:** Track Bobcat	
Field Engineer: Theresa Nunan	**Completed:** 3.11.2019		**Drilling Method:** Hollow Stem Augers	
Notes:	**Backfilled:** 3.11.2019		**Hammer Type:** 140-lb Manual	
Ground Surface Elevation: 73 +/- feet MSL	**Groundwater Depth:** 8 feet	**Groundwater Elev.:**	**Total Depth of Boring:** 38.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
							5 inches Grass and Topsoil	
		SPT	2-1	2 2 5	7		Brown Silty SAND (SM), fine grained, with occassional sandy clay seams, loose, moist	
	5	SPT	2-2	3 4 2	6		- - - Same	% Si/Cl = 42.9 % MC = 29.3
		SPT	2-3	4 8 11	19		Brownish Grey Sandy SILT (ML), fine grained, with occassional 1 to 2-inch thick seams dark grey fine sand, moist to wet, stiff	% Si/Cl = 88.2 % MC = 37.0
	10	SPT	2-4	5 8 8	16		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	% Si/Cl = 14.5 % MC = 25.0
	15	SPT	2-5	28 12 12	24		- - - Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense	% Grav = 0 % Sa = 90.8 % Si/Cl = 8.9 % MC = 22.6
							- - - At 18 feet, drilling choppy due to lots of gravel	
	20	SPT	2-6	18 40 20/8"	60/8"		Dark Grey/Black Poorly Graded GRAVEL (GP-GM) with sand and silt, very dense, wet	
	25							

Krazan & ASSOCIATES, INC.

Project: East Town Crossing		**Project Number:** 062-19007	**Client:** Abbey Road Group	**Boring No.** B-2
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA				**Drilling Company:** Geologic Drill Partners
Project Manager: Theresa Nunan	**Date**	**Started:** 3.11.2019		**Equipment:** Track Bobcat
Field Engineer: Theresa Nunan		**Completed:** 3.11.2019		**Drilling Method:** Hollow Stem Augers
Notes:		**Backfilled:** 3.11.2019		**Hammer Type:** 140-lb. Manual
Ground Surface Elevation: 73 +/- feet MSL		**Groundwater Depth:** 8 feet	**Groundwater Elev.:**	**Total Depth of Boring:** 38.5 ft.

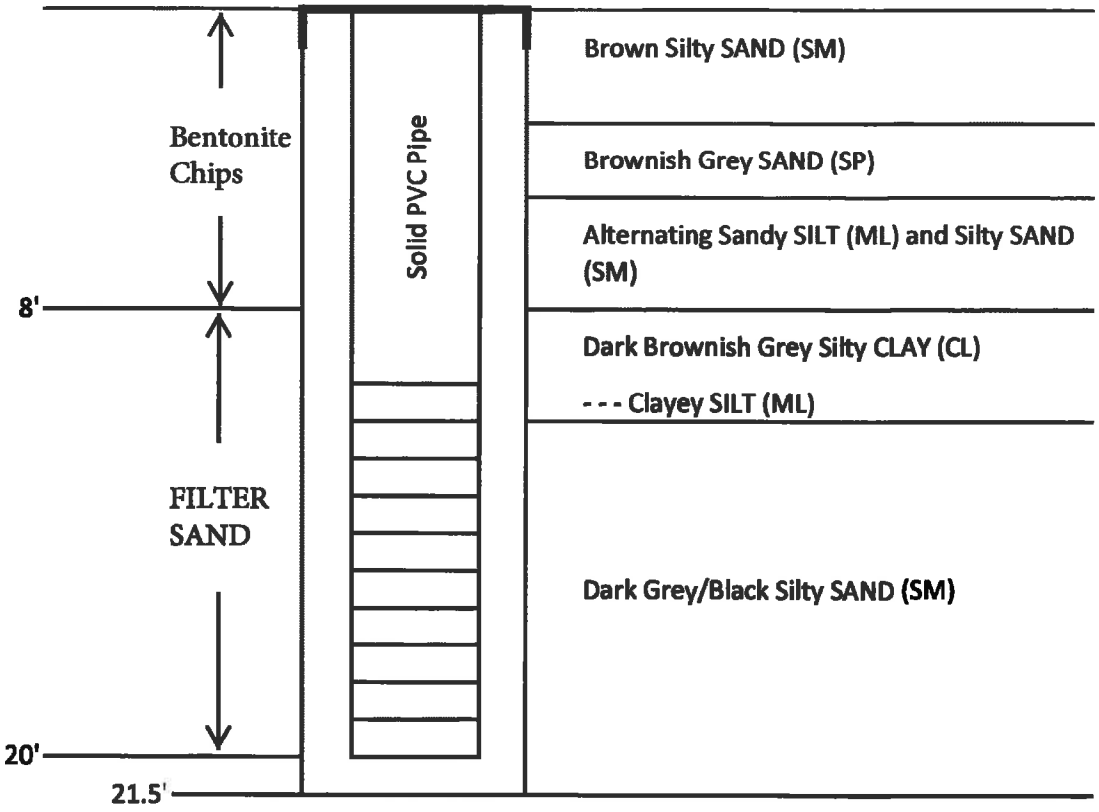
Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
	25	SPT	2-7	10 9 14	23		Dark Grey SAND (SP-SM) with Silt, trace gravel, fine to coarse grained, with occassional 3 to 4-inch thick seams gravel (GP-GM) with silt, medium dense, wet	
	30	SPT	2-8	4 **4** 15	**19**		- - - Same	% Grav = 9.0 % Sa = 82.5 % Si/Cl = 8.5 % MC = 18.8
	35	SPT	2-9	6 5 10	15		At 33 feet, alternating 4 to 12-inch thick layers of Dark Grey/Black SAND (SP-SM) with gravel and silt AND Dark Grey/Black GRAVEL (GP-GM) with sand and silt, medium dense, wet	% Si/Cl = 5.6 % MC = 18.9
		SPT	2-10	37 20 17	37		- - - Becomes dense	% Grav = 44.8 % Sa = 47.4 % Si/Cl = 7.8 % MC = 9.4
	40						**End of Boring at 38.5 Feet**	
	45							
	50							

Krazan & ASSOCIATES, INC.

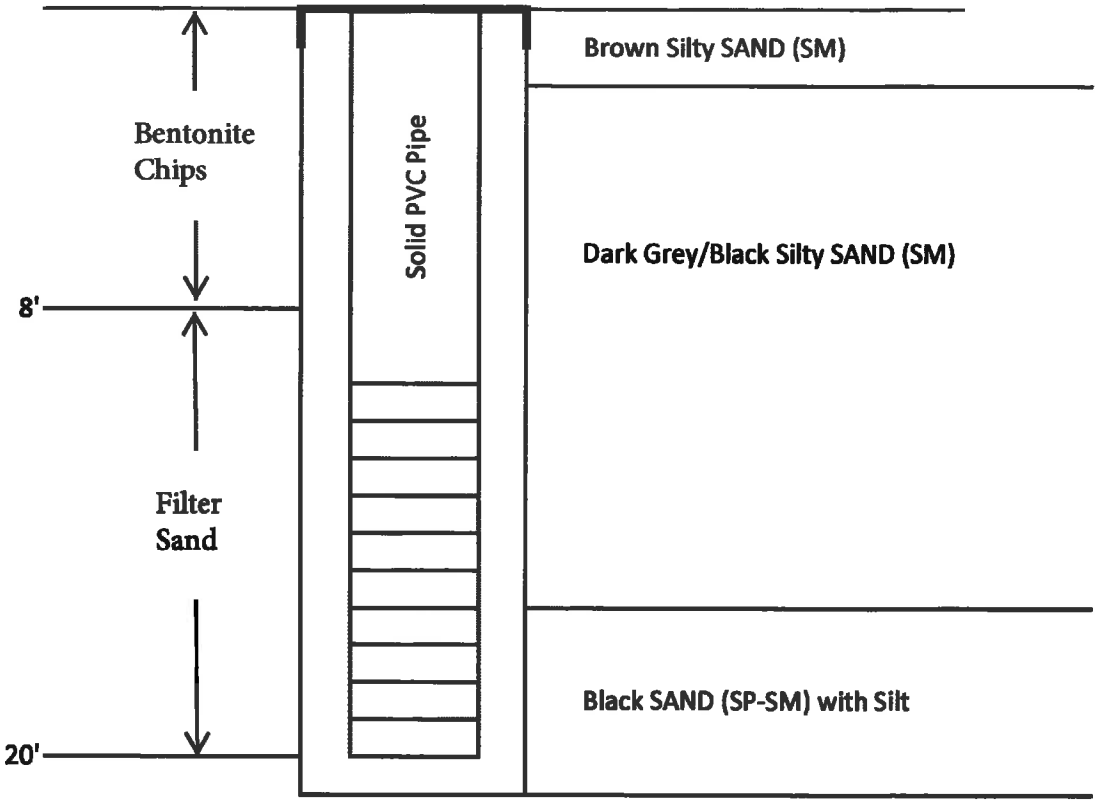
Project: East Town Crossing	**Project Number:** 062-19007	**Client:** Abbey Road Group	**Boring No.**	**B-3**
Address, City, State: SE Corner Shaw Road & E. Pioneer Way, Puyallup, WA			**Drilling Company:** Geologic Drill Partners	
Project Manager: Theresa Nunan	**Date** **Started:** 3.11.2019		**Equipment:** Track Bobcat	
Field Engineer: Theresa Nunan	**Completed:** 3.11.2019		**Drilling Method:** Hollow Stem Augers	
Notes:	**Backfilled:** 3.11.2019		**Hammer Type:** 140-lb. Manual	
Ground Surface Elevation: 74 +/- feet MSL	**Groundwater Depth:** 7 feet		**Total Depth of Boring:** 21.5 ft.	

Elev. (feet)	Depth (feet)	Sample Type	Sample ID	Blow Counts	N-Value (blows/ft)	Graphic Log	Classification	Lab Results
		SPT	3-1	2 4 5	9		Brown Silty SAND (SM), trace gravel and very thin roots, with occassional 2 to 3-inch thick stiff sandy clay layers, loose, moist	
	5	SPT	3-2	4 6 6	12		Brownish Grey Sandy SILT (ML), fine grained, with occassional 0.5 to 2-inch thick seams dark grey fine sand, stiff, moist to wet, stiff	
		SPT	3-3	5 5 5	10		Dark Grey/Black Silty SAND (SM), fine to medium grained, medium dense, wet	
	10	SPT	3-4	3 5 7	12		--- Becomes Sand (SP-SM) with Silt, fine to medium grained, medium dense, wet	
	15	SPT	3-5	6 10 7	17		Dark Grey/Black Silty SAND (SM), fine to medium grained, with a 4-inch thick seam of peat at 20 feet, medium dense, wet	
	20	SPT	3-6	4 6 8	14		**End of Boring at 21.5 Feet**	
	25							

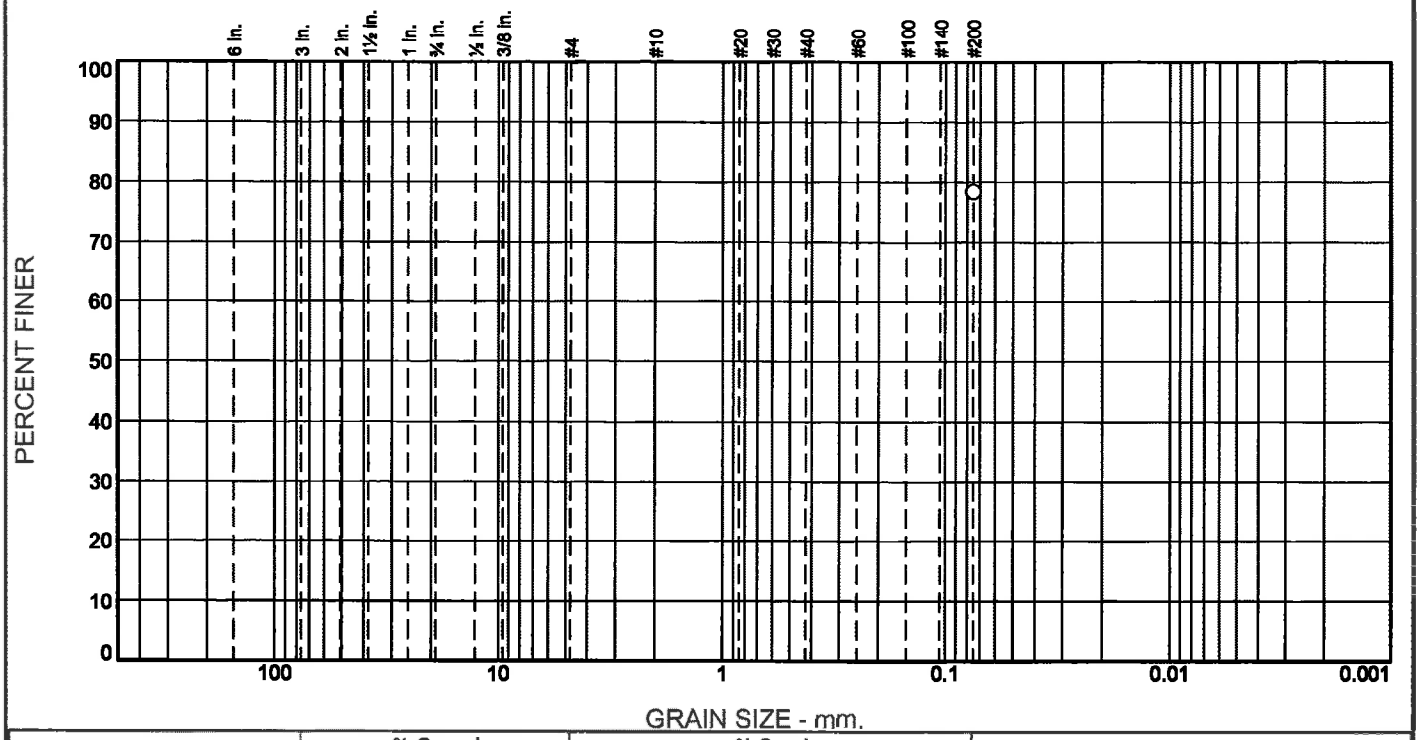
Monitoring Well
MW-1



Monitoring Well
MW-2



Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						78.5

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	78.5		

* (no specification provided)

Material Description

Brown Sandy SILT

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L131
Sample Date:3-11-19
Moisture Content = 35.4 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-1 Sample 1-2B
Sample Number: 19L131 **Depth:** 5'-6.5'

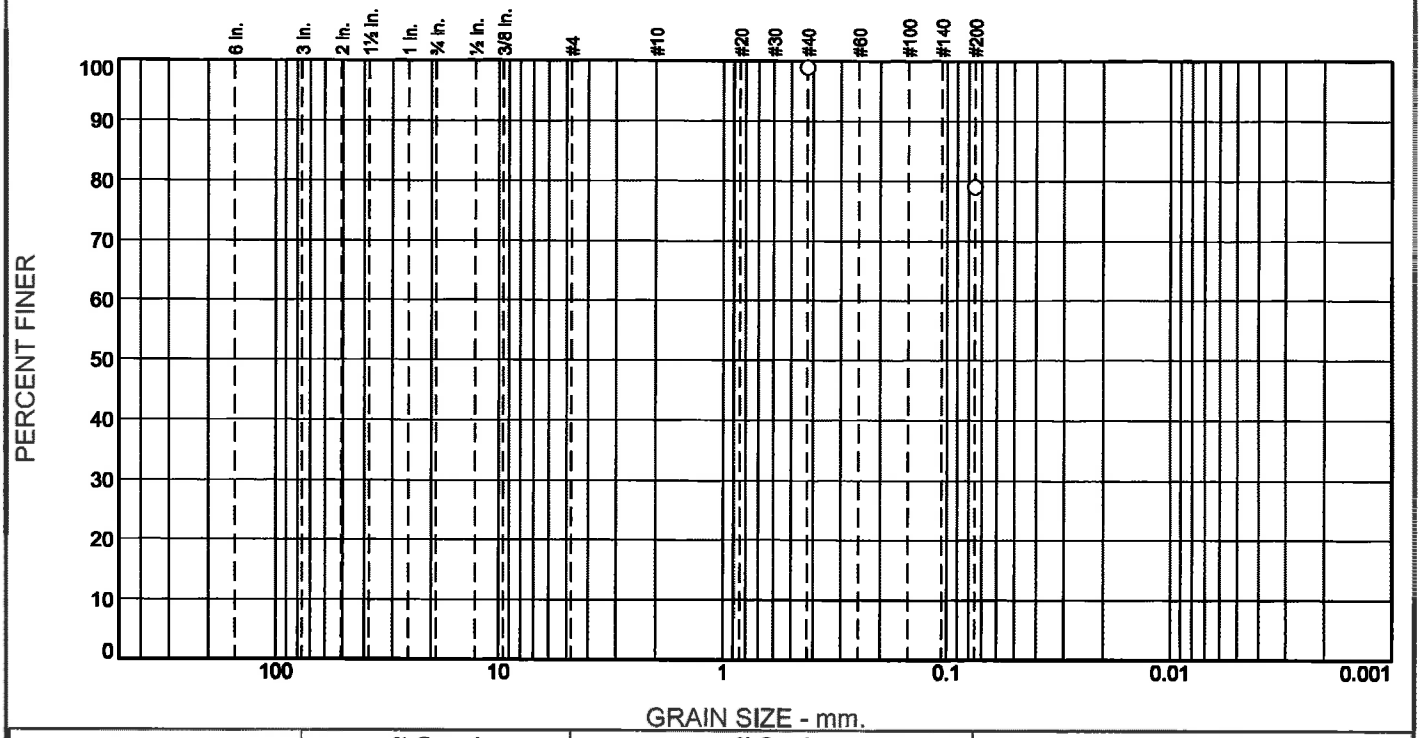
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
					19.8	79.1

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#40	98.9		
#200	79.1		

* (no specification provided)

Material Description

Grey Clayey SILT **with fine sand**

Atterberg Limits (ASTM D 4318)

PL= 33.5 LL= 34.9 PI= 1.4

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= 0.1948 D_{85}= 0.1258 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L120
Sample Date:3-11-19
Moisture Content = 51.2 %

Date Received: 3-15-19 **Date Tested:** 3-15-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-1 Sample 1-3B
Sample Number: 19L120 **Depth:** 7.5'-9'

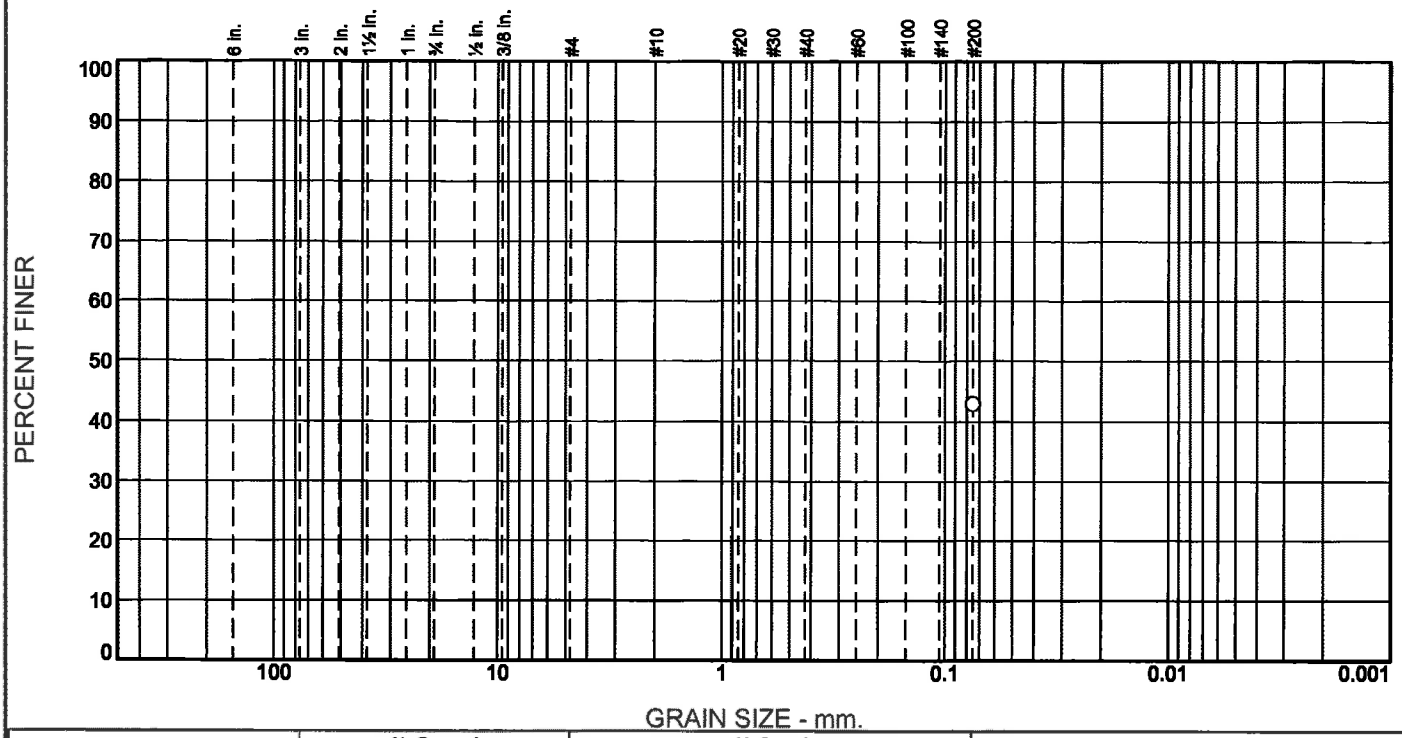
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						42.9

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	42.9		

* (no specification provided)

Material Description

Brown silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L132
Sample Date:3-11-19
Moisture Content = 29.3 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-2
Sample Number: 19L132 **Depth:** 5'-6.5'

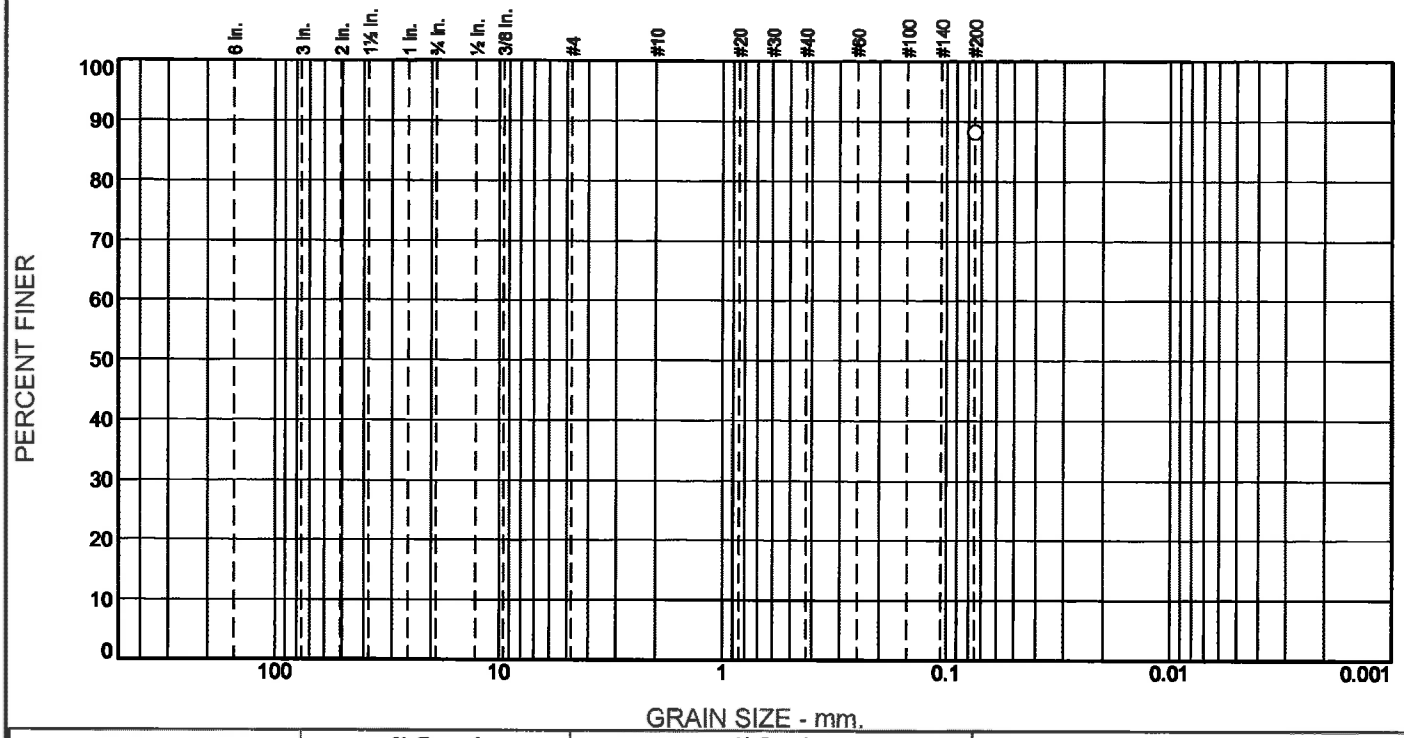
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						88.2

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	88.2		

* (no specification provided)

Material Description

Brown sandy silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L133
Sample Date:3-11-19
Moisture Content = 37.0%

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-3
Sample Number: 19L133 **Depth:** 7.5'-9'

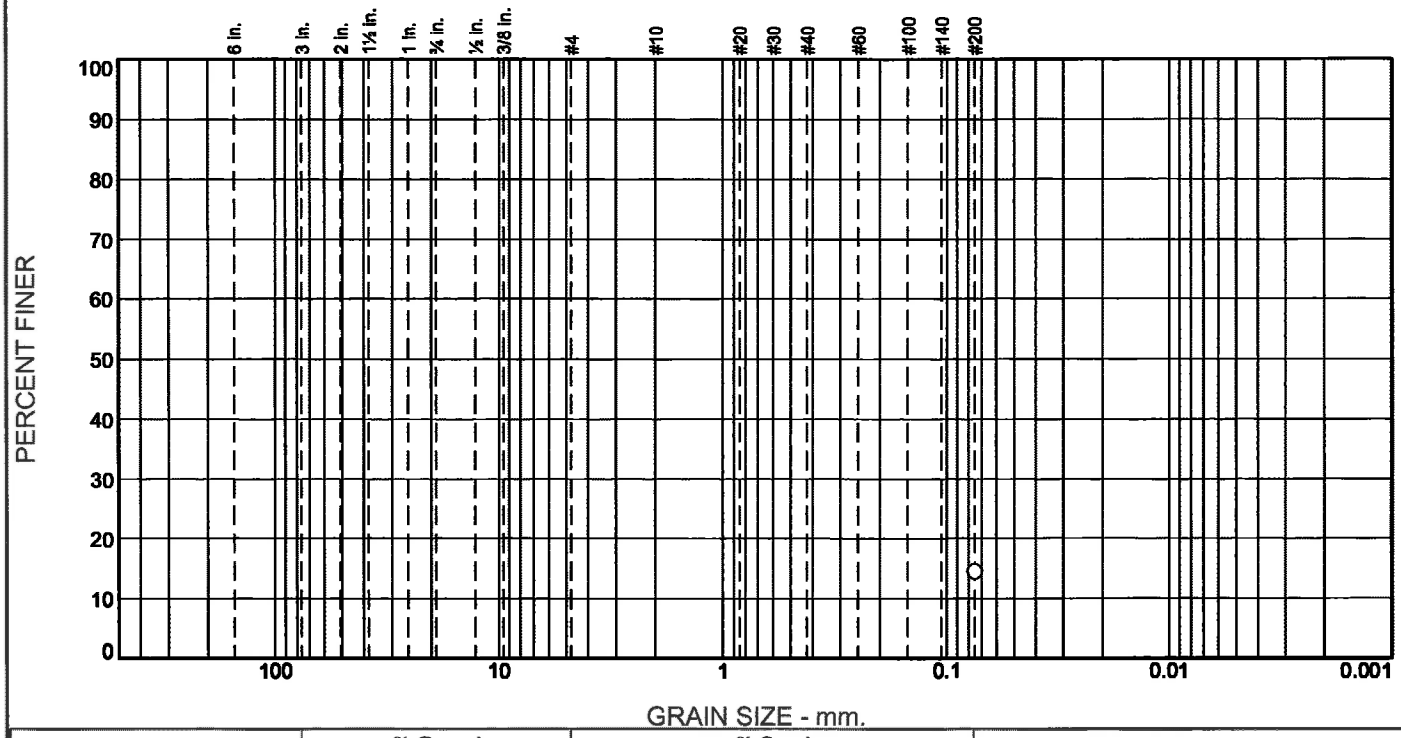
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						14.5

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	14.5		

* (no specification provided)

Material Description

Dark Grey/Black silty sand.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L134
sample Date:3-11-19
Moisture Content = 25.0 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-4
Sample Number: 19L134 **Depth:** 10'-11.5'

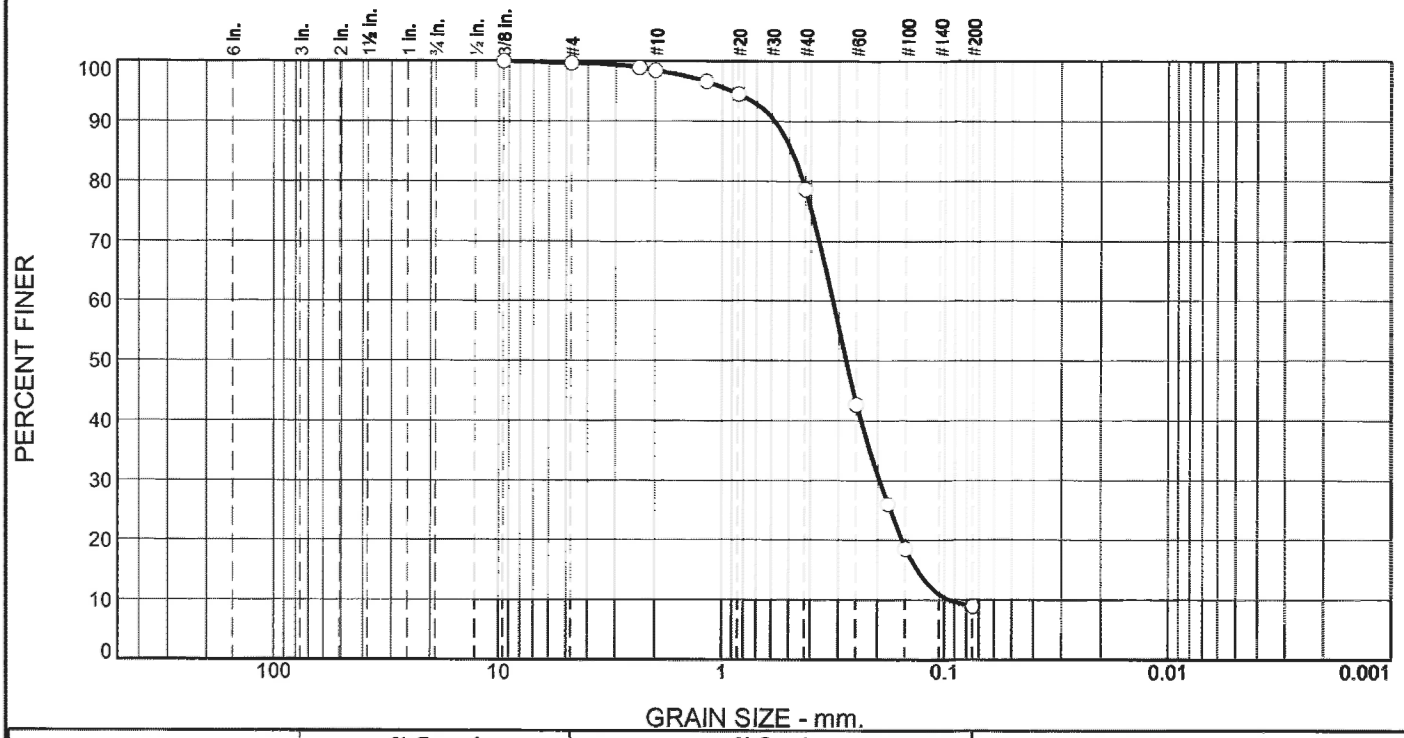
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company,LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.3	1.2	19.8	69.8	8.9

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.7		
#8	**98.9**		
#10	**98.5**		
#16	**96.6**		
#20	**94.5**		
#40	**78.7**		
#60	**42.7**		
#80	**26.0**		
#100	**18.5**		
#200	**8.9**		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.5827 D_{85}= 0.4892 D_{60}= 0.3205
D_{50}= 0.2792 D_{30}= 0.1966 D_{15}= 0.1334
D_{10}= 0.0956 C_u= 3.35 C_c= 1.26

Remarks

Sample ID:19L121
Sample Date:3-11-19
Moisture Content = 22.6 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials laboratory Manager

Location: B-2 Sample 2-5
Sample Number: 19L121 **Depth:** 15'-16.5'

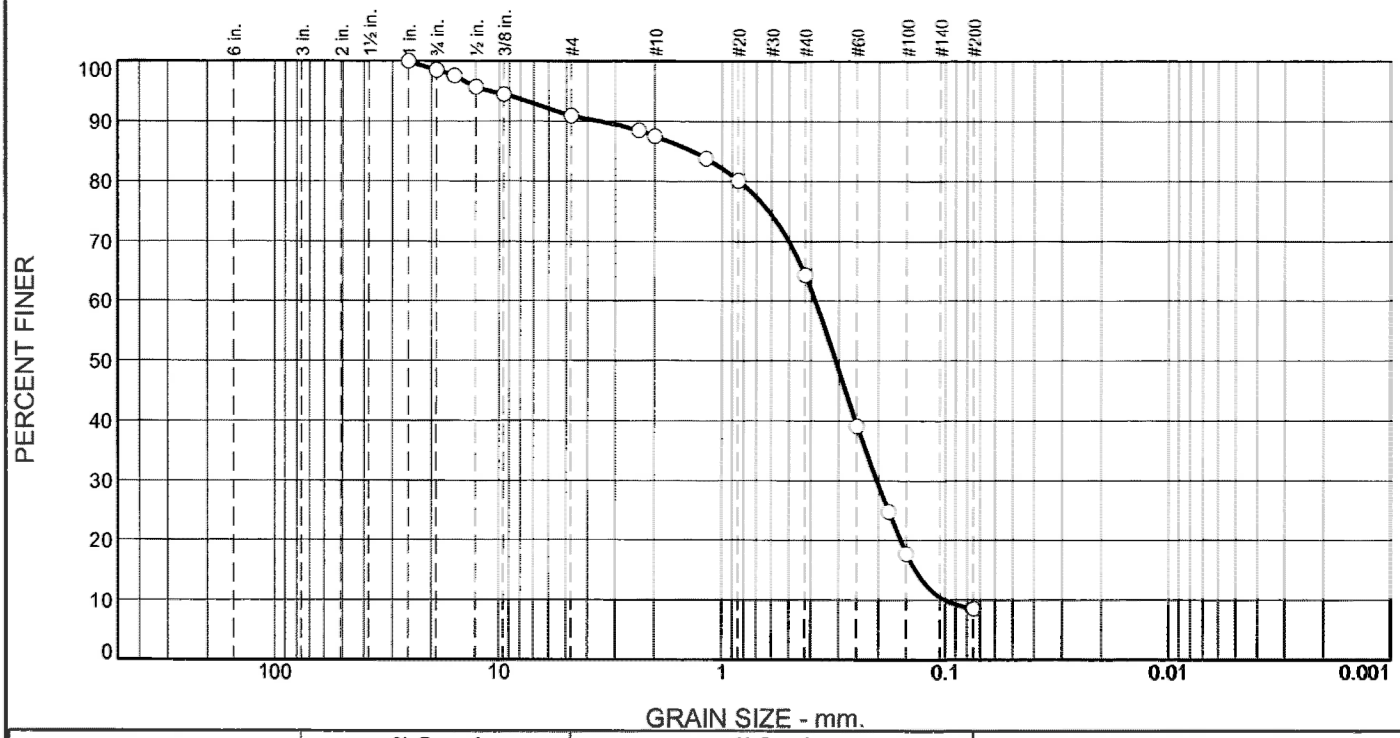
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	1.4	7.6	3.5	23.3	55.7	8.5

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	98.6		
.625	97.6		
.5	**95.7**		
.375	**94.5**		
#4	**91.0**		
#8	**88.5**		
#10	**87.5**		
#16	**83.8**		
#20	**80.2**		
#40	**64.2**		
#60	**39.1**		
#80	**24.7**		
#100	**17.7**		
#200	**8.5**		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 3.5671 D_{85}= 1.3567 D_{60}= 0.3839
D_{50}= 0.3115 D_{30}= **0.2039** D_{15}= 0.1371
D_{10}= 0.1011 C_u= **3.80** C_c= 1.07

Remarks

Sample ID:19L122
Sample Date:3-11-19
Moisture Content = 18.8 %

Date Received: 3-15-19 **Date Tested:** 3-22-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-8
Sample Number: 19L122 **Depth:** 30'-31.5'

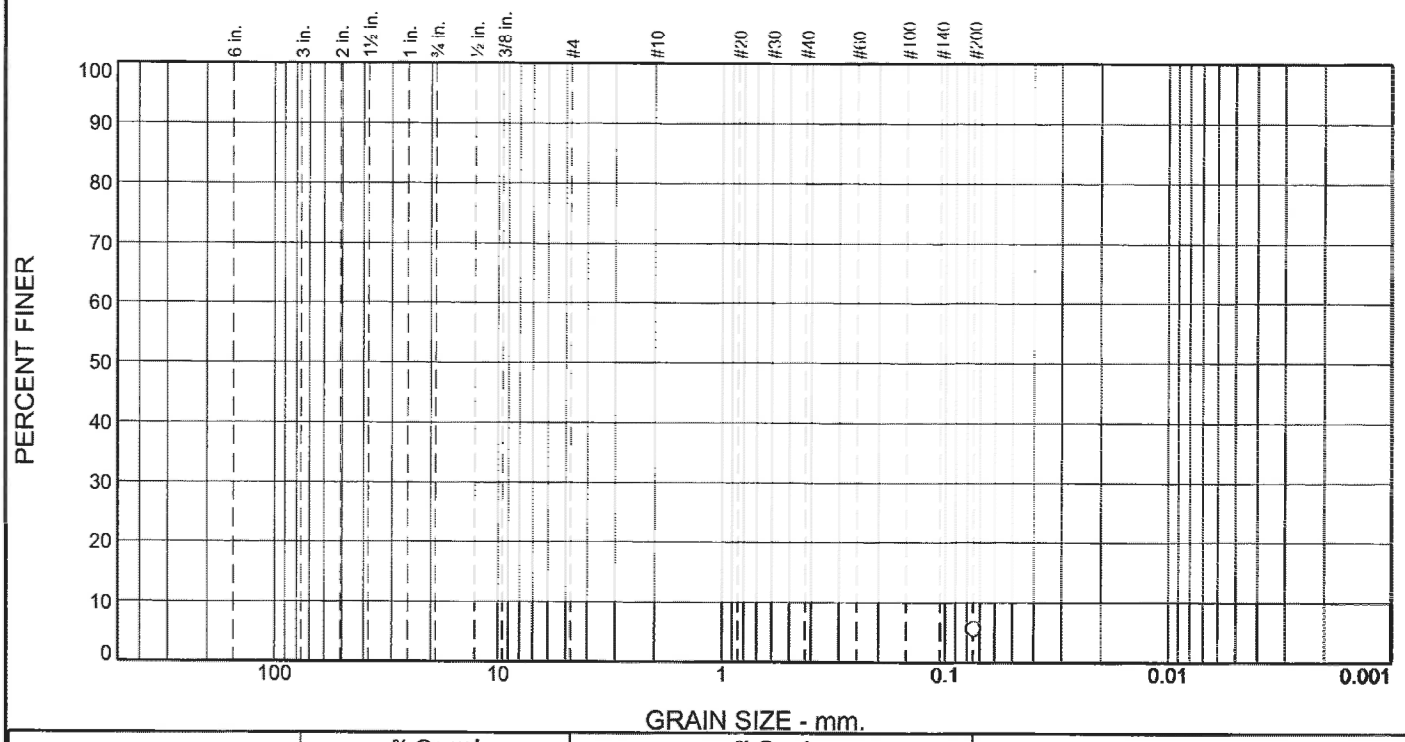
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land **Development Services Company.LLC.**
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
						5.6

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	5.6		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:19L135
Sample Date:3-11-19
Moisture Content = 18.9 %

Date Received: 3-15-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-9
Sample Number: 19L135 **Depth:** 35'-36.5'

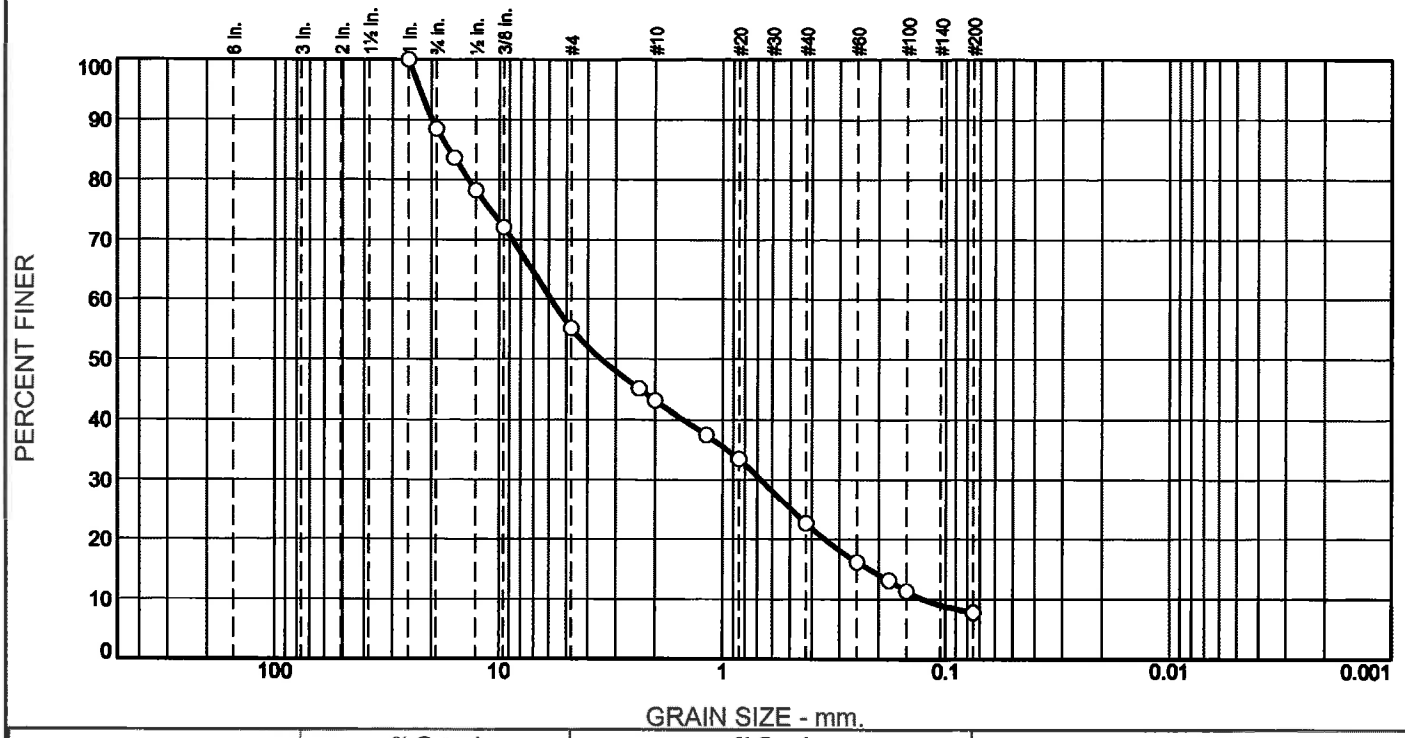
Date Sampled: 3-11-19

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	11.5	33.3	12.0	20.5	14.9	7.8

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	88.5		
.625	83.7		
.5	78.3		
.375	72.1		
#4	55.2		
#8	45.1		
#10	43.2		
#16	37.5		
#20	33.5		
#40	22.7		
#60	16.2		
#80	13.2		
#100	11.4		
#200	7.8		

* (no specification provided)

Material Description

Dark Grey/Black sand with silt and gravel.

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-a

Coefficients

D_{90}= 19.9452 D_{85}= 16.7747 D_{60}= 5.8717
D_{50}= 3.4968 D_{30}= 0.6741 D_{15}= 0.2194
D_{10}= 0.1253 C_u= 46.85 C_c= 0.62

Remarks

Sample ID:19L123
Sample Date:3-11-19
Moisture Content = 9.4 %

Date Received: 3-11-19 **Date Tested:** 3-11-19

Tested By: M.Thomas

Checked By: M.Thomas

Title: Materials Laboratory Manager

Location: B-2 Sample 2-10 **Date Sampled:** 3-11-19
Sample Number: 19L123 **Depth:** 37'-38.5'

Krazan

Client: Abbey Road Group Land Development Services Company.LLC.
Project: East Town Crossing

Project No: 062-19007 **Figure**

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, **the recommendations in the report have precedence**.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and Civil Engineer are the Owner's representatives. If the contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density of not less than 95 percent of maximum dry density as determined by ASTM Test Method D1557 as specified in the technical portion of the Geotechnical Engineering Report. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Geotechnical Engineer.

SOIL AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the contractor for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including Court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

General site clearing should include removal of any organics, asphaltic concrete, abandoned utilities, structures including foundations, basement walls and floors, rubble, and rubbish. After stripping operations and removal of any loose and/or debris-laden fill, the exposed subgrade should be visually inspected and/or proof rolled to identify any soft/loose areas.

SUBGRADE PREPARATION: Subgrade should be prepared as described in our site preparation section of this report.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Geotechnical Engineer. All materials utilized for constructing site fills shall be free from vegetable or other deleterious matter as determined by the Geotechnical Engineer.

PLACEMENT, SPREADING, AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer.

Both cut and fill shall be surface compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. **DEFINITIONS** – The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

2. **SCOPE OF WORK** – This portion of the work shall include all labor, materials, tools, and equipment necessary for and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. **PREPARATION OF THE SUBGRADE** – Subgrade should be prepared as described in our site preparation and pavement design sections of this report.

4. **AGGREGATE BASE** – The aggregate base shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base should conform to WSDOT Standard Specification for Crushed Surfacing Base Course or Top Course (Item 9-03.9(3)). The base material shall be compacted to a minimum compaction of 95% as determined by ASTM D1557. Each layer of subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. **ASPHALTIC CONCRETE SURFACING** – Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The drying, proportioning, and mixing of the materials shall conform to WSDOT Specifications.

The prime coat, spreading and compaction equipment, as well as the process of spreading and compacting the mixture, shall conform to WSDOT Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with combination steel-wheel and pneumatic rollers, as described in WSDOT Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

6. **TACK COAT** – The tack (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of WSDOT Specifications.

Steep Slope Addendum Letter

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

July 31, 2020

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
Parcel Nos. 0420264053, 0420264054, 0420351066
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington 98371

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide our opinion regarding the nearby steep slopes. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019.

Based on our communication with you, it is our understanding that the City of Puyallup has requested to provide our opinion on the hazards and risks to the site due to the site being within 300 feet of steep slopes.

We have reviewed Washington State Department of Natural Resources (DNR), City of Puyallup, and Pierce County published landslide hazard maps and web data. We have also reviewed the Landslide Inventory, Susceptibility, and Exposure Analysis of Pierce County, Washington (DNR), prepared by Katherine A. Mickelson et al., and dated July 2017.

Based on our review, we understand that steep slopes are located roughly 300 feet to the south and east from the site. These nearby slopes are mapped moderate to high for shallow landslide susceptibility, and moderate for deep susceptibility. However, there are no historic landslides or debris mapped at the nearby slopes. The closest landslide mapped is located roughly 1 mile southeast of the site.

There is an existing developed property between the nearby southern slope and the southern boundary of the site. There is a partially developed property between the nearby eastern slope and the eastern boundary of the site. In our opinion, these properties to the south and east create a buffer between the nearby slopes

and the site. Based on our review of available published documents and maps, it is our opinion that there is minimum to no risk to the planned development from the nearby slopes.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

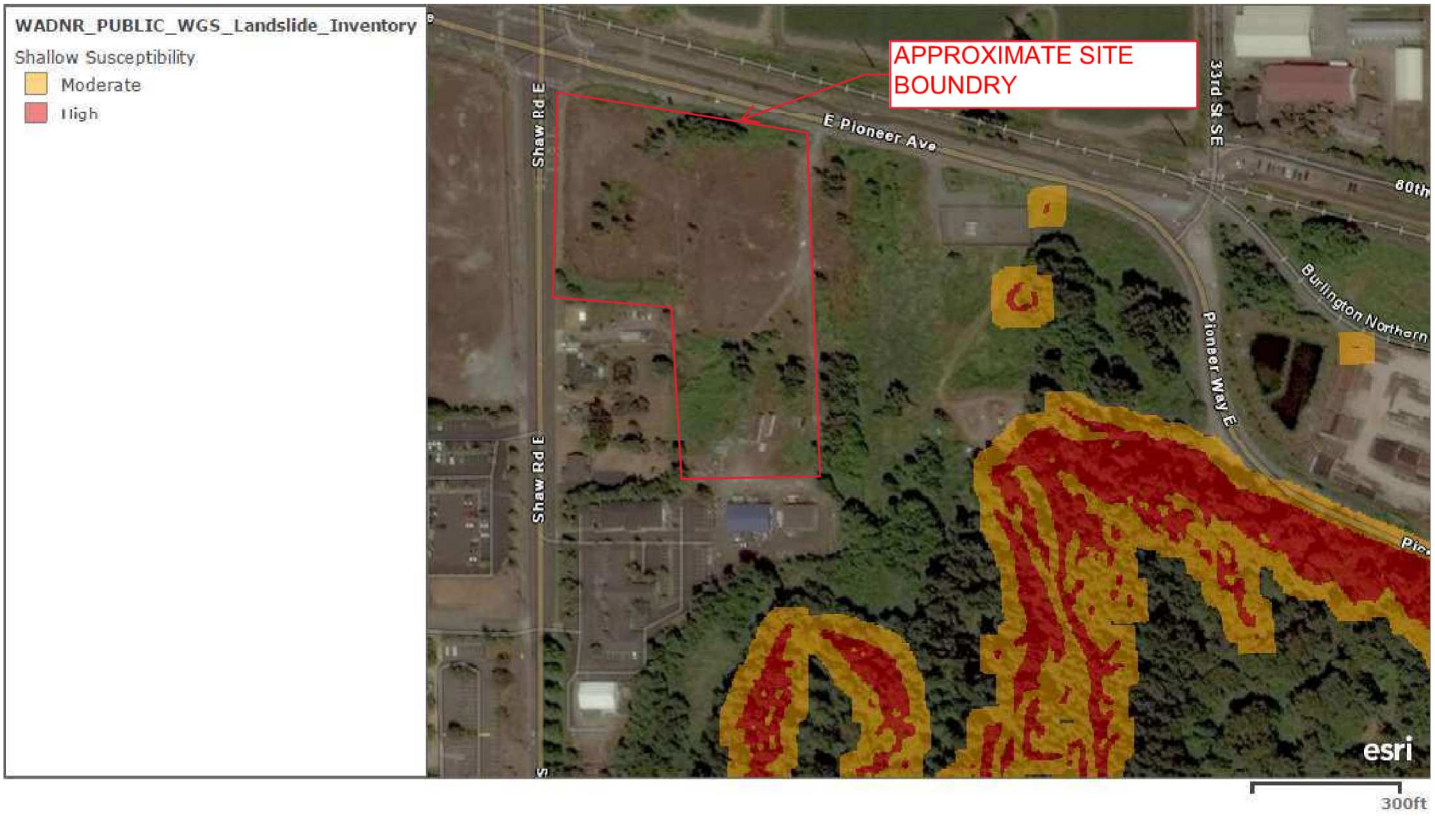
07/31/20

Vijay Chaudhary, P.E.
Project Engineer

Theresa Nunan

Theresa R. Nunan
Project Manager

Attachments: WA DNR Landslide Inventory Maps (Figures A, B, and C)



USDA FSA, GeoEye, Maxar | Esri Community Maps Contributors, King County, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan

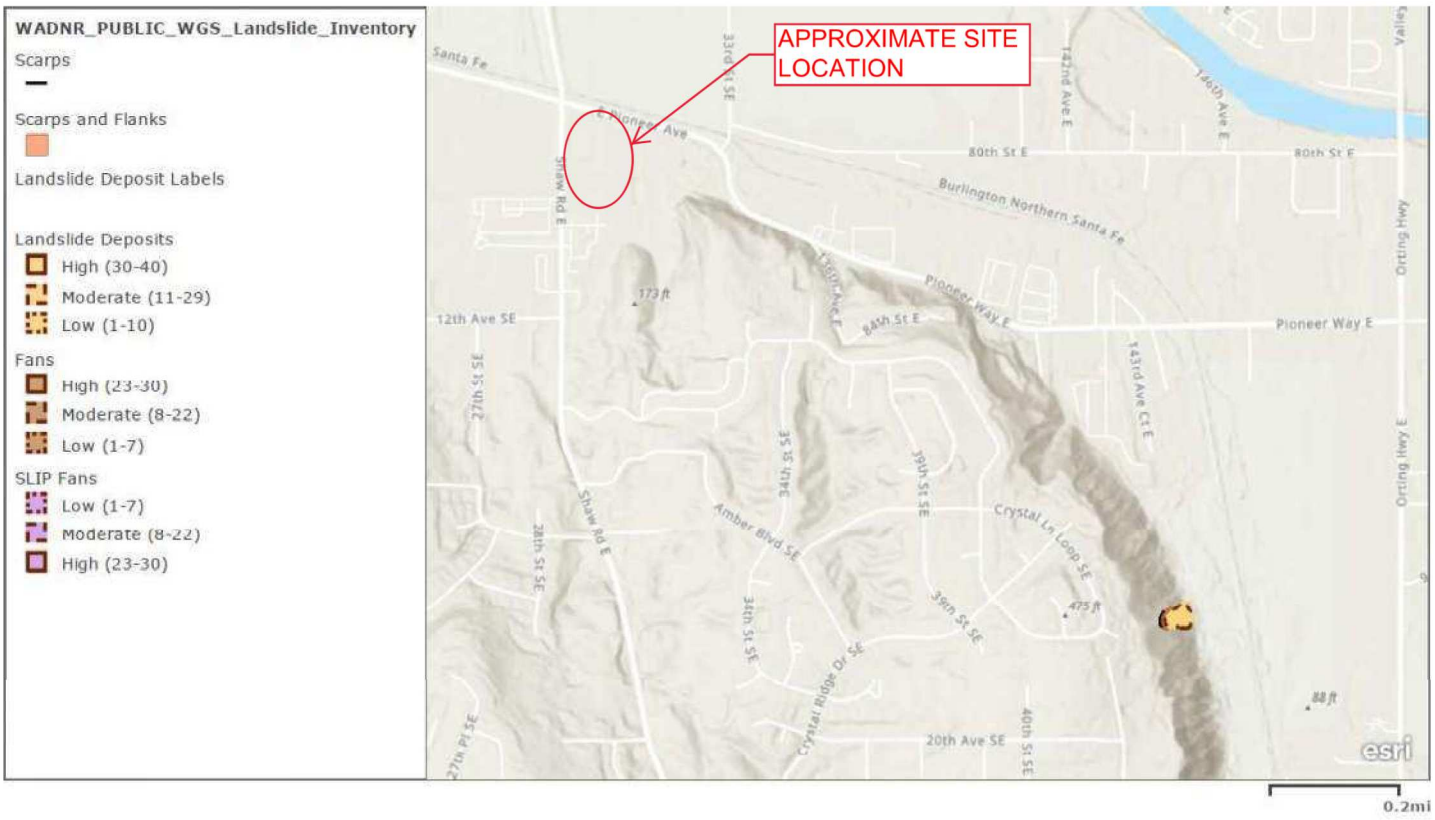
East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: A	Not to scale

USDA FSA, GeoEye, Maxar | Esri Community Maps Contributors, King County, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

N

Krazan

East Town Crossing		
Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: B	Not to scale



N

Krazan

East Town Crossing

Date: July 2020	Project Number: 062-19007	
Drawn By: VC	Figure: C	Not to scale

March 19, 2021

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide the results of two (2) Large-Scale Pilot Infiltration Tests (PITs) we conducted at the above-referenced site. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019, as well as an addendum letter dated July 31, 2020 that addressed the nearby steep slopes.

Large-Scale PITs

Two (2) test pits, designated P-1 and P-2, were excavated near Monitoring Wells MW-1 and MW-2, respectively, on March 4, 2021 at the approximate locations indicated on the Site Plan, Figure 1, in order to conduct large-scale infiltration tests in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The infiltration test locations were selected in the field by the client and excavated using a client provided excavator and operator. The bottom of each pit was excavated 10-feet wide by 10-feet long, which met the minimum required horizontal surface area of 100 square feet (sf). Each test pit was initially excavated to a depth of 2 feet below the existing ground surface (bgs), which exposed silty sand (SM) soils at the pit bottom. Water was observed seeping from the sides of pit P-1 during excavation, and was observed ponded at the ground surface at several locations in the vicinity of pit P-1. Test pits P-1 and P-2 encountered undocumented fill to a depth of 1.8 feet and 0.5 feet bgs, respectively, followed by native brown silty sand (SM) with trace gravel and occasional sandy silt and sandy clay seams and layers to the bottom of the test pits. The soils exposed at the PIT test depth were similar to those encountered in the geotechnical borings conducted during our original exploration of the site.

The infiltration test procedure includes a pre-soak period, followed by steady-state and then falling head infiltration rate testing. Each pit was filled with water to a depth of 12 inches above the bottom of the pit for the pre-soak period. After two (2) hours of pre-soak, the water hose was turned off as even just a slight trickle caused the water level in the pit to continue to rise. Water level readings were obtained for an additional 4 hours in pit P-2 with no change in the water level, while the water level in pit P-1 increased ¾-inches which we attributed to seepage from the sides of this pit which were observed during its excavation. Since the water in pits P-1 and P-2 was not infiltrating, we left the pits open overnight, and returned to the site to record the water level. Since it had commenced to rain just prior to our leaving the site, a 5-gallon bucket was left at the location of pit P-2 to obtain an estimate of the amount of rain that fell overnight. We recorded 0.6 inches of rain in the bucket the following morning. On the morning of March 5, 2021, the water level in pit P-1 had risen another 1.2 inches, while the water level in pit P-2 rose about 0.3 inches. Figure 2 includes photos of pits P-1 and P-2 taken on March 5, 2021. The pits were not over-excavated due to the presence of water. The contractor had excavated three test pits within the northwestern corner of the site on March 4, 2021. We observed about 8 to 10 inches of water in the bottom of two of the test pits on March 5, 2021.

Evaluation of Infiltration Feasibility: One of the Site Suitability Criteria (SSC) presented in Section 3.3.7, Volume III, 2014 SWMMWW, **SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer**, states that the base of all infiltration basins or trench systems shall be greater than or equal to 5 feet above the seasonal high-water mark, bedrock (or hardpan), or other low permeability layer. Based on the results of our field exploration and large-scale PITs, the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Based on the results of our general site assessment and field testing, the low permeability soils encountered at the site do not meet the requirements of Site Suitability Criteria SSC-5 and it is therefore our opinion that onsite infiltration of stormwater using basin or trench system is not considered feasible for the proposed development. **However,** consideration may be given to the use of permeable pavement and other Best Management Practices (BMPs), depending on the final site grading plan.

Limitations

This letter has been prepared for the exclusive use of the Abbey Road Group and their assigns, for the specific application to the site. The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

This letter does not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands or other biological conditions. The information presented herein is based upon professional interpretation using standard industry practices and engineering conservatism that we consider proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

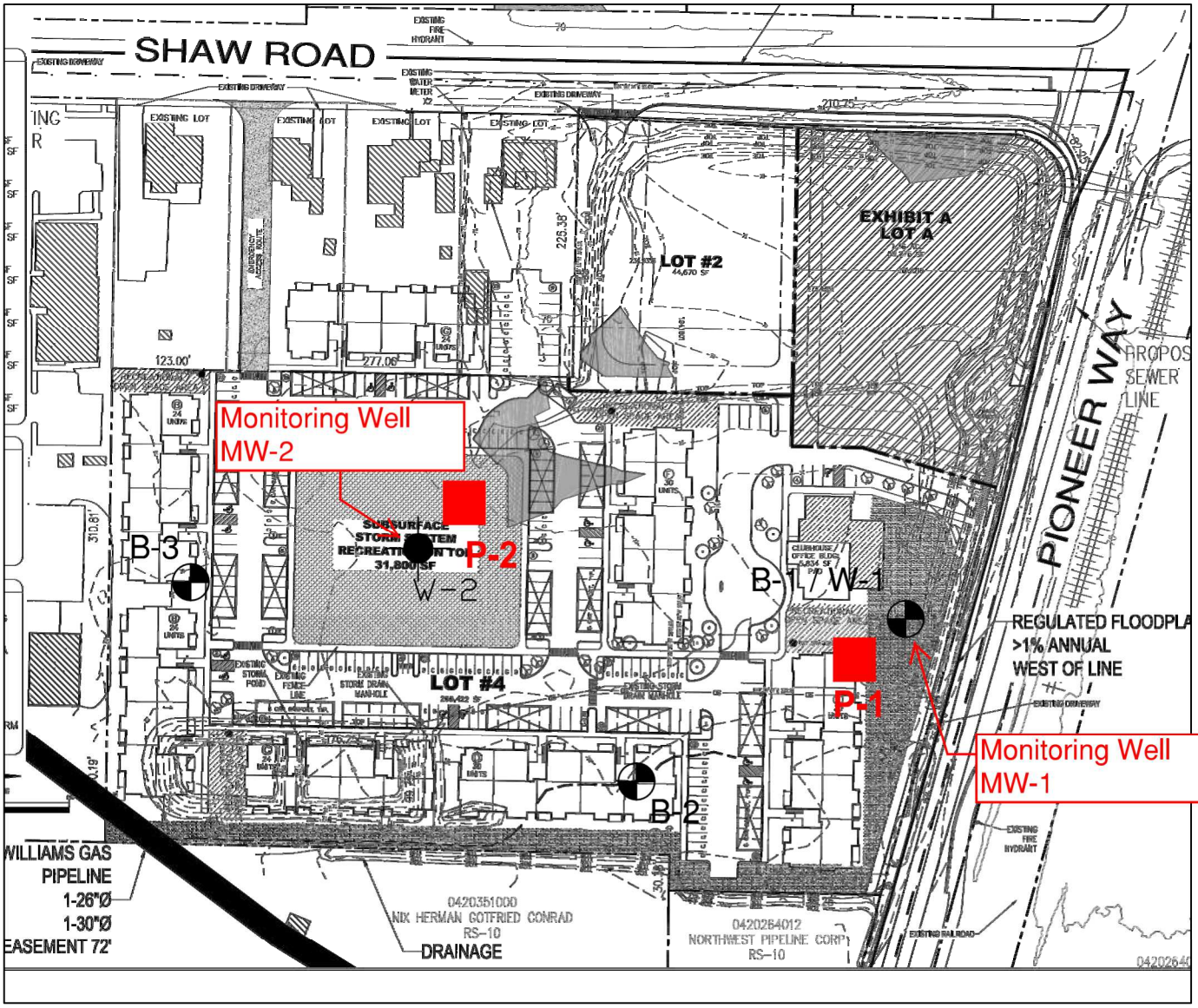
KRAZAN & ASSOCIATES, INC.

3/19/21

Theresa R. Nunan
Project Manager

Vijay Chaudhary, P.E.
Assistant Regional Engineering Manager

Attachments: Figure 1 – Site Plan
Figure 2 – Photos



LEGEND

- B-1 — Number and Approximate Location of Borings
- W-1 — Approximate Location of Monitoring Well
- P-1 — Approximate Location of Pilot Infiltration Test

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: March 2021
Krazan & ASSOCIATES, INC.	Not to Scale

Water in Pit P-1 on March 5, 2021.

Water in Pit P-2 on March 5, 2021.

Water in Test Pit on March 5, 2021. Test pit was excavated in NE portion of site on March 4, 2021.

Figure 2 - Photos (March 5, 2021)

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

December 10, 2021 KA Project No. 062-21033

Abbey Road Group, LLC
P.O. Box 11489
Olympia, WA 98508

Attn: Mr. Gil Hulsmann
Tel: 253-435-3699 x1510
Email: gil.hulsmann@abbeyroadgroup.com

Reference: Laboratory Testing – Recycled Glass
East Town Crossing Project
SE Corner of E Shaw Road & E Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

The gradation and proctor test results for the two recycled glass samples, one designated "clean" and the other designated "with fines", supplied by Dan Lloyd Construction are attached to this letter. The gradation tests were conducted on the samples 'as received' and again after completing the Proctor compaction tests. As can be seen in the summary of test results, Table 1 attached to this letter, the glass pierces broke down significantly due to the compaction efforts.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

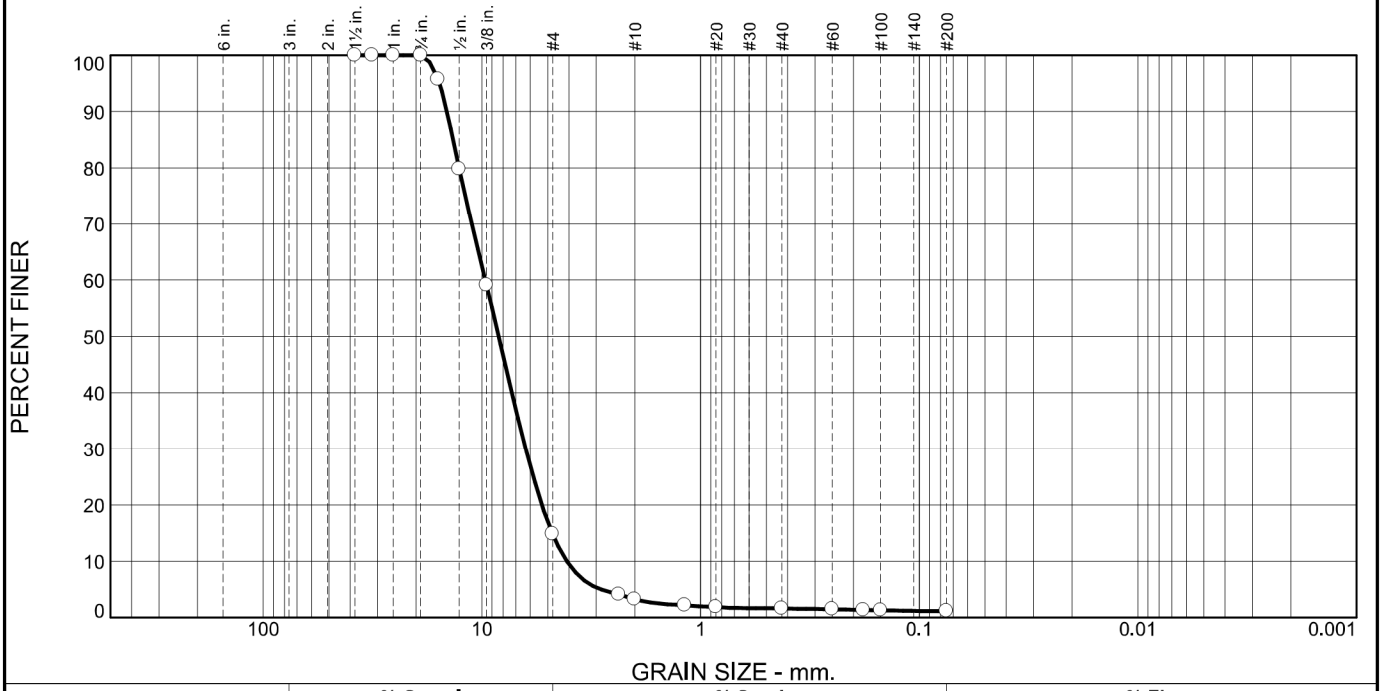
Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

Theresa R. Nunan
Project Manager

Attachments: Recycled Glass Gradation and Proctor Test Results – "Clean" Sample
Recycled Glass Gradation and Proctor Test Results – "With Fines" Sample
Table 1 – Summary of Recycled Glass Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	85	12	1	1	1	

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	96		
.5	80		
.375	59		
#4	15		
#8	4		
#10	3		
#16	2		
#20	2		
#40	2		
#60	1		
#80	1		
#100	1		
#200	1.2		

* (no specification provided)

Material Description

Recycled Glass Clean - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 14.4630 D_{85}= 13.5519 D_{60}= 9.6467
D_{50}= 8.3902 D_{30}= 6.2995 D_{15}= 4.7699
D_{10}= 4.0959 C_u= 2.36 C_c= 1.00

Remarks

Sample ID:21L892
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: T.Nunan
Title: Project Manager

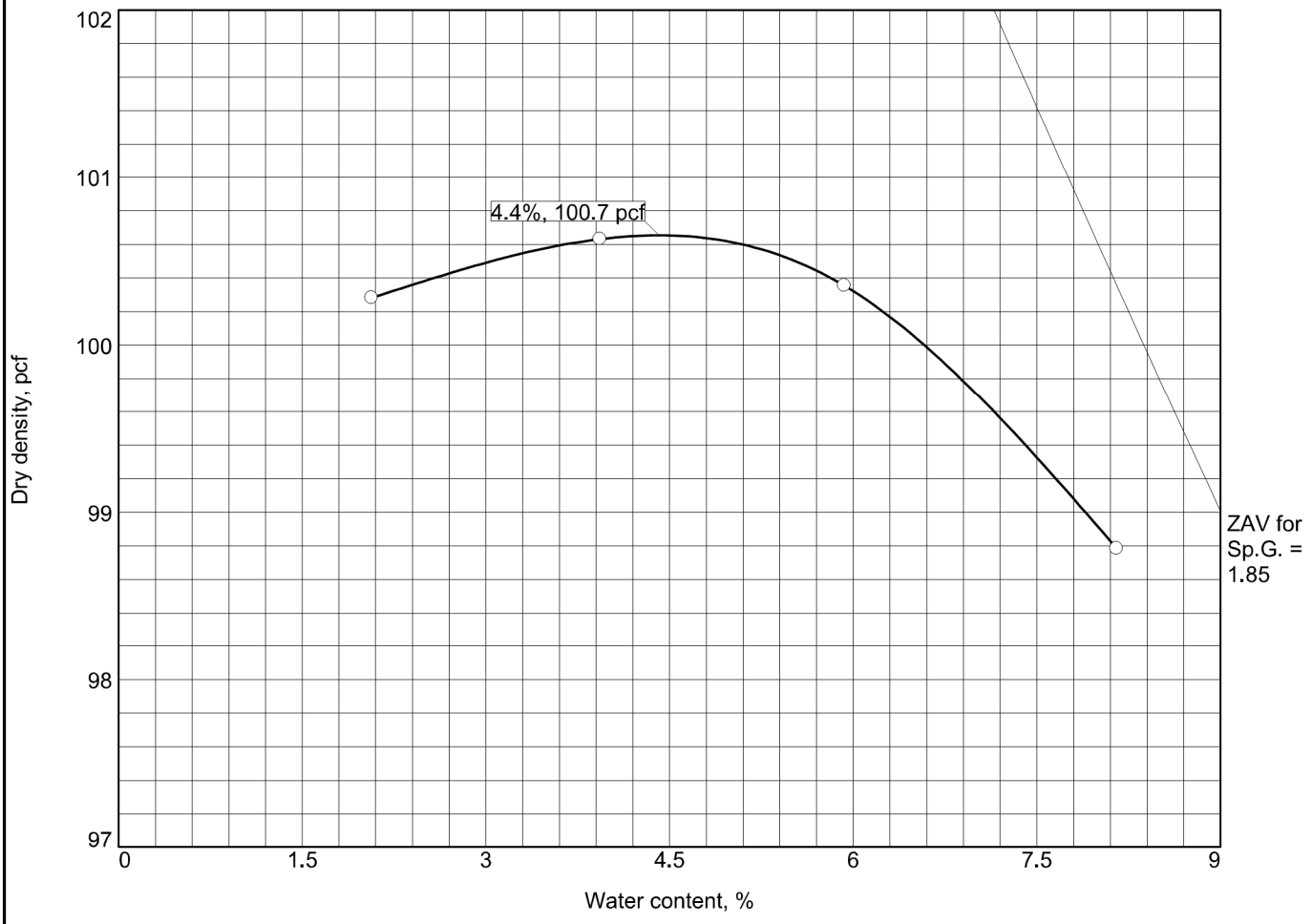
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L892

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GP	A-1-a		1.85	NV	NP	0	1.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 100.7 pcf Optimum moisture = 4.4 %	Recycled Glass Clean. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services

Project: East Town Crossing Lab Testing - Recycled Glass

○**Source of Sample:** Dan Lloyd Construction **Sample Number:** 21L892

Remarks:

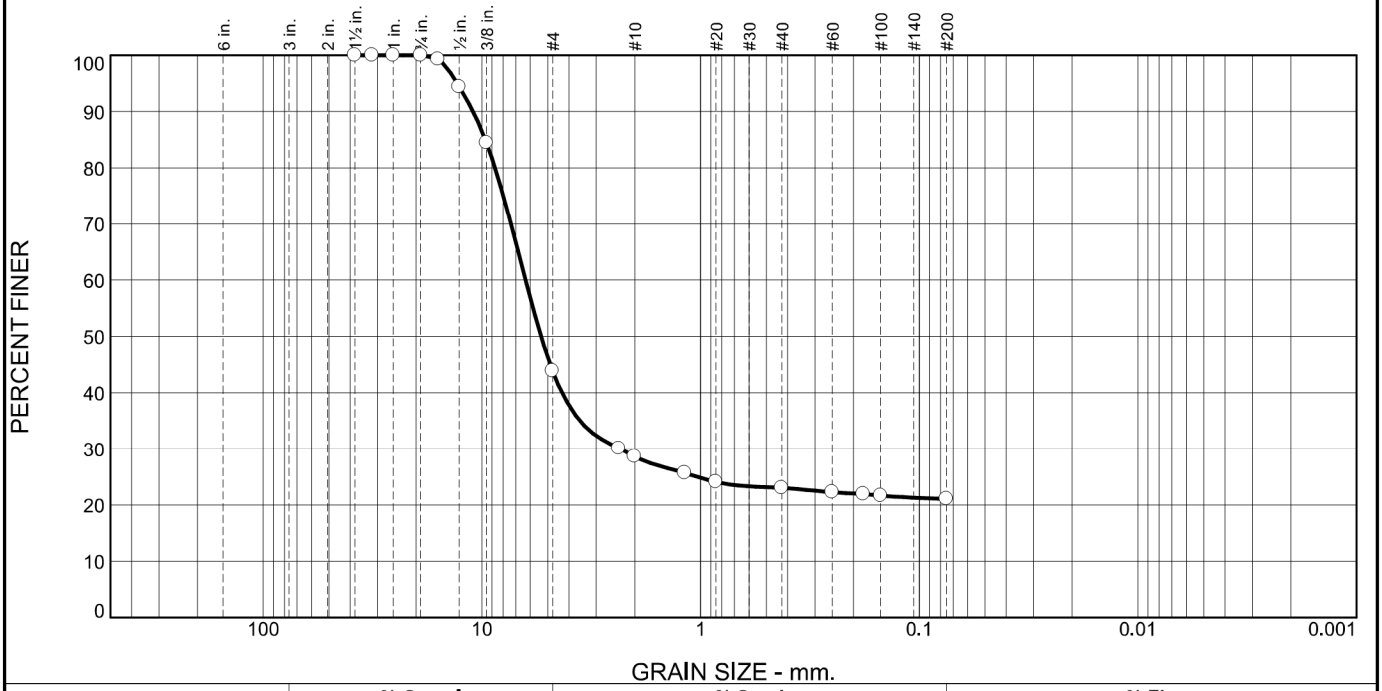
Sample ID:21L892
Sample Date:11-29-21
Void Ratio:0.14
Porosity:12%

Krazan

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	56	15	6	2	21	

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	99		
.5	94		
.375	84		
#4	44		
#8	30		
#10	29		
#16	26		
#20	24		
#40	23		
#60	22		
#80	22		
#100	22		
#200	21		

* (no specification provided)

Material Description

Recycled Glass Clean - After Compaction
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 10.9683 D_{85}= 9.6367 D_{60}= 6.3112
D_{50}= 5.3536 D_{30}= 2.3352 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:21L893
Sample Date: 11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21
Tested By: M.Thomas
Checked By: I.Teriong
Title: Project Manager

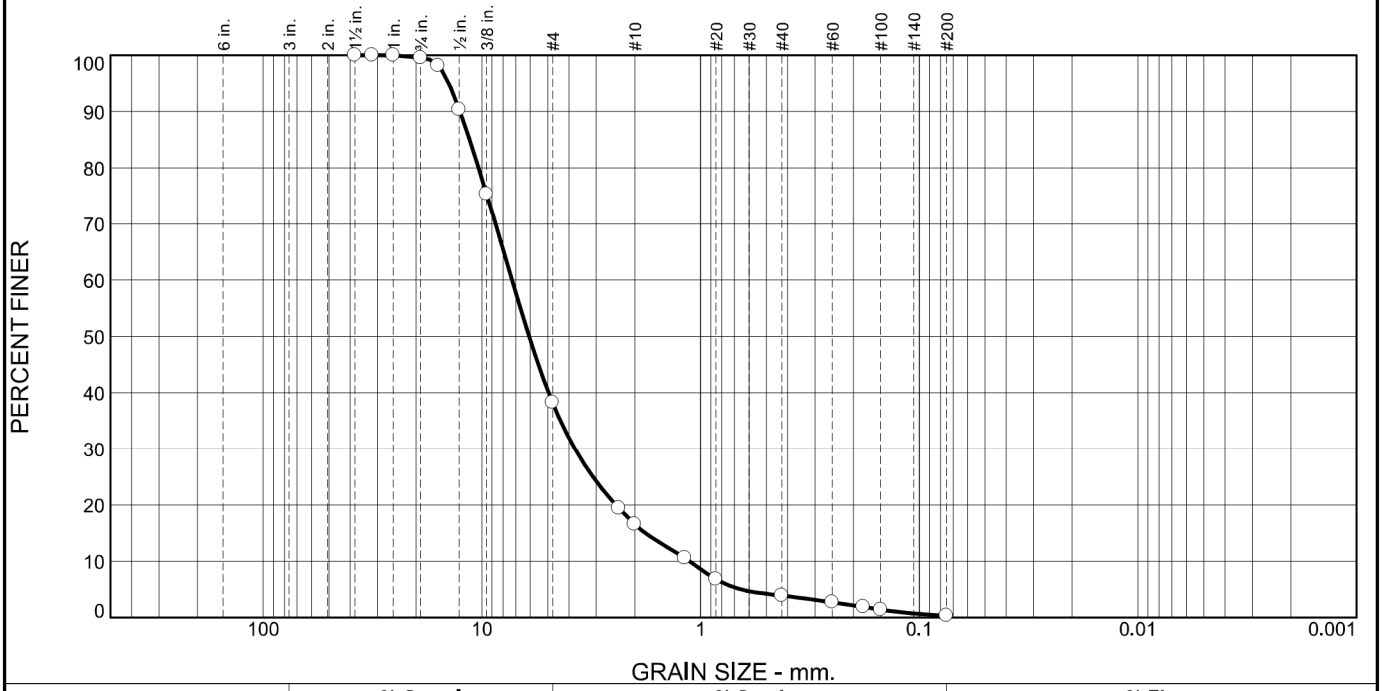
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L892

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	62	21	13	4	0	

Test Results (C-136 & c-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	98		
.5	90		
.375	75		
#4	38		
#8	19		
#10	17		
#16	11		
#20	7		
#40	4		
#60	3		
#80	2		
#100	1		
#200	0.4		

* (no specification provided)

Material Description

Recycled Glass With Fines - Before Compaction.
Sampled by the supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 12.6020 D_{85}= 11.3802 D_{60}= 7.2823
D_{50}= 6.0733 D_{30}= 3.7592 D_{15}= 1.7859
D_{10}= 1.1229 C_u= 6.49 C_c= 1.73

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21

Tested By: M.Thomas

Checked By: T.Nunan

Title: Project Manager

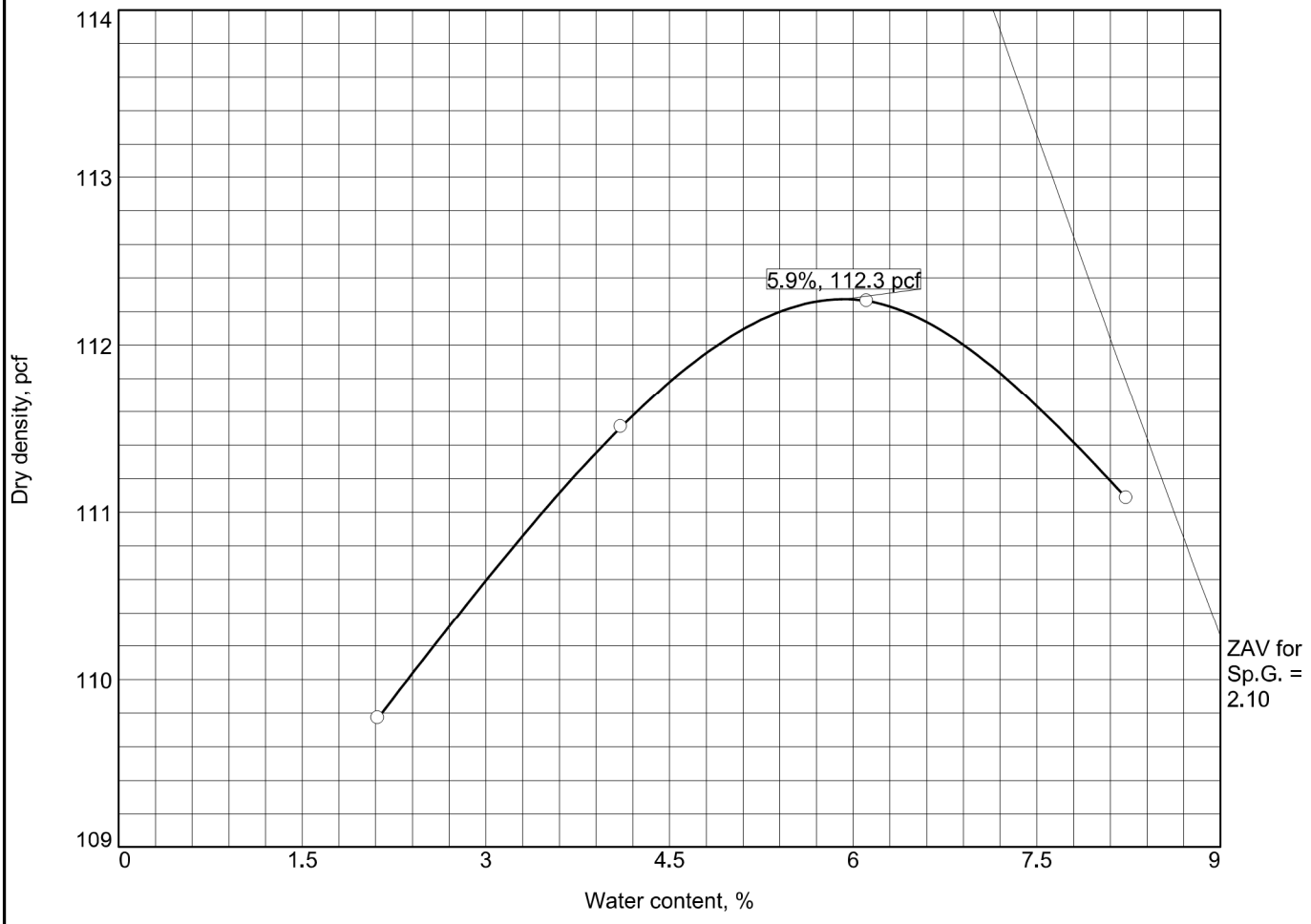
Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L893

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 1557 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GW	A-1-a		2.1	NV	NP	0	0.4

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.3 pcf Optimum moisture = 5.9 %	Recycled Glass With Fines. Sampled by the supplier.

Project No. 062-21033 **Client:** Abbey Road Group Land Development Services

Project: East Town Crossing Lab Testing - Recycled Glass

○**Source of Sample:** Dan Lloyd Construction **Sample Number:** 21L893

Remarks:

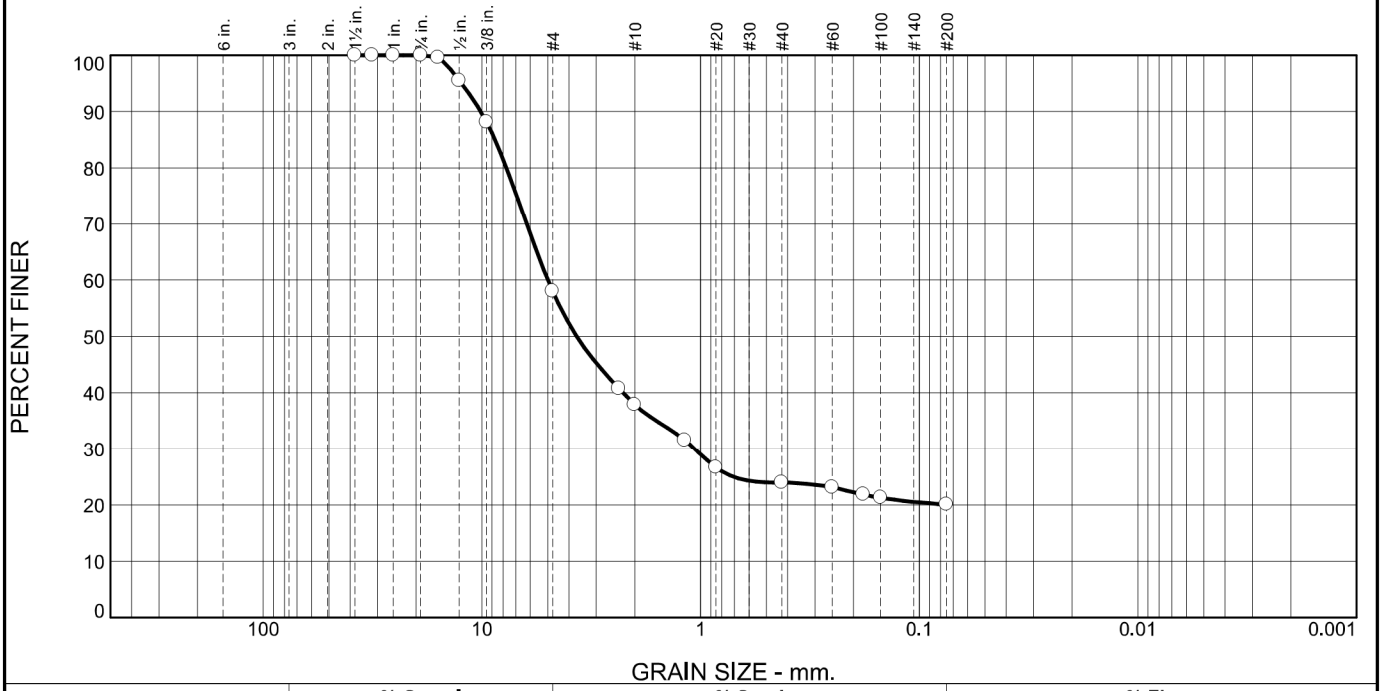
Sample ID:21L893
Sample Date:11-29-21
Void Ratio:0.16
Porosity:14%

Krazan

Figure

Tested By: M.Thomas **Checked By:** T.Nunan.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	42	20	14	4	20	

Test Results (C-136 & C-117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100		
1.25	100		
1	100		
.75	100		
.625	100		
.5	95		
.375	88		
#4	58		
#8	41		
#10	38		
#16	32		
#20	27		
#40	24		
#60	23		
#80	22		
#100	21		
#200	20		

* (no specification provided)

Material Description

Recycled Glass With Fines - After Compaction.
Sampled by the Supplier.

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 10.1195 D_{85}= 8.7171 D_{60}= 4.9887
D_{50}= 3.6862 D_{30}= 1.0651 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample ID:21L893
Sample Date:11-29-21

Date Received: 11-29-21 **Date Tested:** 12-1-21

Tested By: M.Thomas

Checked By: T.Nunan

Title: Project Manager

Source of Sample: Dan Lloyd Construction **Date Sampled:** 11-29-21
Sample Number: 21L893

Krazan

Client: Abbey Road Group Land Development Services Company LLC
Project: East Town Crossing Lab Testing - Recycled Glass

Project No: 062-21033 **Figure**

APPENDIX B-2

MIGIZI GROUP, INC.

PO Box 44840
Tacoma, Washington 98448

PHONE (253) 537-9400
FAX (253) 537-9401

August 25, 2023

Absher Construction
1001 Shaw Road
Puyallup, WA 98372

Attention: Greg Helle
Executive VP, Operations

Subject: **Project Infiltration Feasibility Letter**
Proposed East Town Crossing Development
13102 East Pioneer Rd.
Puyallup, WA 98372
Parcel No. 0420264053, 0420264054, 0420351066

MGI Project Z0582

Dear Mr. Helle:

Migizi Group, Inc. (MGI) is pleased to submit this letter discussing the long-term feasibility of infiltration facilities and permeable pavement at the proposed East Town Crossing development along East Pioneer Road in Puyallup, WA. Previous geotechnical studies for this site were performed by Krazan & Associates and are attached. This includes a *Geotechnical Engineering Investigation* report, dated April 11, 2019, and a March 19, 2021, *Addendum Letter*.

The purpose of this letter is to summarize our geologic research for the project area and immediate region, our review of the previous site reconnaissance, geologic explorations, and infiltration testing performed by Krazan & Associates, and provide MGI's professional recommendations for infiltration feasibility at the site.

SITE AND PROJECT DESCRIPTION

The project site consists of three contiguous parcels, creating a roughly rectangular project area 10.00 acres in size, located along the south side of East Pioneer Road, just east of downtown Puyallup, WA, as shown on the enclosed Topographic and Location Map (Figure 1). The entire parcel is currently undeveloped. The vegetated property is bordered to the north by E Pioneer Rd., to the east by undeveloped land, to the west by Shaw Road, and to the south by a commercial property that houses Absher Construction Office.

The proposed improvements generally consist of eight three-story, wood framed, multi-family apartment buildings, with associated parking stalls, covered car ports, recreational and landscaping areas. A club house will also be constructed at the north end of the site. A total of 70 one-bedroom and 108 two-bedroom units will be created. Three underground storage stormwater facilities, called R-Tank modules, are planned for the detention of generated stormwater. ~~A modular wetland~~ Several BioPods will provide treatment.

In addition to the R-Tank modules, stormwater management procedures will also involve the implementation of Low Impact Development (LID) best management practices (BMPs) to facilitate treatment and infiltration of onsite generated stormwater. This could also include implementation of shallow-depth LID BMPs such as pervious pavement roadways and rain gardens, which are common in developments where deeper infiltration has been proven infeasible due to shallow groundwater tables and/or hydraulically restrictive soils.

LOCAL GEOLOGY

The project area is located along the southern edge of the Puyallup River Valley and at the toe of the Puyallup Highlands slope, roughly between Sumner and Puyallup. The *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington (2015)*, identifies the project area as Qa – Holocene Alluvium. Deposits tend to vary from massive deposits of loose fluvial silts, sands, and gravels, and can locally include sandy to silty estuarine deposits. Puyallup River deposits typically contain local deposits of peat or larger woody debris at depth. An excerpt of the geologic map of the immediate project area (Figure 2) can be found below:

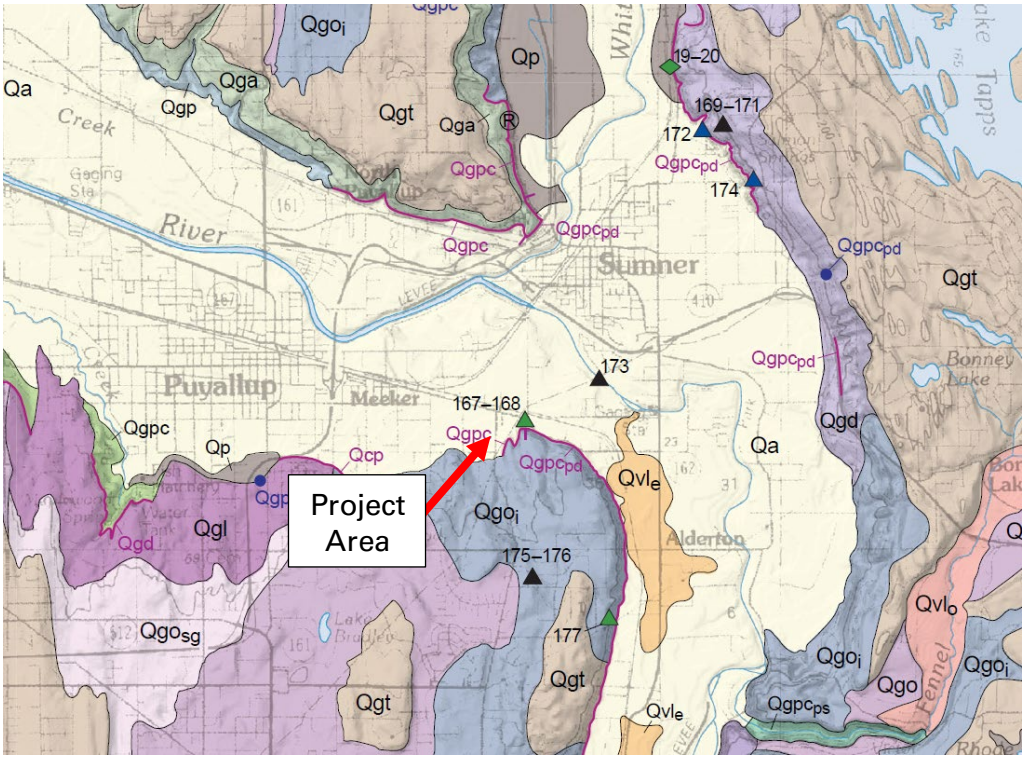


Figure 2: Immediate project area; excerpt of Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington, WSDNR, Schuster et al. 2015.

PREVIOUS PROJECT RECONNAISSANCE AND EXPLORATIONS

Previous explorations by Krazan & Associates included three hollow stem auger borings drilled across the site. In addition, two groundwater monitoring wells also installed at the same time. Drilling was conducted on March 11, 2019, which is within the wet season defined by Department of Ecology guidelines.

According to Krazan, shallow soils encountered in the borings are typical of alluvium deposits, ranging from poorly graded sand and silty sand to silty clay with interbedded seams of peat. Soils were generally observed to be moist to wet, and soft to medium dense or stiff. During drilling operations, groundwater was encountered at depths of between 7 to 8 feet below grade.

PREVIOUS INFILTRATION TESTING

On March 4-5, 2021, Krazan conducted follow up infiltration testing of the project area adjacent to monitoring wells W-1 and W-2, as described in the attached *Addendum Letter*. Krazan elected to conduct two Large-Scale Pilot Infiltration Tests (PITs), labeled P-1 and P-2, with procedures outlined in the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The excavations passed through shallow undocumented fill and into the native silty sand at approximately 2 feet below grade.

The Krazan *Addendum* indicates that field testing used the procedures listed in the 2014 SWMMWW. The two excavations were filled with water and allowed to presoak for the requisite timeframe. Water level measurements taken after presoak indicated that no head change was observed within P-2 and a head increase of 0.75 inches was measured in P-1. Due to a lack of infiltration during the testing period, tests were left open overnight, and measurements were taken the following morning. Measurements taken show that water levels had again risen, with 1.2 inches of head increase in P-1, and 0.3-inch head increase in P-2.

Based on these results, Krazan and Associates concluded that shallow soils of the upper three feet of the project area represented a hydraulic restrictive layer, with the calculated infiltration rate of **0 inches per hour**, based on Site Suitability Criteria of Vol. III, Section 3.3.7 of the 2014 SWMMWW.

PERMEABLE PAVEMENT FEASIBILITY

Currently, the City of Puyallup's stormwater management has adopted the 2019 Washington State Department of Ecology's *Stormwater Management Manual for Western Washington* (SWMMWW). Volume V covers runoff treatment, flow control, and the low impact development (LID) best management practices (BMP) library. Beginning on Page 748 through 751, V-5.6 considers the BMP Permeable Pavements, the Applications and Limitations, and the Infeasibility Criteria. The manual states on page 748:

> The following infeasibility criteria describe conditions that make permeable pavement infeasible when applying The List Approach within I-3.4.5 MR5: On-Site Stormwater Management. If a project proponent wishes to use a permeable pavement BMP even though one of the infeasibility criteria within this section are met, they may propose a functional design to the local government.
>
> These criteria also apply to impervious pavements that would employ stormwater collection from the surface of impervious pavement with redistribution below the pavement.
>
> Any of the following circumstances allow the designer to determine permeable pavement as "infeasible" when applying the The List Approach within I-3.4.5 MR5: On-Site Stormwater Management:

Specifically, three bullet points listed on page 750 of the manual note that:

- Where seasonal high ground water or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the permeable pavement BMP. The bottom of the permable pavement BMP is the bottom of the lowest layer that has been designed to be part of the BMP, such as the lowest gravel base course or a sand layer used for treatment below the permeable pavement.
- Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
- Where appropriate field testing indicates soils have a measured (a.k.a., initial) native soil saturated hydraulic conductivity (K_{sat}) less than 0.3 inches per hour. See V-5.4 Determining the Design Infiltration Rate of the Native Soils. (Note: In these instances, unless other infeasibility restrictions apply, roads and parking lots may be built with an underdrain, preferably elevated within the base course, if Flow Control benefits are desired.)

Volume III Chapter 3 section 2, beginning on page 468 of the 2019 Dept. of Ecology *Stormwater Management Manual*, considers the steps of preparing a stormwater site plan. Step 1 – "Analyze Existing Site Conditions to Determine LID Feasibility" states that a **hydraulic restrictive layer** is "ground water, soil layer with less than 0.3 in/hr Ksat, bedrock, etc." Field testing conducted by Krazan during the western Washington wet season, as described above, confirms that shallow onsite soils in the upper 3 feet are classified as a hydraulicly restrictive layer and are therefore unsuitable for infiltration of site produced stormwater. These shallow soils would be the exposed subgrade base for any proposed pervious pavement subgrade reservoir in areas of pavement for the East Town Crossing development.

CONCLUSIONS

Based on the infiltration testing information provided in the *Geotechnical Engineering Investigation* (April 11, 2019), and the *Addendum Letter* (March 19, 2021) written by Krazan & Associates, and the Criteria guidelines cited in Volumes III and V of the 2019 SWMMWW, it is our opinion that shallow infiltration through the use of permeable pavement is infeasible in the onsite native soils across the project area. Without significant improvement to the in-situ subgrade soils, which could seriously comprise the infiltration characteristics, soil-supported permeable asphalt would likely fail under long term dynamic load usage, such as HS20 loading conditions.

Based on the above, it is our opinion that any generated onsite stormwater should be directed to underground R-Tank modules for detention.

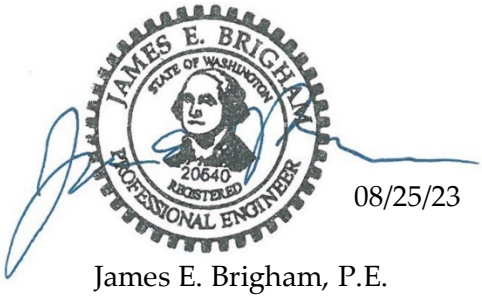
CLOSURE

We appreciate the opportunity to be of service on this project. If you have any questions regarding this letter or any aspects of the project, please feel free to contact our office.

Sincerely,

MIGIZI GROUP, INC.

Randall V. Conger-Best, L.G.
Senior Staff Geologist



08/25/23

James E. Brigham, P.E.
Senior Principal Engineer

Attachments: *Krazan and Associates, Geotechnical Engineering Investigation,* April 11, 2019
Krazan and Associates, Addendum Letter, March 19, 2021

March 19, 2021

KA Project No. 062-190007

Abbey Road Group Land Development Services Company, LLC
PO Box 1224
Puyallup, Washington 98371

Attn: Gil Hulsmann
Email: Gil.Hulsmann@AbbeyRoadGroup.com
Phone: (253) 435-3699 (ext. 101)

Reference: **Geotechnical Engineering Investigation Addendum Letter**
East Town Crossing
SE Corner of E. Shaw Road and E. Pioneer Way
Puyallup, Washington

Dear Mr. Hulsmann,

Per your request, we have prepared this letter to provide the results of two (2) Large-Scale Pilot Infiltration Tests (PITs) we conducted at the above-referenced site. We previously prepared a geotechnical report titled "Geotechnical Engineering Investigation – East Town Crossing – Parcel Nos. 0420264053, 0420264054, 0420351066 – SE Corner of E. Shaw Road & E. Pioneer Way – Puyallup, Washington", dated April 11, 2019, as well as an addendum letter dated July 31, 2020 that addressed the nearby steep slopes.

Large-Scale PITs

Two (2) test pits, designated P-1 and P-2, were excavated near Monitoring Wells MW-1 and MW-2, respectively, on March 4, 2021 at the approximate locations indicated on the Site Plan, Figure 1, in order to conduct large-scale infiltration tests in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW). The infiltration test locations were selected in the field by the client and excavated using a client provided excavator and operator. The bottom of each pit was excavated 10-feet wide by 10-feet long, which met the minimum required horizontal surface area of 100 square feet (sf). Each test pit was initially excavated to a depth of 2 feet below the existing ground surface (bgs), which exposed silty sand (SM) soils at the pit bottom. Water was observed seeping from the sides of pit P-1 during excavation, and was observed ponded at the ground surface at several locations in the vicinity of pit P-1. Test pits P-1 and P-2 encountered undocumented fill to a depth of 1.8 feet and 0.5 feet bgs, respectively, followed by native brown silty sand (SM) with trace gravel and occasional sandy silt and sandy clay seams and layers to the bottom of the test pits. The soils exposed at the PIT test depth were similar to those encountered in the geotechnical borings conducted during our original exploration of the site.

The infiltration test procedure includes a pre-soak period, followed by steady-state and then falling head infiltration rate testing. Each pit was filled with water to a depth of 12 inches above the bottom of the pit for the pre-soak period. After two (2) hours of pre-soak, the water hose was turned off as even just a slight trickle caused the water level in the pit to continue to rise. Water level readings were obtained for an additional 4 hours in pit P-2 with no change in the water level, while the water level in pit P-1 increased ¾-inches which we attributed to seepage from the sides of this pit which were observed during its excavation. Since the water in pits P-1 and P-2 was not infiltrating, we left the pits open overnight, and returned to the site to record the water level. Since it had commenced to rain just prior to our leaving the site, a 5-gallon bucket was left at the location of pit P-2 to obtain an estimate of the amount of rain that fell overnight. We recorded 0.6 inches of rain in the bucket the following morning. On the morning of March 5, 2021, the water level in pit P-1 had risen another 1.2 inches, while the water level in pit P-2 rose about 0.3 inches. Figure 2 includes photos of pits P-1 and P-2 taken on March 5, 2021. The pits were not over-excavated due to the presence of water. The contractor had excavated three test pits within the northwestern corner of the site on March 4, 2021. We observed about 8 to 10 inches of water in the bottom of two of the test pits on March 5, 2021.

Evaluation of Infiltration Feasibility: One of the Site Suitability Criteria (SSC) presented in Section 3.3.7, Volume III, 2014 SWMMWW, **SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer**, states that the base of all infiltration basins or trench systems shall be greater than or equal to 5 feet above the seasonal high-water mark, bedrock (or hardpan), or other low permeability layer. Based on the results of our field exploration and large-scale PITs, the soils at the site contain high silt content and are considered a very low to relatively impermeable layer. Based on the results of our general site assessment and field testing, the low permeability soils encountered at the site do not meet the requirements of Site Suitability Criteria SSC-5 and it is therefore our opinion that onsite infiltration of stormwater using basin or trench system is not considered feasible for the proposed development. **However,** consideration may be given to the use of permeable pavement and other Best Management Practices (BMPs), depending on the final site grading plan.

Limitations

This letter has been prepared for the exclusive use of the Abbey Road Group and their assigns, for the specific application to the site. The geotechnical information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. We emphasize that this letter is valid for this project as outlined above, and should not be used for any other site.

This letter does not include any environmental site assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater or atmosphere, or the presence of wetlands or other biological conditions. The information presented herein is based upon professional interpretation using standard industry practices and engineering conservatism that we consider proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical developments.

Within the limitations of scope, schedule and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this letter was prepared. No other warranty, expressed or implied, is made.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (253) 939-2500.

Respectfully submitted,

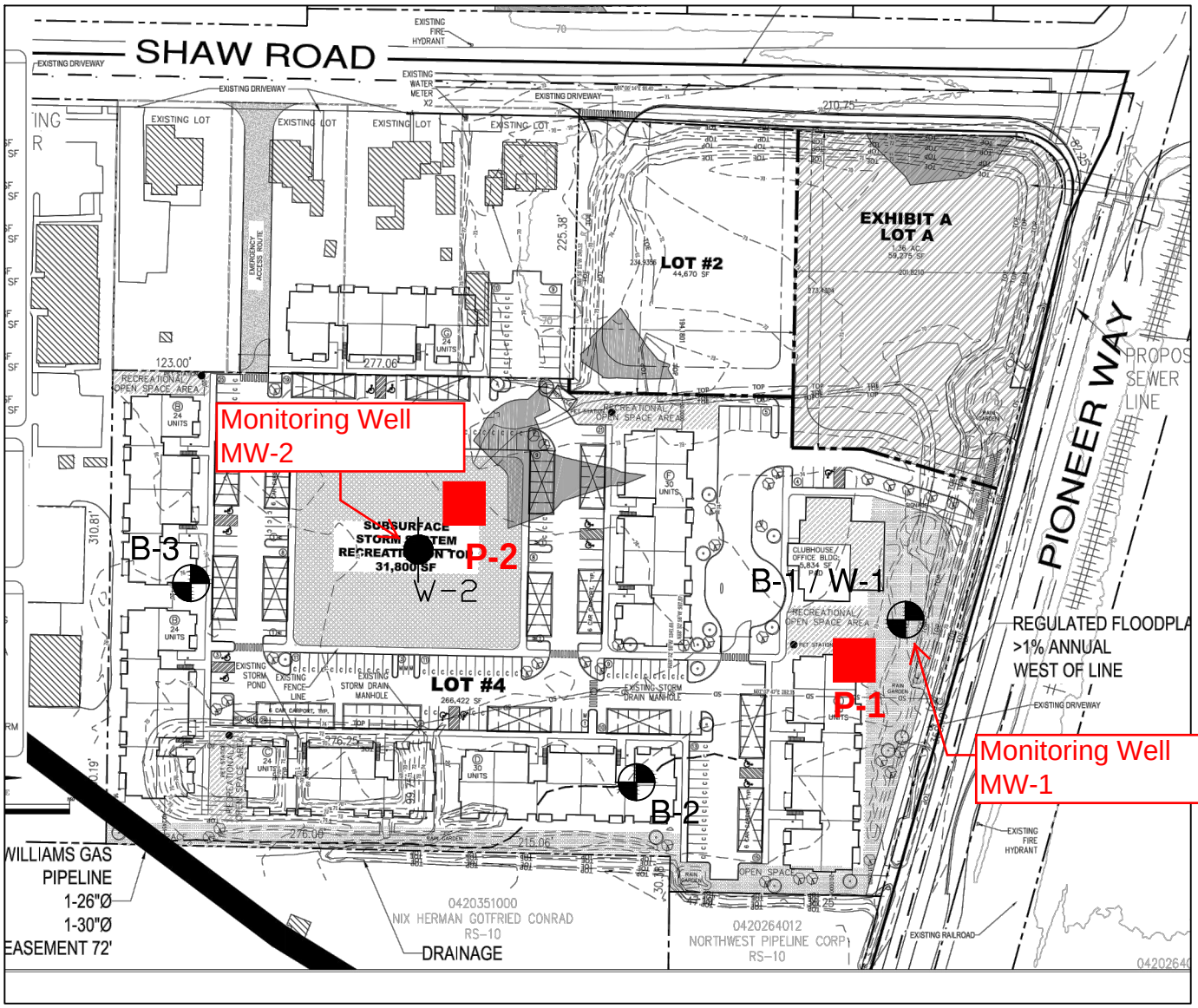
KRAZAN & ASSOCIATES, INC.

3/19/21

Theresa R. Nunan
Project Manager

Vijay Chaudhary, P.E.
Assistant Regional Engineering Manager

Attachments: Figure 1 – Site Plan
Figure 2 – Photos



LEGEND

B-1 Number and Approximate Location of Borings

W-1 Approximate Location of Monitoring Well

P-1 Approximate Location of Pilot Infiltration Test

N

Reference: Plan Sheet titled "Overall Site Plan", prepared by Abbey Road Group dated December 7, 2018.

Site Plan

East Town Crossing	Figure 1
Shaw Rd & E Pioneer Way, Puyallup, WA	
Project Number: 062-19007	Drawn By: T. Nunan Date: March 2021
Krazan & ASSOCIATES, INC.	Not to Scale

Water in Pit P-1 on March 5, 2021.

Water in Pit P-2 on March 5, 2021.

Water in Test Pit on March 5, 2021. Test pit was excavated in NE portion of site on March 4, 2021.

Figure 2 - Photos (March 5, 2021)

APPENDIX B-3

Service Disabled Veteran Owned Small Business

Job #: 06-171
Project Name: East Town Crossing
As Of Date: 1/17/2023

Subject: Water Monitoring Information for the East Town Crossing Site

Special Notes:

On Site Average Elevation: 70 Elevation

Max Boring Depth for the Shaw / Pioneer Crossing: 51.75 IE sloping to 60.60 IE

Shaw / Pioneer Intersection Elevation: 69.9 Top Surface

East Town Crossing Monitoring Well Information:

Well # 1 (B-1/W-1): 72.84, Rim IE
Well # 2 (W-2) 74.13 Rim IE

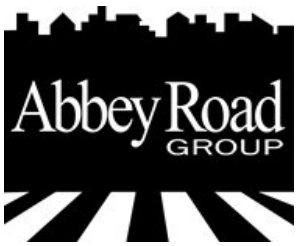
Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
3/18/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
3/26/2019	East Town Crossing	B-1/W-1	64.94	7.90	Krazans Report	Water Monitoring Well Testing
4/2/2019	East Town Crossing	B-1/W-1	64.84	8.00	Krazans Report	Water Monitoring Well Testing
4/10/2019	East Town Crossing	B-1/W-1	64.54	8.30	Krazans Report	Water Monitoring Well Testing
4/19/2019	East Town Crossing	B-1/W-1	64.54	8.30	Krazans Report	Water Monitoring Well Testing
4/24/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
4/28/2019	East Town Crossing	B-1/W-1	64.64	8.20	Krazans Report	Water Monitoring Well Testing
12/27/2019	East Town Crossing	B-1/W-1	69.14	3.70	Krazans Report	Water Monitoring Well Testing
1/31/2020	East Town Crossing	B-1/W-1	69.84	3.00	Krazans Report	Water Monitoring Well Testing
2/17/2020	East Town Crossing	B-1/W-1	66.44	6.40	Krazans Report	Water Monitoring Well Testing
3/16/2020	East Town Crossing	B-1/W-1	65.54	7.30	Krazans Report	Water Monitoring Well Testing
8/21/2020	East Town Crossing	B-1/W-1	63.94	8.90	Abbey Road Group	Water Monitoring Well Testing
8/28/2020	East Town Crossing	B-1/W-1	63.99	8.85	Abbey Road Group	Water Monitoring Well Testing
9/4/2020	East Town Crossing	B-1/W-1	63.84	9.00	Abbey Road Group	Water Monitoring Well Testing
9/11/2020	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
9/21/2020	East Town Crossing	B-1/W-1	63.72	9.12	Abbey Road Group	Water Monitoring Well Testing
9/25/2020	East Town Crossing	B-1/W-1	64.36	8.48	Abbey Road Group	Water Monitoring Well Testing
10/2/2020	East Town Crossing	B-1/W-1	64.27	8.57	Abbey Road Group	Water Monitoring Well Testing
10/9/2020	East Town Crossing	B-1/W-1	64.25	8.59	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
10/16/2020	East Town Crossing	B-1/W-1	64.82	8.02	Abbey Road Group	Water Monitoring Well Testing
10/23/2020	East Town Crossing	B-1/W-1	64.81	8.03	Abbey Road Group	Water Monitoring Well Testing
11/6/2020	East Town Crossing	B-1/W-1	65.59	7.25	Abbey Road Group	Water Monitoring Well Testing
11/13/2020	East Town Crossing	B-1/W-1	65.49	7.35	Abbey Road Group	Water Monitoring Well Testing
11/19/2020	East Town Crossing	B-1/W-1	65.89	6.95	Abbey Road Group	Water Monitoring Well Testing
12/4/2020	East Town Crossing	B-1/W-1	65.67	7.17	Abbey Road Group	Water Monitoring Well Testing
12/11/2020	East Town Crossing	B-1/W-1	66.64	6.20	Abbey Road Group	Water Monitoring Well Testing
12/21/2020	East Town Crossing	B-1/W-1	67.28	5.56	Abbey Road Group	Water Monitoring Well Testing
12/28/2020	East Town Crossing	B-1/W-1	67.09	5.75	Abbey Road Group	Water Monitoring Well Testing
1/4/2021	East Town Crossing	B-1/W-1	68.44	4.40	Abbey Road Group	Water Monitoring Well Testing
1/11/2021	East Town Crossing	B-1/W-1	67.84	5.00	Abbey Road Group	Water Monitoring Well Testing
1/18/2021	East Town Crossing	B-1/W-1	67.89	4.95	Abbey Road Group	Water Monitoring Well Testing
2/1/2021	East Town Crossing	B-1/W-1	67.24	5.60	Abbey Road Group	Water Monitoring Well Testing
2/8/2021	East Town Crossing	B-1/W-1	66.96	5.88	Abbey Road Group	Water Monitoring Well Testing
2/16/2021	East Town Crossing	B-1/W-1	67.79	5.05	Abbey Road Group	Water Monitoring Well Testing
2/22/2021	East Town Crossing	B-1/W-1	68.09	4.75	Abbey Road Group	Water Monitoring Well Testing
3/1/2021	East Town Crossing	B-1/W-1	67.43	5.41	Abbey Road Group	Water Monitoring Well Testing
3/5/2021	East Town Crossing	B-1/W-1	67.11	5.73	Abbey Road Group	Water Monitoring Well Testing
3/15/2021	East Town Crossing	B-1/W-1	66.54	6.30	Abbey Road Group	Water Monitoring Well Testing
3/22/2021	East Town Crossing	B-1/W-1	66.36	6.48	Abbey Road Group	Water Monitoring Well Testing
4/5/2021	East Town Crossing	B-1/W-1	66.28	6.56	Abbey Road Group	Water Monitoring Well Testing
4/13/2021	East Town Crossing	B-1/W-1	66.01	6.83	Abbey Road Group	Water Monitoring Well Testing
4/19/2021	East Town Crossing	B-1/W-1	65.82	7.02	Abbey Road Group	Water Monitoring Well Testing
4/22/2021	East Town Crossing	B-1/W-1	65.73	7.11	Abbey Road Group	Water Monitoring Well Testing
4/30/2021	East Town Crossing	B-1/W-1	65.77	7.07	Abbey Road Group	Water Monitoring Well Testing
5/072021	East Town Crossing	B-1/W-1	65.66	7.18	Abbey Road Group	Water Monitoring Well Testing
5/172021	East Town Crossing	B-1/W-1	65.39	7.45	Abbey Road Group	Water Monitoring Well Testing
5/24/2021	East Town Crossing	B-1/W-1	65.39	7.45	Abbey Road Group	Water Monitoring Well Testing
5/28/2021	East Town Crossing	B-1/W-1	65.34	7.50	Abbey Road Group	Water Monitoring Well Testing
6/4/2021	East Town Crossing	B-1/W-1	65.19	7.65	Abbey Road Group	Water Monitoring Well Testing
6/14/2021	East Town Crossing	B-1/W-1	65.49	7.35	Abbey Road Group	Water Monitoring Well Testing
6/22/2021	East Town Crossing	B-1/W-1	65.29	7.55	Abbey Road Group	Water Monitoring Well Testing
6/29/2021	East Town Crossing	B-1/W-1	65.03	7.81	Abbey Road Group	Water Monitoring Well Testing
7/8/2021	East Town Crossing	B-1/W-1	64.79	8.05	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	B-1/W-1	64.64	8.20	Abbey Road Group	Water Monitoring Well Testing



Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
7/20/2021	East Town Crossing	B-1/W-1	64.42	8.42	Abbey Road Group	Water Monitoring Well Testing
7/27/2021	East Town Crossing	B-1/W-1	64.21	8.63	Abbey Road Group	Water Monitoring Well Testing
8/2/2021	East Town Crossing	B-1/W-1	64.05	8.79	Abbey Road Group	Water Monitoring Well Testing
8/10/2021	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
8/16/2021	East Town Crossing	B-1/W-1	63.82	9.02	Abbey Road Group	Water Monitoring Well Testing
8/23/2021	East Town Crossing	B-1/W-1	63.73	9.11	Abbey Road Group	Water Monitoring Well Testing
8/30/2021	East Town Crossing	B-1/W-1	63.69	9.15	Abbey Road Group	Water Monitoring Well Testing
9/9/2021	East Town Crossing	B-1/W-1	63.59	9.25	Abbey Road Group	Water Monitoring Well Testing
9/13/2021	East Town Crossing	B-1/W-1	63.54	9.30	Abbey Road Group	Water Monitoring Well Testing
9/20/2021	East Town Crossing	B-1/W-1	63.73	9.11	Abbey Road Group	Water Monitoring Well Testing
9/27/2021	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
10/4/2021	East Town Crossing	B-1/W-1	64.20	8.64	Abbey Road Group	Water Monitoring Well Testing
10/18/2021	East Town Crossing	B-1/W-1	64.20	8.64	Abbey Road Group	Water Monitoring Well Testing
10/25/2021	East Town Crossing	B-1/W-1	64.44	8.40	Abbey Road Group	Water Monitoring Well Testing
11/1/2021	East Town Crossing	B-1/W-1	65.34	7.50	Abbey Road Group	Water Monitoring Well Testing
11/8/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/17/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/22/2021	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
11/29/2021	East Town Crossing	B-1/W-1	66.52	6.32	Abbey Road Group	Water Monitoring Well Testing
12/6/2021	East Town Crossing	B-1/W-1	66.33	6.51	Abbey Road Group	Water Monitoring Well Testing
12/13/2021	East Town Crossing	B-1/W-1	67.49	5.35	Abbey Road Group	Water Monitoring Well Testing
1/3/2022	East Town Crossing	B-1/W-1	67.44	5.40	Abbey Road Group	Water Monitoring Well Testing
1/25/2022	East Town Crossing	B-1/W-1	63.80	9.04	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering
1/28/2022	East Town Crossing	B-1/W-1	63.08	9.76	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering (2 Pumps Running)
2/4/2022	East Town Crossing	B-1/W-1	65.01	7.83	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering ended 2/03/2022
2/8/2022	East Town Crossing	B-1/W-1	65.54	7.30	Abbey Road Group	Water Monitoring Well Testing
2/16/2022	East Town Crossing	B-1/W-1	65.55	7.29	Abbey Road Group	Water Monitoring Well Testing
3/9/2022	East Town Crossing	B-1/W-1	66.94	5.90	Abbey Road Group	Water Monitoring Well Testing
3/22/2022	East Town Crossing	B-1/W-1	67.09	5.75	Abbey Road Group	Water Monitoring Well Testing
3/31/2022	East Town Crossing	B-1/W-1	66.33	6.51	Abbey Road Group	Water Monitoring Well Testing
4/12/2022	East Town Crossing	B-1/W-1	66.16	6.68	Abbey Road Group	Water Monitoring Well Testing
4/19/2022	East Town Crossing	B-1/W-1	66.06	6.78	Abbey Road Group	Water Monitoring Well Testing
4/25/2022	East Town Crossing	B-1/W-1	65.94	6.90	Abbey Road Group	Water Monitoring Well Testing
5/3/2022	East Town Crossing	B-1/W-1	66.08	6.76	Abbey Road Group	Water Monitoring Well Testing
5/10/2022	East Town Crossing	B-1/W-1	66.27	6.57	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #1):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
5/18/2022	East Town Crossing	B-1/W-1	66.29	6.55	Abbey Road Group	Water Monitoring Well Testing
5/25/2022	East Town Crossing	B-1/W-1	66.84	6.00	Abbey Road Group	Water Monitoring Well Testing
6/1/2022	East Town Crossing	B-1/W-1	65.94	6.90	Abbey Road Group	Water Monitoring Well Testing
6/6/2022	East Town Crossing	B-1/W-1	66.14	6.70	Abbey Road Group	Water Monitoring Well Testing
6/16/2022	East Town Crossing	B-1/W-1	66.46	6.38	Abbey Road Group	Water Monitoring Well Testing
6/20/2022	East Town Crossing	B-1/W-1	66.14	6.70	Abbey Road Group	Water Monitoring Well Testing
6/30/2022	East Town Crossing	B-1/W-1	65.54	7.30	Abbey Road Group	Water Monitoring Well Testing
7/6/2022	East Town Crossing	B-1/W-1	65.44	7.40	Abbey Road Group	Water Monitoring Well Testing
7/11/2022	East Town Crossing	B-1/W-1	65.14	7.70	Abbey Road Group	Water Monitoring Well Testing
7/19/2022	East Town Crossing	B-1/W-1	64.84	8.00	Abbey Road Group	Water Monitoring Well Testing
7/28/2022	East Town Crossing	B-1/W-1	64.59	8.25	Abbey Road Group	Water Monitoring Well Testing
8/1/2022	East Town Crossing	B-1/W-1	64.49	8.35	Abbey Road Group	Water Monitoring Well Testing
8/10/2022	East Town Crossing	B-1/W-1	64.24	8.60	Abbey Road Group	Water Monitoring Well Testing
8/15/2022	East Town Crossing	B-1/W-1	64.19	8.65	Abbey Road Group	Water Monitoring Well Testing
8/25/2022	East Town Crossing	B-1/W-1	64.04	8.80	Abbey Road Group	Water Monitoring Well Testing
8/30/2022	East Town Crossing	B-1/W-1	63.89	8.95	Abbey Road Group	Water Monitoring Well Testing
9/6/2022	East Town Crossing	B-1/W-1	63.86	8.98	Abbey Road Group	Water Monitoring Well Testing
9/12/2022	East Town Crossing	B-1/W-1	63.69	9.15	Abbey Road Group	Water Monitoring Well Testing
9/19/2022	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
9/28/2022	East Town Crossing	B-1/W-1	63.64	9.20	Abbey Road Group	Water Monitoring Well Testing
10/7/2022	East Town Crossing	B-1/W-1	63.61	9.23	Abbey Road Group	Water Monitoring Well Testing
10/12/2022	East Town Crossing	B-1/W-1	63.68	9.16	Abbey Road Group	Water Monitoring Well Testing
10/17/2022	East Town Crossing	B-1/W-1	63.62	9.22	Abbey Road Group	Water Monitoring Well Testing
10/24/2022	East Town Crossing	B-1/W-1	63.84	9.00	Abbey Road Group	Water Monitoring Well Testing
10/31/2022	East Town Crossing	B-1/W-1	64.16	8.68	Abbey Road Group	Water Monitoring Well Testing
11/7/2022	East Town Crossing	B-1/W-1	65.04	7.80	Abbey Road Group	Water Monitoring Well Testing
11/14/2022	East Town Crossing	B-1/W-1	64.80	8.04	Abbey Road Group	Water Monitoring Well Testing
11/29/2022	East Town Crossing	B-1/W-1	65.12	7.72	Abbey Road Group	Water Monitoring Well Testing
12/5/2022	East Town Crossing	B-1/W-1	65.71	7.13	Abbey Road Group	Water Monitoring Well Testing
12/16/2022	East Town Crossing	B-1/W-1	65.73	7.11	Abbey Road Group	Water Monitoring Well Testing
12/20/2022	East Town Crossing	B-1/W-1	65.75	7.09	Abbey Road Group	Water Monitoring Well Testing
12/27/2022	East Town Crossing	B-1/W-1	67.19	5.65	Abbey Road Group	Water Monitoring Well Testing
1/3/2023	East Town Crossing	B-1/W-1	66.60	6.24	Abbey Road Group	Water Monitoring Well Testing
1/9/2023	East Town Crossing	B-1/W-1	66.61	6.23	Abbey Road Group	Water Monitoring Well Testing
1/17/2023	East Town Crossing	B-1/W-1	66.68	6.16	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Job #: 06-171

Project Name: East Town Crossing

As Of Date: 1/17/2023

Subject: Water Monitoring Information for the East Town Crossing Site

Special Notes:

On Site Average Elevation: 70 Elevation

Max Boring Depth for the Shaw / Pioneer Crossing: 51.75 IE sloping to 60.60 IE

Shaw / Pioneer Intersection Elevation: 69.9 Top Surface

East Town Crossing Monitoring Well Information:

Well # 1 (B-1/W-1): 72.84, Rim IE

Well # 2 (W-2) 74.13 Rim IE

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
3/18/2019	East Town Crossing	W-2	66.63	7.50	Krazans Report	Water Monitoring Well Testing
3/26/2020	East Town Crossing	W-2	66.83	7.30	Krazans Report	Water Monitoring Well Testing
4/2/2019	East Town Crossing	W-2	66.83	7.30	Krazans Report	Water Monitoring Well Testing
4/10/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/19/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/24/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
4/28/2019	East Town Crossing	W-2	66.33	7.80	Krazans Report	Water Monitoring Well Testing
12/27/2019	East Town Crossing	W-2	70.03	4.10	Krazans Report	Water Monitoring Well Testing
1/31/2020	East Town Crossing	W-2	70.63	3.50	Krazans Report	Water Monitoring Well Testing
2/17/2020	East Town Crossing	W-2	68.33	5.80	Krazans Report	Water Monitoring Well Testing
3/16/2020	East Town Crossing	W-2	67.33	6.80	Krazans Report	Water Monitoring Well Testing
8/21/2020	East Town Crossing	W-2	66.08	8.05	Abbey Road Group	Water Monitoring Well Testing
8/28/2020	East Town Crossing	W-2	65.98	8.15	Abbey Road Group	Water Monitoring Well Testing
9/4/2020	East Town Crossing	W-2	65.81	8.32	Abbey Road Group	Water Monitoring Well Testing
9/11/2020	East Town Crossing	W-2	65.68	8.45	Abbey Road Group	Water Monitoring Well Testing
9/21/2020	East Town Crossing	W-2	65.58	8.55	Abbey Road Group	Water Monitoring Well Testing
9/25/2020	East Town Crossing	W-2	65.79	8.34	Abbey Road Group	Water Monitoring Well Testing
10/2/2020	East Town Crossing	W-2	65.82	8.31	Abbey Road Group	Water Monitoring Well Testing
10/9/2020	East Town Crossing	W-2	65.82	8.31	Abbey Road Group	Water Monitoring Well Testing
10/16/2020	East Town Crossing	W-2	66.27	7.86	Abbey Road Group	Water Monitoring Well Testing
10/23/2020	East Town Crossing	W-2	66.27	7.86	Abbey Road Group	Water Monitoring Well Testing
11/6/2020	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
11/13/2020	East Town Crossing	W-2	66.68	7.45	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
11/19/2020	East Town Crossing	W-2	67.08	7.05	Abbey Road Group	Water Monitoring Well Testing
12/4/2020	East Town Crossing	W-2	67.18	6.95	Abbey Road Group	Water Monitoring Well Testing
12/11/2020	East Town Crossing	W-2	68.10	6.03	Abbey Road Group	Water Monitoring Well Testing
12/21/2020	East Town Crossing	W-2	68.56	5.57	Abbey Road Group	Water Monitoring Well Testing
12/28/2020	East Town Crossing	W-2	68.73	5.40	Abbey Road Group	Water Monitoring Well Testing
1/4/2021	East Town Crossing	W-2	69.98	4.15	Abbey Road Group	Water Monitoring Well Testing
1/11/2021	East Town Crossing	W-2	69.73	4.40	Abbey Road Group	Water Monitoring Well Testing
1/18/2021	East Town Crossing	W-2	70.13	4.00	Abbey Road Group	Water Monitoring Well Testing
2/1/2021	East Town Crossing	W-2	69.31	4.82	Abbey Road Group	Water Monitoring Well Testing
2/8/2021	East Town Crossing	W-2	69.10	5.03	Abbey Road Group	Water Monitoring Well Testing
2/16/2021	East Town Crossing	W-2	69.48	4.65	Abbey Road Group	Water Monitoring Well Testing
2/22/2021	East Town Crossing	W-2	69.73	4.40	Abbey Road Group	Water Monitoring Well Testing
3/1/2021	East Town Crossing	W-2	69.52	4.61	Abbey Road Group	Water Monitoring Well Testing
3/5/2021	East Town Crossing	W-2	69.13	5.00	Abbey Road Group	Water Monitoring Well Testing
3/15/2021	East Town Crossing	W-2	68.60	5.53	Abbey Road Group	Water Monitoring Well Testing
3/22/2021	East Town Crossing	W-2	68.32	5.81	Abbey Road Group	Water Monitoring Well Testing
4/5/2021	East Town Crossing	W-2	68.15	5.98	Abbey Road Group	Water Monitoring Well Testing
4/13/2021	East Town Crossing	W-2	67.91	6.22	Abbey Road Group	Water Monitoring Well Testing
4/19/2021	East Town Crossing	W-2	67.75	6.38	Abbey Road Group	Water Monitoring Well Testing
4/22/2021	East Town Crossing	W-2	67.62	6.51	Abbey Road Group	Water Monitoring Well Testing
4/30/2021	East Town Crossing	W-2	67.67	6.46	Abbey Road Group	Water Monitoring Well Testing
5/7/2021	East Town Crossing	W-2	67.63	6.50	Abbey Road Group	Water Monitoring Well Testing
5/17/2021	East Town Crossing	W-2	67.48	6.65	Abbey Road Group	Water Monitoring Well Testing
5/24/2021	East Town Crossing	W-2	67.51	6.62	Abbey Road Group	Water Monitoring Well Testing
5/28/2021	East Town Crossing	W-2	67.49	6.64	Abbey Road Group	Water Monitoring Well Testing
6/4/2021	East Town Crossing	W-2	67.17	6.96	Abbey Road Group	Water Monitoring Well Testing
6/14/2021	East Town Crossing	W-2	67.51	6.62	Abbey Road Group	Water Monitoring Well Testing
6/22/2021	East Town Crossing	W-2	67.50	6.63	Abbey Road Group	Water Monitoring Well Testing
6/29/2021	East Town Crossing	W-2	67.18	6.95	Abbey Road Group	Water Monitoring Well Testing
7/8/2021	East Town Crossing	W-2	67.08	7.05	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.95	7.18	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.73	7.40	Abbey Road Group	Water Monitoring Well Testing
7/12/2021	East Town Crossing	W-2	66.45	7.68	Abbey Road Group	Water Monitoring Well Testing
8/2/2021	East Town Crossing	W-2	66.39	7.74	Abbey Road Group	Water Monitoring Well Testing
8/10/2021	East Town Crossing	W-2	66.18	7.95	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
8/16/2021	East Town Crossing	W-2	66.02	8.11	Abbey Road Group	Water Monitoring Well Testing
8/23/2021	East Town Crossing	W-2	65.87	8.26	Abbey Road Group	Water Monitoring Well Testing
8/30/2021	East Town Crossing	W-2	65.72	8.41	Abbey Road Group	Water Monitoring Well Testing
9/9/2021	East Town Crossing	W-2	65.58	8.55	Abbey Road Group	Water Monitoring Well Testing
9/13/2021	East Town Crossing	W-2	65.55	8.58	Abbey Road Group	Water Monitoring Well Testing
9/20/2021	East Town Crossing	W-2	65.66	8.47	Abbey Road Group	Water Monitoring Well Testing
9/27/2021	East Town Crossing	W-2	65.63	8.50	Abbey Road Group	Water Monitoring Well Testing
10/4/2021	East Town Crossing	W-2	65.70	8.43	Abbey Road Group	Water Monitoring Well Testing
10/18/2021	East Town Crossing	W-2	65.81	8.32	Abbey Road Group	Water Monitoring Well Testing
10/25/2021	East Town Crossing	W-2	65.98	8.15	Abbey Road Group	Water Monitoring Well Testing
11/1/2021	East Town Crossing	W-2	66.53	7.60	Abbey Road Group	Water Monitoring Well Testing
11/8/2021	East Town Crossing	W-2	67.23	6.90	Abbey Road Group	Water Monitoring Well Testing
11/17/2021	East Town Crossing	W-2	68.93	5.20	Abbey Road Group	Water Monitoring Well Testing
11/22/2021	East Town Crossing	W-2	68.98	5.15	Abbey Road Group	Water Monitoring Well Testing
11/29/2021	East Town Crossing	W-2	69.17	4.96	Abbey Road Group	Water Monitoring Well Testing
12/6/2021	East Town Crossing	W-2	68.92	5.21	Abbey Road Group	Water Monitoring Well Testing
12/13/2021	East Town Crossing	W-2	69.35	4.78	Abbey Road Group	Water Monitoring Well Testing
1/3/2022	East Town Crossing	W-2	69.30	4.83	Abbey Road Group	Water Monitoring Well Testing
1/25/2022	East Town Crossing	W-2	65.88	8.25	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering
1/28/2022	East Town Crossing	W-2	65.05	9.08	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering (2 Pumps Running)
2/4/2022	East Town Crossing	W-2	64.98	9.15	Abbey Road Group	Water Monitoring Well Testing-Onsite Dewatering ended 2/03/2022
2/8/2022	East Town Crossing	W-2	66.23	7.90	Abbey Road Group	Water Monitoring Well Testing
2/16/2022	East Town Crossing	W-2	67.13	7.00	Abbey Road Group	Water Monitoring Well Testing
3/9/2022	East Town Crossing	W-2	68.53	5.60	Abbey Road Group	Water Monitoring Well Testing
3/22/2022	East Town Crossing	W-2	68.43	5.70	Abbey Road Group	Water Monitoring Well Testing
3/31/2022	East Town Crossing	W-2	68.05	6.08	Abbey Road Group	Water Monitoring Well Testing
4/12/2022	East Town Crossing	W-2	67.97	6.16	Abbey Road Group	Water Monitoring Well Testing
4/19/2022	East Town Crossing	W-2	67.97	6.16	Abbey Road Group	Water Monitoring Well Testing
4/25/2022	East Town Crossing	W-2	67.73	6.40	Abbey Road Group	Water Monitoring Well Testing
5/3/2022	East Town Crossing	W-2	67.68	6.45	Abbey Road Group	Water Monitoring Well Testing
5/10/2022	East Town Crossing	W-2	67.83	6.30	Abbey Road Group	Water Monitoring Well Testing
5/18/2022	East Town Crossing	W-2	68.10	6.03	Abbey Road Group	Water Monitoring Well Testing
5/25/2022	East Town Crossing	W-2	68.43	5.70	Abbey Road Group	Water Monitoring Well Testing
6/1/2022	East Town Crossing	W-2	67.63	6.50	Abbey Road Group	Water Monitoring Well Testing
6/6/2022	East Town Crossing	W-2	67.85	6.28	Abbey Road Group	Water Monitoring Well Testing
6/16/2022	East Town Crossing	W-2	68.13	6.00	Abbey Road Group	Water Monitoring Well Testing
6/20/2022	East Town Crossing	W-2	68.03	6.10	Abbey Road Group	Water Monitoring Well Testing
6/30/2022	East Town Crossing	W-2	67.43	6.70	Abbey Road Group	Water Monitoring Well Testing

Service Disabled Veteran Owned Small Business

Water Monitoring Information (Well #2):

Date	Location	Boring Site #	Water Elevation	Depth	Source	Comments
7/6/2022	East Town Crossing	W-2	67.33	6.80	Abbey Road Group	Water Monitoring Well Testing
7/11/2022	East Town Crossing	W-2	67.03	7.10	Abbey Road Group	Water Monitoring Well Testing
7/19/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
7/28/2022	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
8/1/2022	East Town Crossing	W-2	66.68	7.45	Abbey Road Group	Water Monitoring Well Testing
8/10/2022	East Town Crossing	W-2	66.48	7.65	Abbey Road Group	Water Monitoring Well Testing
8/15/2022	East Town Crossing	W-2	66.38	7.75	Abbey Road Group	Water Monitoring Well Testing
8/25/2022	East Town Crossing	W-2	66.28	7.85	Abbey Road Group	Water Monitoring Well Testing
8/30/2022	East Town Crossing	W-2	66.18	7.95	Abbey Road Group	Water Monitoring Well Testing
9/6/2022	East Town Crossing	W-2	66.15	7.98	Abbey Road Group	Water Monitoring Well Testing
9/12/2022	East Town Crossing	W-2	65.88	8.25	Abbey Road Group	Water Monitoring Well Testing
9/19/2022	East Town Crossing	W-2	65.86	8.27	Abbey Road Group	Water Monitoring Well Testing
9/28/2022	East Town Crossing	W-2	65.85	8.28	Abbey Road Group	Water Monitoring Well Testing
10/7/2022	East Town Crossing	W-2	65.76	8.37	Abbey Road Group	Water Monitoring Well Testing
10/12/2022	East Town Crossing	W-2	65.66	8.47	Abbey Road Group	Water Monitoring Well Testing
10/17/2022	East Town Crossing	W-2	65.49	8.64	Abbey Road Group	Water Monitoring Well Testing
10/24/2022	East Town Crossing	W-2	65.70	8.43	Abbey Road Group	Water Monitoring Well Testing
10/31/2022	East Town Crossing	W-2	65.97	8.16	Abbey Road Group	Water Monitoring Well Testing
11/7/2022	East Town Crossing	W-2	66.83	7.30	Abbey Road Group	Water Monitoring Well Testing
11/14/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
11/29/2022	East Town Crossing	W-2	66.46	7.67	Abbey Road Group	Water Monitoring Well Testing
12/5/2022	East Town Crossing	W-2	66.88	7.25	Abbey Road Group	Water Monitoring Well Testing
12/16/2022	East Town Crossing	W-2	66.85	7.28	Abbey Road Group	Water Monitoring Well Testing
12/20/2022	East Town Crossing	W-2	66.61	7.52	Abbey Road Group	Water Monitoring Well Testing
12/27/2022	East Town Crossing	W-2	68.00	6.13	Abbey Road Group	Water Monitoring Well Testing
1/3/2023	East Town Crossing	W-2	68.26	5.87	Abbey Road Group	Water Monitoring Well Testing
1/9/2023	East Town Crossing	W-2	68.23	5.90	Abbey Road Group	Water Monitoring Well Testing
1/17/2023	East Town Crossing	W-2	67.44	6.69	Abbey Road Group	Water Monitoring Well Testing

MITIGATION PLAN

EAST TOWN CROSSING STREAM RESTORATION AND MIXED-USE DEVELOPMENT

MARCH 20, 2024

Soundview Consultants
Environmental Assessment
Planning + Land Use Solutions

MITIGATION PLAN

EAST TOWN CROSSING STREAM RESTORATION AND MIXED-USE DEVELOPMENT

MARCH 20, 2024

PROJECT LOCATION
2902, 13102, & 3104 EAST PIONEER AVENUE
813, 901, & 911 SHAW ROAD EAST
PUYALLUP, WASHINGTON 98374

PREPARED FOR
ASH DEVELOPMENT
1001 SHAW ROAD
PUYALLUP, WASHINGTON 98371

PREPARED BY
SOUNDVIEW CONSULTANTS LLC
2907 HARBORVIEW DRIVE
GIG HARBOR, WASHINGTON 98335
(253) 514-8952

Soundview Consultants
Environmental Assessment
Planning + Land Use Solutions

Executive Summary

Soundview Consultants LLC (SVC) has been assisting Ash Development (Applicant) with a Mitigation Plan for the proposed stream restoration and mixed-use development of a 10.93-acre site located at 2902, 13102, and 3104 East Pioneer Avenue and 813, 901, and 911 Shaw Road East in the City of Puyallup, Pierce County, Washington. The subject property consists of seven parcels situated in the Southeast ¼ of Section 26 and the Northeast ¼ of Section 35, Township 20 North, Range 4 East, W.M. (Pierce County Tax Parcel Numbers 0420264021, 0420264053, 0420264054, 0420351030, 0420351029, 0420351026 & 0420351066).

The subject property was previously investigated by John Comis Associates, LLC in 2008, 2009, and 2020 for the presence of potentially regulated wetlands, waterbodies, and fish and wildlife habitat conservation areas, with follow-up investigations in 2020 to verify initial findings. More recently, Habitat Technologies investigated the site in 2021 and again in 2022. Using current methodology, John Comis Associates (2020) and Habitat Technologies (2021) confirmed the absence of onsite wetlands. However, Habitat Technologies identified two streams on the eastern and northern portions of the site and one potential wetland offsite to the east of the site. Habitat Technologies later treated the potential wetland offsite to the east of the site as a wetland; however, no wetland hydrology indicators were observed during a summer site investigation (Habitat Technologies, 2022). The east stream (herein referred to as Stream Y) is classified as a Type IV water and the north stream (herein referred to as Stream Z) is classified as a Type III water per Puyallup Municipal Code (PMC) 21.06.1010(3)(a). Type III streams are subject to a standard 50-foot buffer, and Type IV streams are subject to a standard 35-foot buffer per PMC 21.06.1050(2). The wetland identified offsite to the east was preliminarily classified as a Category III wetland with an associated 80-foot buffer under PMC 21.06.930(2). In addition, John Comis Associates identified and delineated one wetland (previously Wetland A, herein referred to as Wetland 1) offsite to the south, as previously delineated by Herrera Environmental Consultants in 2000. Wetland 1 was classified as a Category II wetland subject to a standard 100-foot buffer per PMC 21.06.930(2).

SVC investigated the area offsite to the east for the presence of potentially-regulated wetlands, waterbodies, fish and wildlife habitat, and/or priority habitats or species in February 2023. Using current methodology, the site investigation confirmed the absence of wetlands in the area of Habitat Technologies' preliminary wetland determination in 2022. No areas met all three required wetland delineation criteria (a predominance of hydrophytic vegetation, hydric soils, and wetland hydrology). Specifically, no wetland hydrology was observed under normal hydrologic conditions during the winter wet season when groundwater was fully recharged. No other potentially-regulated wetlands, waterbodies, or priority habitats or species were identified within 300 feet of the site. Offsite wetland determinations will be discussed in detail under separate cover. SVC conducted a joint site investigation with Washington State Department of Fish and Wildlife (WDFW) on July 19, 2023. During the site investigation, WDFW concluded that Streams Y and Z are Type F (fish habitat) streams.

The Applicant proposes a phased project to construct a mixed-use development. Phase I will include development of residential and commercial buildings, parking, utilities, stormwater infrastructure, and frontage improvements along Shaw Road East. Phase II of the project will implement the required frontage improvements along East Pioneer Avenue and expand the mixed-use development onsite. The proposed project has been carefully designed to avoid and minimize impacts to the greatest extent

feasibly by utilizing the existing disturbed upland areas onsite. During Phase I, the proposed project will avoid in-water work and locate buildings and parking areas outside of modified buffers. Work within the critical area buffers will be limited to the utility crossings of the Stream Z buffer necessary to connect to existing infrastructure, the relocation of a power pole within the Stream Z buffer necessary to support required frontage improvements along East Pioneer Avenue, work necessary to provide site access from East Pioneer Avenue, and the work needed to maintain site drainage patterns. Stormwater discharge locations are proposed to be located landward of OHW. To ensure no net loss of ecological functions from Phase I, the project proposes to provide modified stream buffers that provide an equivalent buffer area as the standard buffers required per PMC 21.06.1050(2) and to rectify temporary buffer impacts (1,345 square feet) by seeding temporarily disturbed areas with a native seed mix. The proposed modified stream buffers consist of 866 square feet of Stream Z buffer decrease and 1,030 square feet of Stream Z increase.

During Phase II of the project, required frontage improvements and the proposed Stream Z crossing for site access cannot avoid critical area impacts. Given the location of Stream Z within the existing right-of-way (ROW) of East Pioneer Avenue, shifting Stream Z south is necessary and unavoidable to provide updated sidewalk, curb gutters, and landscaping to meet current City requirements. Given the proposed mixed-use development with several apartment buildings and commercial space, one site access point from Shaw Road East is not practicable. Therefore, the existing crossing from East Pioneer Avenue will need to be upgraded and widened to provide safe site access for the new development across the realigned Stream Z; the upgraded crossing will alleviate traffic issues by aiding in vehicle circulation and splitting use between two arterials and will also allow multiple access points for safety vehicles. The crossing will be designed as a bottomless culvert to allow for fish passage. Due to the realignment of Stream Z, the onsite buffer width for the new Stream Z channel is proposed to be less than the standard 50-foot buffer for a Type III stream required per PMC 21.06.1050(2), resulting in 3,594 square feet of buffer decrease. PMC 21.06.1030(1) states that relocation of Type II, III, and IV streams are permitted when the action will result in equal of better habitat and water quality and will not diminish the flow capacity of the stream. The mitigation actions described herein demonstrate how the project is anticipated to increase ecological functions when compared to the existing degraded conditions of the streams.

To offset the necessary and unavoidable direct impacts to Stream Z during Phase II, the project proposes to restore and realign Stream Z within a reestablished, riparian corridor on the northern portion of the project area. In the existing linear, ditched alignment, Stream Z is extremely degraded as the system lacks riparian cover, habitat complexity, and floodplain function and is situated in a roadside ditch with several piped segments. The proposal will provide a highly functional stream with large woody debris, flood benches, and dense riparian plantings that will all increase the complexity and functionality of the stream system. In addition, the Applicant proposes to voluntarily restore Stream Y in a new stream channel near the eastern property boundary and to enhance buffer areas surrounding the new stream channel during Phase II. In its existing alignment, Stream Y is diverted into a stormwater pond and then piped for approximately 471 feet before discharging into Stream Z along East Pioneer Avenue. Therefore, in its current alignment, Stream Y is extremely degraded and restoring the stream channel and providing buffer enhancement will increase stream habitat availability and functions. Habitat Technologies previously described Stream Z and Stream Y as seasonal streams. The streams are tributaries to Deer Creek, which provides habitats for a number of fish species. However, prior assessments by Habitat Technologies and the Puyallup Tribe did not document fish utilization within the ditch system associated with the Pioneer Way East Corridor east of the confluence with Deer Creek (Habitat Technologies, 2022). WDFW has classified the streams as Type

F (fish habitat). The proposed project will restore and enhance 74,796 square feet of buffer surrounding Streams Y and Z. The proposed buffer restoration and enhancement will provide 14,566 square feet of additional buffer in excess of the buffer areas that would be required under the standard 50-foot buffer required for Type III stream and a standard 35-foot buffer required for a Type IV stream.

The mitigation plan will provide a comprehensive stream restoration approach with watershed-level benefits to significantly increase stream functions of two tributaries that drain to Upper Deer Creek approximately 0.25-mile offsite to the west. Upper Deer Creek drains to the Puyallup River and is a gradient accessible stream for coho, Chinook, chum, pink and steelhead and also has known trout populations. In addition, Upper Deer Creek has documented water quality issues due to the 4A listing for high levels of bacteria from fecal coliform. Downgradient of the site, the Puyallup River also has documented water quality issues due to the 303d listings for high levels of bacteria from fecal coliform, high water temperatures, and high levels of mercury; these 303d listings resulted in the development of Puyallup River Watershed Fecal Coliform Total Maximum Daily Load (TMDL) Water Quality Report and Implementation Plan (WSDOE, 2011). The Puyallup River TMDL identifies Deer Creek in the Shaw Road area near the project site as an ideal area to restore riparian habitat. Further, both streams are within mapped FEMA 100-year floodplain but currently provide de minimis flood functions due to the straightened, ditched conditions. Restoring stream and riparian habitat will improve usable fish habitat within Stream Z over time, increase sediment and pollutant filtration to improve documented water quality issues, and provide flood benches to increase hydrologic functions and flow capacity that will reduce local flooding. Therefore, the project is aligned with the Puyallup River TMDL and is anticipated to result in a net gain in ecological functions in the watershed when compared to the existing degraded conditions of the stream that will be impacted from the frontage improvements and upgraded crossing. A Conceptual Mitigation Plan is provided in Chapter 2 of this report.

The City issued a Mitigated Determination of Non-Significance (MDNS) dated June 27, 2023 (City of Puyallup, 2023b) for the proposed project's Conceptual Mitigation Plan dated April 7, 2023 and provided conditions of approval in a Final Development Review Team Letter dated June 20, 2023 (City of Puyallup, 2023a). In addition, the City issues Civil Review Comments for the proposed site plan August 31, 2023 (City of Puyallup, 2023c). The proposed site plan and mitigation plan have been updated based on the City's conditions of approval provided in the Final Development Review Team Letter, the coordination with WDFW, and the civil review comments. Most recent changes to the site plan include a reduction in the number of proposed parking stalls, relocation of two buildings to reduce impacts to the buffer of Stream Z, and the relocation of a power pole along East Pioneer Avenue further within the buffer of Stream Z to support frontage improvements along the road.

The table below identifies the critical areas and summarizes the potential regulatory status by local, state, and federal agencies.

Wetland/ Waterbody Name	City Category/ Type[1]	State Category/Type[2]	Regulated Under PMC Chapter 21.06	Regulated Under RCW 90.48	Regulated Under Clean Water Act
Wetland 1	II	II	Yes	Yes	Likely
Stream Y	Type IV	F	Yes	Yes	Likely
Stream Z	Type III	F	Yes	Yes	Likely

Note:

1. Current Washington State Department of Ecology (WSDOE) wetland rating system (Hruby, 2014) per PMC 21.06.910(3); stream definitions per PMC 21.06.1010(3)(a) and Habitat Technologies (2021).
2. Current Washington State Department of Ecology (WSDOE) wetland rating system (Hruby, 2014) per PMC 21.06.910(3); stream classifications per Washington Administrative Code (WAC) 222-16-030.

The table below identifies the proposed stream impacts.

Stream	City Type[1]	State Type[2]	Impact Type	Impact Area
Z	Type III	Type F	Direct	592 LF

Note:
1. Stream definitions per PMC 21.06.1010(3)(a) and Habitat Technologies (2021).
2. Stream classification per Washington Administrative Code (WAC) 222-16-030.

The summary table below identifies linear feet of stream segments in the project area pre- and post-development.

Stream	City Type[1]	State Type[2]	Condition	Existing	Proposed
Y	IV	F	Open Channel	110 LF	463 LF
			Culvert	471 LF	0 LF
			Total	**581 LF**	**463 LF**
Z	III	F	Open Channel	465 LF	475 LF
			Culvert	127 LF	138 LF
			Total	**592 LF**	**613 LF**

Note:
1. Stream definitions per PMC 21.06.1010(3)(a) and Habitat Technologies (2021).
2. Stream classification per Washington Administrative Code (WAC) 222-16-030.

Site Map

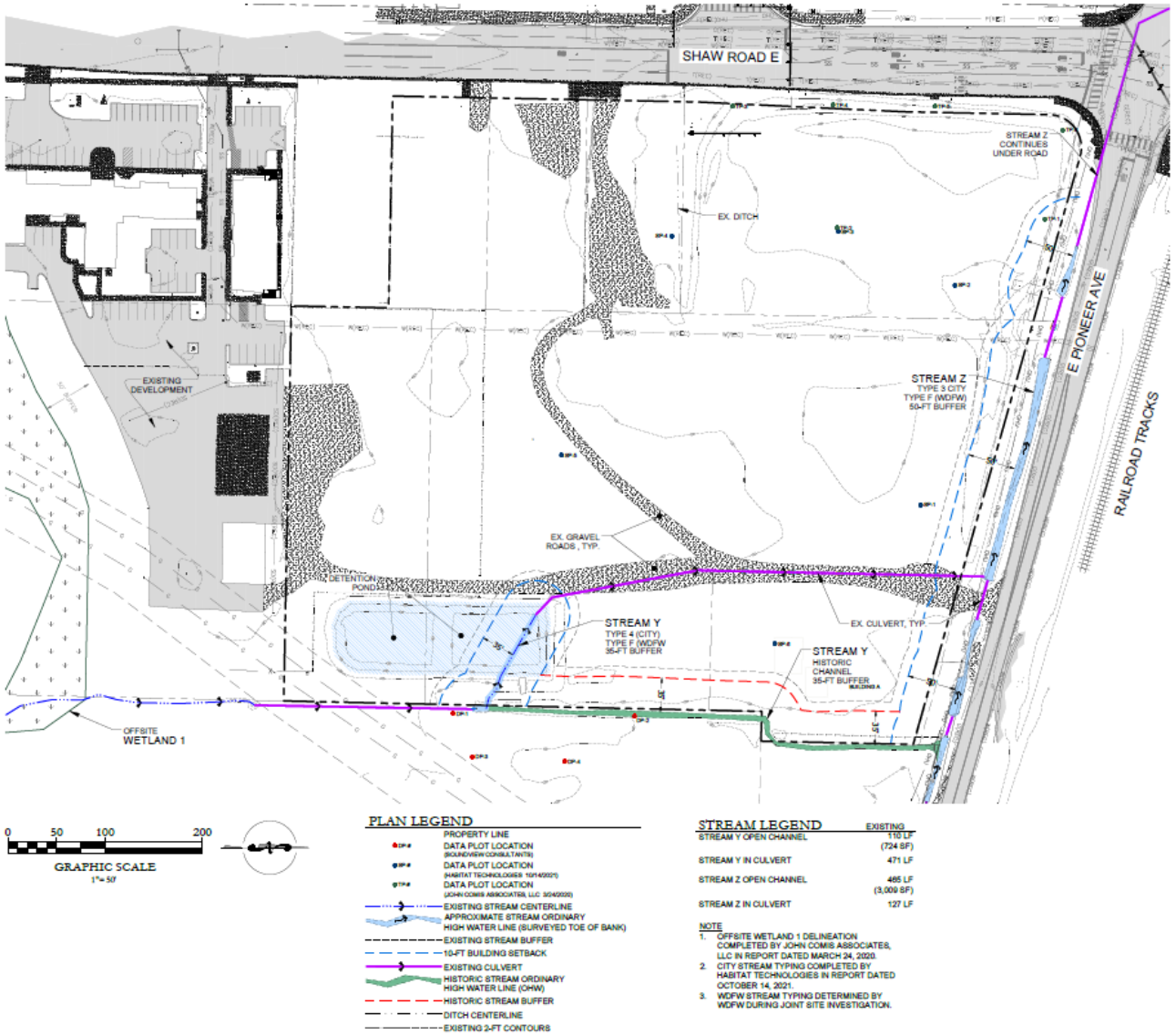

SHAW ROAD E
STREAM Z CONTINUES UNDER ROAD
EX. DITCH
E PIONEER AVE
RAILROAD TRACKS
EXISTING DEVELOPMENT
STREAM Z
TYPE 5 CITY
TYPE F (WDFW)
50-FT BUFFER
EX. GRAVEL ROADS, TYP.
DETENTION POND
STREAM Y
TYPE 4 (CITY)
TYPE F (WDFW
35-FT BUFFER
EX. CULVERT, TYP.
STREAM Y
HISTORIC
CHANNEL
35-FT BUFFER
OFFSITE WETLAND 1
0 50 100 200
GRAPHIC SCALE
1" = 50'
PLAN LEGEND
PROPERTY LINE
DATA PLOT LOCATION (SOUNDVIEW CONSULTANTS)
DATA PLOT LOCATION (HABITAT TECHNOLOGIES 10/14/2021)
DATA PLOT LOCATION (JOHN COMIS ASSOCIATES, LLC 3/24/2020)
EXISTING STREAM CENTERLINE
APPROXIMATE STREAM ORDINARY HIGH WATER LINE (SURVEYED TOE OF BANK)
EXISTING STREAM BUFFER
10-FT BUILDING SETBACK
EXISTING CULVERT
HISTORIC STREAM ORDINARY HIGH WATER LINE (OHW)
HISTORIC STREAM BUFFER
DITCH CENTERLINE
EXISTING 2-FT CONTOURS
STREAM LEGEND
EXISTING
STREAM Y OPEN CHANNEL 110 LF (724 SF)
STREAM Y IN CULVERT 471 LF
STREAM Z OPEN CHANNEL 465 LF (3,009 SF)
STREAM Z IN CULVERT 127 LF
NOTE
1. OFFSITE WETLAND 1 DELINEATION COMPLETED BY JOHN COMIS ASSOCIATES, LLC IN REPORT DATED MARCH 24, 2020.
2. CITY STREAM TYPING COMPLETED BY HABITAT TECHNOLOGIES IN REPORT DATED OCTOBER 14, 2021.
3. WDFW STREAM TYPING DETERMINED BY WDFW DURING JOINT SITE INVESTIGATION.

Table of Contents

Tables

Appendices

Chapter 1. Regulatory Considerations

The proposed project utilizes a combination of prior referenced critical area reports and current site investigations for a complete determination of identified critical areas. John Comis Associates (2020) established the presence of offsite Wetland 1 (previously referred to as Wetland A) south of the subject property. Most recently, Habitat Technologies (2021) confirmed the absence of onsite wetlands and the presence of two onsite streams (Streams Y and Z) on the eastern and northern portions of the site, respectively. A copy of the prior referenced critical areas report is provided under separate cover. In addition, SVC's site investigation in February 2023 confirmed the absence of offsite wetlands to the east of the subject property. No other potentially-regulated wetlands, waterbodies, fish and wildlife habitat, or priority habitats or species were identified within 300 feet of the site during the site investigations.

1.1 Local Considerations

1.1.1 Buffer Standards

PMC 21.06.910(3) has adopted the current wetland rating system for western Washington (Hruby, 2014). Category II wetlands provide a high level of function and ecological characteristics. Wetland 1 was identified offsite to the south of the subject property by John Comis Associates (2020). Wetland 1 was classified as a Category II wetland subject to a standard 100-foot buffer per PMC 21.06.930(2). The buffer associated with Wetland 1 does not project onsite.

Habitat Technologies (2021) identified two streams on the eastern and northern portions of the site. The east stream (Stream Y) is classified as a Type IV water and the north stream (Stream Z) is classified as a Type III water per PMC 21.06.1010(3)(a). Type III streams are subject to a standard 50-foot buffer, and Type IV streams are subject to a standard 35-foot buffer per PMC 21.06.1050(2).

A building setback of 10 feet is required for all buildings and structures from the edges of all critical area buffers per PMC 21.06.840.

1.1.2 Mitigation Sequencing

The Applicant proposes necessary and unavoidable direct impacts to Stream Z. Under PMC 21.06.1020(1) and PMC 21.06.1080, adverse impacts to riparian and non-riparian habitats shall be fully mitigated in accordance with the standards set forth in PMC 21.06.610. Per PMC 21.06.610(1), when an alteration to a critical area is proposed, the applicant shall demonstrate that all reasonable efforts have been taken to avoid, minimize, or compensate for impacts in that order with the mitigation definition contain in PMC 21.06.210(84).

a) Avoiding the impact altogether by not taking a certain action or parts of actions.

The Applicant proposes a phased project to construct a mixed-use development. Phase I will include development of residential and commercial buildings, parking, utilities, stormwater infrastructure, and frontage improvements along Shaw Road East. Phase II of the project will implement the required frontage improvements along East Pioneer Avenue and Stream Z crossing and expand the mixed-use development onsite.

The proposed project has been carefully designed to avoid and minimize impacts to the greatest extent feasibly by utilizing the existing disturbed upland areas onsite. During Phase I, the proposed project will avoid in-water work (i.e. work below OHW) and locate buildings and parking areas outside of modified buffers. To provide a reasonable site and building layout on the northwest corner of the site, the project proposes decreasing a portion of the Stream Z buffer width below the standard 50-foot buffer for a Type III stream required per PMC 21.06.1050(2). Work within the modified critical area buffers will be limited to the utility crossings of the Stream Z buffer necessary to connect to existing infrastructure, the relocation of a power pole within the Stream Z buffer necessary to support required frontage improvements along East Pioneer Avenue, work necessary to provide site access from East Pioneer Avenue, and the work needed to maintain site drainage patterns. Stormwater discharge locations are proposed to be located landward of OHW.

During Phase II of the project, required frontage improvements and the proposed stream crossing for site access cannot avoid critical area impacts. Given the location of Stream Z within the exiting right-of-way (ROW) of East Pioneer Avenue, shifting Stream Z south is also necessary and unavoidable to provide updated sidewalk, curb gutters, and landscaping to meet current City requirements. Due to the shifting of Stream Z to the south, the proposed site layout will result in a variable buffer width along the new Stream Z channel that is less than the standard 50-foot buffer width for a Type III stream specified under PMC 21.06.1050(2).

Given the proposed mixed-use development with several apartment buildings and commercial space, one site access point from Shaw Road East is not practicable. Therefore, the existing crossing from East Pioneer Avenue will need to be upgraded and widened to provide safe site access for the new development; this site access will alleviate traffic issues by aiding in vehicle circulation and splitting use between two arterials and will also allow multiple access points for safety vehicles. PMC 21.06.1030(1) states that relocation of Type II, III, and IV streams are permitted when the action will result in equal of better habitat and water quality and will not diminish the flow capacity of the stream; the mitigation actions described herein demonstrate how the project is anticipated to increase ecological functions when compared to the existing degraded conditions of the streams.

The project avoids direct impacts and take of listed threated or endangered species per PMC 21.06.1020(4) as no threatened or endangered species are present in the project area.

b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

During Phase I, the proposed project has minimized impacts by avoiding in-water work, locating buildings and parking areas outside of modified buffer widths for the existing stream alignments and incorporating an underground stormwater vault that avoids the need for an above ground detention facility.

The site plan has also been revised to reduce the number of proposed parking stalls and relocated two buildings in proximity to Stream Z, reducing stream buffer impacts and allowing for and increased buffer width between Stream Z and the proposed development during Phase II. During Phase II, the proposed direct impacts to Stream Z are the minimum necessary to provide the required frontage improvements and upgrade the existing crossing from East Pioneer Avenue for safe site access. The upgraded crossing will consist of a bottomless, fish-passable, culvert. To

accommodate future potential fish passage along Stream Z at the request of WDFW, the project proposes to install a box culvert to connect the new Stream Z channel to the existing downgradient piped Stream Z. Appropriate BMPs and TESC measures will be implemented for the duration of project activities to minimize potential construction impacts. The stream relocation work will be completed in the dry season when hydrology is either absent or minimal to limit temporary turbidity.

c) *Rectifying impacts by repairing, rehabilitating, or restoring the affected environment.*

During Phase I, the proposed project will rectify the temporary Stream Z buffer impacts by replanting temporarily impacted areas with a native seed mix. To rectify the proposed Stream Z buffer decrease below standard buffer width, the project proposes to add additional buffer area to provide an equivalent buffer area as the standard buffer required per PMC 21.06.1050(2). The proposed modified stream buffers consist of 866 square feet of Stream Z buffer decrease and 1,030 square feet of Stream Z increase.

To offset the necessary and unavoidable direct impacts to Stream Z during Phase II, the project proposes to restore and realign Stream Z within a reestablished riparian corridor on the northern portion of the project area. In the existing linear, ditched alignment, Stream Z is extremely degraded as the system lacks riparian cover, habitat complexity, and floodplain function and is situated in a roadside ditch with several piped segments. The proposal will provide a protected riparian corridor with a highly functional stream with large woody debris, flood benches, and dense riparian plantings that will all increase the complexity and functionality of the stream system. In addition, the Applicant proposes to voluntarily restore Stream Y to a new, offsite stream channel near the east property boundary and to enhance and restore the surrounding buffer during Phase II. In its existing alignment, Stream Y is diverted into a stormwater pond and then piped for approximately 471 feet before discharging into Stream Z along East Pioneer Avenue. Therefore, in its current alignment, Stream Y is extremely degraded and daylighting and creating a new stream channel will increase stream habitat availability and functions. The restored stream channels are proposed to be protected by 74,796 square feet of buffer, exceeding the buffer area that would result from a standard application of a 35-foot buffer to a Type IV stream and 50-foot buffer to a Type III stream by 14,566 square feet.

The mitigation plan will provide a comprehensive stream restoration approach with watershed-level benefits to significantly increase stream functions of two tributaries that drain to Upper Deer Creek approximately 0.25-mile offsite to the west. Upper Deer Creek drains to the Puyallup River and is a gradient accessible stream for coho, Chinook, chum, pink and steelhead and also has known trout populations. In addition, Upper Deer Creek has documented water quality issues due to the 4A listing for high levels of bacteria from fecal coliform. Downgradient of the site, the Puyallup River also has documented water quality issues due to the 303d listings for high levels of bacteria from fecal coliform, high water temperatures, and high levels of mercury; these 303d listings resulted in the development of Puyallup River Watershed Fecal Coliform Total Maximum Daily Load (TMDL) Water Quality Report and Implementation Plan (WSDOE, 2011). The Puyallup River TMDL identifies Deer Creek in the Shaw Road area near the project site as an ideal area to restore riparian habitat. Further, both streams are within mapped FEMA 100-year floodplain but currently provide de minimis flood functions due to the straightened, ditched conditions. Restoring stream and riparian habitat will improve usable fish habitat within Stream Z over time, increase sediment and pollutant filtration to improve documented water quality

issues, and provide flood benches to increase hydrologic functions and flow capacity that will reduce local flooding. Therefore, the project is aligned with the Puyallup River TMDL, will result in equal or better habitat and water quality per PMC 21.06.1030(1), and is anticipated to result in a net gain in ecological functions in the watershed per PMC 21.06.1080(3) when compared to the existing degraded conditions of the stream that will be impacted from the frontage improvements and upgraded crossing.

d) Reducing or eliminating an impact over time by preservation and maintenance operations during the life of the action.

The stream restoration areas created during Phase II will be monitored for a period of up to 10 years to ensure success of the mitigation actions over time. In addition, the mitigation areas will be placed in a separate tract or dedicated to the City as a permanent protective mechanism per PMC 21.06.610(7) and PMC 21.06.830. Fencing and signage will also be provided per PMC 21.06.810 to reduce intrusion into the critical areas and prevent future impacts to the critical areas.

e) Compensating for an impact by replacing or providing substitute resources or environments.

See response to criterion C above. During Phase I, the proposed Stream Z buffer decrease will be compensated through the addition of buffer area. During Phase II, the unavoidable direct stream impacts will be compensated through onsite and offsite, in-kind stream creation mitigation measures. The project will ensure no net loss of area under PMC 21.06.1080(3) and PMC 21.06.610(2) by providing buffer enhancement and a minimum 1:1 ratio of creation to impacts to achieve equivalent or greater functions for Stream Z per PMC 21.06.1080(2). The mitigation will result in no net loss of ecological functions when compared to the existing degraded condition of the stream proposed to be impacted.

f) Monitoring the mitigation and taking remedial action when necessary.

The stream mitigation and voluntary restoration areas created during Phase II will be monitored for a period of 10 years to ensure success of the actions over time, consistent with PMC 21.06.630. Appropriate contingency measures will be implemented if monitoring indicates that goals and performance standards of the mitigation plan are not being met.

1.1.3 Performance Standards – Alteration of Streams and Riparian Habitats

PMC 21.06.1030 outlines standards for allowed alterations to streams and associated riparian habitats. Necessary and unavoidable stream impacts are required for frontage improvements, upgrading an existing crossing from East Pioneer Avenue for additional site access, and providing power to the property.

PMC 21.06.1030(2) states the following for proposed bridges/culverts:

> *Bridges are the preferred crossing for fish-bearing streams. Culverts are allowed only in Type II, III, and IV streams; provided, that they are designed according to the Washington Department of Fish and Wildlife criteria for fish passage, are necessary for utility crossings, road crossings, or other limited access situations, and are in accordance with a state Hydraulic Project Approval permit. The applicant or property owner shall keep any culvert free of debris and sediment at all times to allow free passage of water and, if applicable, fish. The city may require that a stream be removed from a culvert as a condition of approval, unless the culvert is not detrimental to fish habitat or water quality, or removal would be detrimental to fish or wildlife habitat or water quality.*

The proposed crossing will be in accordance with the most recent WDFW crossing design criteria for fish passage, and the Applicant will apply for a Hydraulic Project Approval (HPA) from WDFW. The crossing is essential for providing necessary site access. Having two site access points is required by City development standards and will alleviate traffic issues by aiding in vehicle circulation and splitting use between two arterials and will also allow multiple access points for safety vehicles. The new/upgraded crossing will be bottomless to allow free passage of water. The bottomless crossing will be monitored to ensure that it functions as intended over time.

PMC 21.06.1030(6) states that utility lines may be permitted to cross streams and riparian habitat areas subject to the following standards:

a) *Impacts to fish and wildlife shall be avoided to the maximum extent possible;*

   The proposed utility installations are necessary to connect to existing infrastructure and to maintain existing site drainage patterns. In addition, the relocation of an existing power pole adjacent to Stream Z further within the stream buffer is necessary to support frontage improvements. During Phase I, the project proposes to install a new power drop, consisting of a transformer box and electrical line within the existing Stream Z buffer. The new power drop will connect to an existing power line along East Pioneer Avenue; the proposed transformer box and electrical line will be located as near to an existing power pole as feasible to minimize the length of electrical line in the buffer. As documented in the Conceptual Mitigation Plan dated April 7, 2023, the project previously proposed to install a stormwater line in the Stream Z buffer during Phase I to connect to an existing pipe adjacent to East Pioneer Avenue using a manhole. The proposed stormwater discharge from the site has been redesigned to avoid the manhole connection as requested by WDFW. The proposed stormwater discharge will release treated and detained runoff into the Stream Z buffer. The discharge infrastructure is anticipated to consist of temporary release points during Phase I that will be replaced with a permanent discharge infrastructure during Phase II. The power pole proposed to be relocated is an existing impact within the stream buffer and will result only in new temporary impacts that will be fully restored.

b) *Installation shall be accomplished by boring beneath the scour depth and hyporheic zone of the water body and channel migration zone, where feasible;*

   The proposed stormwater discharge location and power pole relocation will be located landward of the Stream Z OHW. The proposed transformer box will be located within the existing Stream Z buffer; the proposed electrical line will cross a piped section of the existing and proposed Stream Z alignments. Due to the presence of piped stream sections, boring beneath the scour depth and hyporheic zone of the water body is not applicable.

c) *The utilities shall cross at an angle greater than 60 degrees to the centerline of the channel in streams or perpendicular to the channel centerline whenever boring under the channel is not feasible;*

   No stormwater crossing of the stream channel is proposed. The proposed transformer box and relocated power pole will be located within the existing Stream Z buffer; the proposed electrical line will cross a piped section of the existing and proposed Stream Z alignments.

d) *Crossings shall be contained within the footprint of an existing road or utility crossing where possible;*

The proposed stormwater discharge location has been revised as requested by WDFW to avoid a manhole connection to an existing pipe conveying Stream Z waters downgradient of the site. The proposed stormwater discharge location will be located landward of the Stream Z OHW and is designed to maintain existing site drainage patterns given the site grading.

No power crossings currently existing along East Pioneer Avenue and crossing location is limited by the proximity of adjacent power poles.

e) *The utility route shall avoid paralleling the stream or following a down-valley course near the channel where feasible; and*

The proposed stormwater discharge and electric utilities will be perpendicular to the stream to the extent feasible. In addition, the existing buffer conditions are degraded and temporary impacts are proposed to be restored using a native seed mix.

f) *The utility installation shall not increase or decrease the natural rate of channel migration.*

The proposed utility crossings will not disturb the new stream channel and will not increase or decrease the rate of channel migration.

1.2 State Considerations

The identified streams and offsite wetland are also likely to be regulated as natural surface waters by the WSDOE under the Revised Code of Washington (RCW) 90.48.

RCW 77.55 requires that in-water work requires Hydraulic Project Approval (HPA) from WDFW. WDFW conducted a joint site investigation with SVC on July 19, 2023. During the joint site investigation, WDFW determined that Streams Z and Y were Type F (fish habitat) streams based on the field observations and prior WDFW fish passage inventory assessment notes.

1.3 Federal Considerations

On January 18, 2023, USACE and EPA published a revised definition of "Waters of the United States." The revised rule becomes effective on March 20, 2023. Under the 2023 revised rule, Waters of the United States is described as follows (USACE and EPA, 2023):

(a) Waters of the United States means:

(1) Waters which are: (i) Currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (ii) The territorial seas; or (iii) Interstate waters, including interstate wetlands;

(2) Impoundments of waters otherwise defined as waters of the United States under this definition, other than impoundments of waters identified under paragraph (a)(5) of this section;

(3) Tributaries of waters identified in paragraph (a)(1) or (2) of this section: (i) That are relatively permanent, standing or continuously flowing bodies of water; or (ii) That either alone or in combination with similarly situated waters in the region, significantly affect the chemical, physical, or biological integrity of waters identified in paragraph (a)(1) of this section;

(4) Wetlands adjacent to the following waters: (i) Waters identified in paragraph (a)(1) of this section; or (ii) Relatively permanent, standing or continuously flowing bodies of water identified in paragraph (a)(2) or (a)(3)(i) of this section and with a continuous surface connection to those waters; or (iii) Waters identified in paragraph (a)(2) or (3) of this section when the wetlands either alone or in combination with similarly situated waters in the region, significantly affect the chemical, physical, or biological integrity of waters identified in paragraph (a)(1) of this section;

(5) Intrastate lakes and ponds, streams, or wetlands not identified in paragraphs (a)(1) through (4) of this section: (i) That are relatively permanent, standing or continuously flowing bodies of water with a continuous surface connection to the waters identified in paragraph (a)(1) or (a)(3)(i) of this section; or (ii) That either alone or in combination with similarly situated waters in the region, significantly affect the chemical, physical, or biological integrity of waters identified in paragraph (a)(1) of this section.

Wetland 1 appears hydrologically connected to Stream Y. Streams Y and Z are relatively permanent tributaries that discharge into Upper Deer Creek and eventually the Puyallup River, a traditional navigable water. Therefore, the identified critical areas are likely jurisdictional under the Clean Water Act. The project proposal assumes that the USACE will assert jurisdiction over the identified streams and wetland. On May 25, 2023, the U.S. Supreme Court issued a decision affecting the definition of Waters of the United States in Sackett Et Ux. V Environmental Protection Agency Et Al. While USACE is in receipt of the Supreme Court decision, no formal, revised definition of Waters of the United States has been issued at the time of this report drafting. The proposed project therefore continues to assume that the identified streams and wetland are considered Waters of the United States.

Chapter 2. Conceptual Mitigation Plan

The proposed compensatory mitigation actions for the project attempt to strike a balance between achieving project goals as well as a positive ecological result. In general, joint USACE and EPA rules have been established that require more careful mitigation planning efforts utilizing a watershed approach in site selection (USACE & EPA, 2008). The proposed impacts and mitigation actions attempt to closely adhere to these rules and to the local critical areas regulations specified in PMC Chapter 21.06 and local watershed planning and restoration documents. This chapter presents the mitigation details for the proposed mixed-use project.

The Applicant will submit any proposed substantial changes to the project or mitigation plan, such as significant changes to the amount, location, or design of mitigation; the goals, benchmarks, or performance standards; the monitoring or adaptive management provisions, to WSDOE for review and approval prior to implementation. Minor changes, such as alterations to the species listed in the planting plan, will be documented in the as-built report.

2.1 Purpose and Need

The purpose of the proposed project is to provide a mixed-use development that will help alleviate the shortage of housing in the greater Seattle area and expand the local economy by providing new services to the area through available commercial space.

2.2 Description of Impacts

The Applicant proposes a phased project to construct a mixed-use development. Phase I will include development of residential and commercial buildings, parking, utilities, stormwater infrastructure, and frontage improvements along Shaw Road East. Phase II of the project will implement the required frontage improvements along East Pioneer Avenue and expand the mixed-use development onsite. The proposed project has been carefully designed to avoid and minimize impacts to the greatest extent feasibly by utilizing the existing disturbed upland areas onsite. During Phase I, the proposed project will avoid in-water work and locate buildings and parking areas outside of modified buffers. Work within the critical area buffers will be limited to the utility crossings of the Stream Z buffer necessary to connect to existing infrastructure, the relocation of a power pole within the Stream Z buffer necessary to support required frontage improvements along East Pioneer Avenue, work necessary to provide site access from East Pioneer Avenue, and the work needed to maintain site drainage patterns. Stormwater discharge locations are proposed to be located landward of OHW. During Phase II of the project, required frontage improvements and the proposed Stream Z crossing for site access cannot avoid critical area impacts. Mitigation sequencing for the proposed project is provided under Section 1.1.2 Mitigation Sequencing.

Under Phase I, approximately 1,345 square feet of temporary impacts to the existing Stream Z buffer are proposed are anticipated to install the power drop, which will consist of a transformer box and electrical line, and to relocate an existing power pole adjacent to East Pioneer Avenue to support required frontage improvements.

Under Phase II, the project requires the complete fill and relocation of 592 linear feet of the Stream Z channel to provide City-required frontage improvements. A crossing of the proposed, realigned

Stream Z channel is required to provide safe site access, allow multiple points of access for emergency vehicles, and alleviate traffic congestion by aiding in vehicle circulation and splitting use between two arterials. Due to the realignment of Stream Z, the onsite buffer width for the new stream channel will be less than the standard 50-foot buffer for a Type III stream required per PMC 21.06.1050(2), resulting in 3,594 square feet of buffer decrease. The site plan has recently been revised to reduce the number of proposed parking stalls and relocate two buildings on the northwest portion of the subject property, minimizing the proposed buffer decrease. Temporary construction impacts may also occur but will be minimized to the greatest extent feasible with the implementation of all appropriate BMPs and TESC measures.

The Applicant proposes to voluntarily restore Stream Y within a new stream channel near the east property boundary and to enhance and restore a buffer surrounding the stream channel. The proposed beneficial realignment of Stream Y may also result in temporary stream impacts. Habitat Technologies previously described Stream Z and Stream Y as seasonal streams. The streams are tributaries to Deer Creek, which provides habitats for a number of fish species. However, prior assessments by Habitat Technologies and the Puyallup Tribe did not document fish utilization within the ditch system associated with the Pioneer Way East Corridor east of the confluence with Deer Creek (Habitat Technologies, 2022). During the joint site investigation with WDFW, WDFW characterized Streams Y and Z as Type F (fish habitat) streams.

2.2.1 Permanent Stream Impacts

In the existing linear, ditched alignment, Stream Z is extremely degraded as the system is situated in a roadside ditch with several piped segments and lacks riparian cover, habitat complexity, and floodplain function. The stream consists of one long run that lacks pool and riffle sequences. The stream along the majority of its length is choked with non-native, invasive reed canarygrass, which reduces water velocity and creates low levels of dissolved oxygen due to the stagnant conditions and die-off of vegetative material. The majority of the onsite stream channel will be permanently filled, and portions of the stream piped will be modified pre- and post-development based on frontage improvement requirements and existing conditions. The proposed stream relocation will result in a permanent loss of existing degraded habitat. Refer to Appendix C for photographs of Stream Z in its existing degraded condition.

A summary of impacted streams is provided in Table 1 below.

Table 1. Stream Impact Summary

Stream	City Type[1]	State Type[2]	Impact Type	Impact Area
Z	Type III	Type F	Direct	592 LF

Notes:
1. Stream definitions per PMC 21.06.1010(3)(a) and Habitat Technologies (2021).
2. Stream typing per Washington Administrative Code (WAC) 222-16-030.

2.2.1 Temporary Stream Impacts

To minimize temporary impacts, stream relocation activities will occur in the summer during low stream flow or dry conditions. Dewatering activities associated with the realignment of Stream Z and restoration of Stream Y are not anticipated to significantly impact fish and other aquatic vertebrate

species potentially present in the channels at the time of construction given the timeline of construction in the summer months when hydrology is minimal and with all appropriate BMPs and TESC measures in place.

If water is present in the existing stream channels prior to realignment, then fish exclusion, capture and relocation actions and water quality monitoring actions will be implemented. Temporary turbidity increases within the new stream channels of Streams Y and Z are likely to occur during the rewatering of the new stream channels. Rewatering within the new channels is not anticipated to be completed in more than one segment for each stream separately. The Washington Administrative Code (WAC) 173-201A-200(1)(e) makes allowances for a temporary area of mixing during and immediately after in-water construction activities subject to the constraints of WAC 173-201A-400(4) and (6). For waters less than or equal to 10 cfs flow at the time of construction, the point of compliance shall be 100 feet downstream of the action. Water quality monitoring will be completed to evaluate compliance during rewatering, and fish exclusion nets will remain in place until suspended sediment levels match the point of compliance. The proposed fish exclusion and sediment controls are anticipated to lead to an avoidance or significant reduction in direct fish exposure to elevated suspended sediments if fish are present in the streams. A Water Quality Monitoring Plan has been prepared under separate cover. A Fish Protection and Exclusion Plan will be prepared under separate cover if requested by regulatory agencies.

2.3 Stream and Riparian Mitigation Strategy

2.3.1 Phase I

1,345 square feet of temporary impacts to the existing Stream Z buffer resulting from the power drop (e.g. transformer box and electric line) will be restored through reseeding of the existing degraded buffer using a native seed mix. 1,030 of Stream Z buffer area will be added to offset the impacts to 866 square feet of buffer.

2.3.2 Phase II

The compensatory mitigation actions outlined herein are intended to compensate for lost stream functions and values by providing an overall improvement in water quality, hydrologic, and habitat functions according to the needs of the site, local sub-basin, and overall Puyallup River watershed. The unavoidable direct stream impacts will be compensated through onsite and offsite, in-kind stream creation mitigation measures. The project will ensure no net loss of area under PMC 21.06.1080(3) and PMC 21.06.610(2) by providing a minimum 1:1 stream creation to impact ratio to achieve equivalent or greater Stream Z functions per PMC 21.06.1080(2) (Table 2). To offset the necessary and unavoidable direct impacts to Stream Z, the project proposes to restore and realign Stream Z within a reestablished riparian corridor on the northern portion of the project area. Voluntary restoration of Stream Y will occur through realignment of the stream through a new stream channel that is located immediately offsite adjacent to the eastern property boundary and buffer restoration and enhancement. 74,796 square feet of buffer enhancement and restoration is proposed to protect the realigned Streams Y and Z.

In the existing linear, ditched alignment, Stream Z is extremely degraded as the system lacks riparian cover, habitat complexity, and floodplain function and is situated in a roadside ditch with several piped segments. The proposal will provide a protected riparian corridor with a highly functional stream with

large woody debris, flood benches, and dense riparian plantings that will all increase the complexity and functionality of the stream system. In addition, the Applicant proposes to restore Stream Y to a new stream channel immediately offsite adjacent to the eastern property boundary and restore and enhance the stream buffer. In its existing alignment, Stream Y overflows into a stormwater pond and is then piped for approximately 471 feet before discharging into Stream Z along East Pioneer Avenue. The proposed realignment of Stream Y will daylight the stream, increasing functional stream habitat (Table 2). Table 2 quantifies the length and condition of stream segments onsite pre- and post-development.

Table 2. Summary of Stream Segments Pre- and Post-Development

Stream	City Type[1]	State Type[2]	Condition	Existing	Proposed
Y	IV	F	Open Channel	110 LF	463 LF
			Culvert	471 LF	0 LF
			Total	**581 LF**	**463 LF**
Z	III	F	Open Channel	465 LF	475 LF
			Culvert	127 LF	138 LF
			Total	**592 LF**	**613 LF**

Notes:

1. Stream definitions per PMC 21.06.1010(3)(a) and Habitat Technologies (2021).
2. Stream typing per Washington Administrative Code (WAC) 222-16-030.

The mitigation plan will provide a comprehensive stream restoration approach with watershed-level benefits to significantly increase stream functions of two tributaries that drain to Upper Deer Creek approximately 0.25-mile offsite to the west. Upper Deer Creek drains to the Puyallup River and is a gradient accessible stream for coho, Chinook, chum, pink and steelhead and also has known trout populations. In addition, Upper Deer Creek has documented water quality issues due to the 4A listing for high levels of bacteria from fecal coliform. Downgradient of the site, the Puyallup River also has documented water quality issues due to the 303d listings for high levels of bacteria from fecal coliform, high water temperatures, and high levels of mercury; these 303d listings resulted in the development of Puyallup River Watershed Fecal Coliform Total Maximum Daily Load (TMDL) Water Quality Report and Implementation Plan (WSDOE, 2011). The Puyallup River TMDL identifies Deer Creek in the Shaw Road area near the project site as an ideal area to restore riparian habitat. Further, both streams are within mapped FEMA 100-year floodplain but currently provide de minimis flood functions due to the straightened, ditched conditions. Restoring stream and riparian habitat will improve usable fish habitat within the streams over time, increase sediment and pollutant filtration to improve documented water quality issues, and provide flood benches to increase hydrologic functions and flow capacity that will reduce local flooding. Therefore, the project is aligned with the Puyallup River TMDL, will result in equal or better habitat and water quality per PMC 21.06.1030(1), and is anticipated to result in a net gain in ecological functions in the watershed per PMC 21.06.1080(3) when compared to the existing degraded conditions of the stream that will be impacted from the frontage improvements and upgraded crossing.

"Pilot channels" will be created for the new Streams Z and Y that will naturally scour to create a sinuous stream with pool and riffle structure. Creating a pilot channel allows the stream to naturally form within the constructed bankfull width. The restored Stream Z channel will connect to the existing downgradient piped stream infrastructure with a box culvert. The restored stream channels will consist of meandering channels with connected flood terrace habitats within a riparian corridor containing native forest, shrub, and herbaceous plant communities. The stream creation will provide

gradual side slopes above the OHWM and created flood terraces. Large woody debris will be incorporated along the realigned and restored stream channels for additional habitat complexity and provide cover for aquatic wildlife. The proposed Stream Z and Stream Y upland buffers will also be restored and enhanced to provide sediment and pollutant filtration, reduction of surface flows, and habitat interspersion and complexity beneficial to urban fauna. Once established, the riparian habitat corridor will provide immediate and long-term benefits for terrestrial and aquatic wildlife and provide cool, clean, and clear water from the native plantings, which will increase stream shading, stormwater filtration, and wood recruitment as well as decreased streambank erosion.

The proposed native plant communities will be established according to location relative to the stream channels and topographic position within the remaining riparian corridor buffer areas. Tree and shrub plantings are proposed. Willows (*Salix* spp.) will dominate the banks of the stream channels to provide bank stability and shading. The proposed native species have been carefully selected according to indicator status and local vegetation observations to ensure the plants take root and thrive in the newly created riparian corridor. Given the limited space within the riparian corridor, smaller trees will be proposed to maximize use and plant quantities within the area to ensure dense screening and protections to Streams Y and Z. With establishment of the protective riparian corridor, fencing and signage around the entire sensitive areas tracts, and implementation of the required monitoring and maintenance actions, the mitigation areas are projected to be highly functional, persistent, and successful.

The proposed actions include, but are not limited to, the following:

- Install bottomless culvert crossing of the new Stream Z channel and box culvert to connect the new Stream Z channel to the existing piped stream infrastructure;
- Realign and restore Stream Z within a new riparian corridor;
- Realign and restore Stream Y within a new riparian corridor;
- Pre-treat invasive plants with an herbicide approved by the Washington State Department of Agriculture for use in aquatic areas. After pre-treatment, grub to remove the invasive plants and replant all cleared areas with native trees, shrubs, and ground covers listed in Appendix A; Pre-treatment of the invasive plants should occur a minimum of two weeks prior to removal;
- Replant all impacted areas with native trees, shrubs, and groundcovers listed in Appendix A, or substitutes approved by the responsible Project Scientist, to help retain soils, filter stormwater, and increase biodiversity;
- Install large woody debris habitat features within the realigned Stream Z channel and restored Stream Y channel;
- An approved native seed mix will be used to seed the disturbed mitigation areas after planting to reduce short-term erosion potential;
- Maintain and control invasive plants annually, at a minimum, or more frequently if necessary. Maintenance to reduce the growth and spread of invasive plants is not restricted to chemical applications but may include hand removal, if warranted;
- Provide dry-season irrigation as necessary to ensure native plant survival;
- Install split-rail fencing and critical area signage at the locations indicated in Appendix A;
- Store all construction equipment and materials outside of the critical areas and associated buffers;

- Direct exterior lights away from the streams and buffers wherever possible; and
- Place all activities that generate excessive noise (e.g., generators and air conditioning equipment) away from the streams and buffers where feasible.

2.4 Approach and Best Management Practices

Planting or seeding will occur immediately after grading is complete to the extent practicable. TESC measures will be implemented that consists of high-visibility fencing (HVF) installed around native vegetation along existing stream areas not proposed to be impacted, silt fencing between the graded areas and buffers, plastic sheeting on stockpiled materials, and seeding of disturbed soils. These TESC measures will be installed prior to the start of development or mitigation actions and actively managed for the duration of the project.

Equipment used will be typical for land clearing, grading, and excavation activities and will be kept in good working conditions and free of leaks. Equipment to be used will likely include excavators, backhoes, bulldozers, dump trucks, graders, et cetera. All equipment staging and materials stockpiles will be kept out of the critical areas and regulated buffers avoided by the proposed project, and the area will be kept free of spills and/or hazardous materials using a SPCCC prepared and implemented by the contractor. All clean fill material for site preparation will be sourced from upland areas onsite or from approved suppliers and will be free of pollutants and hazardous materials.

All equipment staging and materials stockpiles will be kept out of the identified critical areas and associated buffer areas, and the areas will need to be kept free of spills and/or hazardous materials. Construction materials along with all construction waste and debris will be effectively managed and stockpiled on paved surfaces and kept free of the critical areas and associated buffers. Following completion of the development, the entire site will be cleaned and detail graded using hand tools wherever necessary, and TESC measures will be removed.

Additional BMPs for the proposed in-water work are provided under separate cover in the Water Quality Monitoring Plan.

2.5 Mitigation Implementation

Compensatory mitigation and voluntary restoration actions will occur concurrently with the development of Phase II of the project. Initial actions will include excavation and grading required for Streams Z and Y realignment. Minor portions of the mitigation site may initially remain ungraded to ensure the separation of the proposed stream channels from the existing channels. Realignment of the streams should occur during the summer during low flow conditions and shall occur during in-water work windows approved by the regulatory agencies. Following the initial excavation and grading, native plants may be installed following consultation with the Project Scientist to determine feasibility given summer hydrology conditions. Streams Y and Z will then be realigned; minor excavation and grading work will be necessary in order to provide the connections between the new and existing stream channels. Native plants are anticipated to be fully installed during the fall or early winter (September 1– December 31) following the realignment of Streams Y and Z during the summer season. The mitigation site should be seeded prior to the beginning of the wet season to minimize erosion.

TESC measures will be implemented according to the TESC plan prepared for the proposed project. Typical TESC measures include silt fencing where appropriate to protect potential offsite critical areas, plastic sheeting on stockpiled materials, and seeding of disturbed soils which will be actively managed for the duration of the project.

The Project Scientist should be consulted prior and during the mitigation actions to ensure that mitigation actions are conducted according to the intent of the mitigation plan. The Project Scientist will inspect and approve the planting stock and review the planting plans with the landscaping contractor to ensure clear understanding of the plan prior to installation of plant materials. The Project Scientist will assist the landscape contractor in making any final adjustments in the planting schedule as needed, in response to field conditions.

The proposed actions will include the excavation of material to create the new Stream Z and Stream Y channels. Mitigation and restoration actions may be completed separately from clearing and grading actions in the rest of the Project Area. The new stream channels will be entirely excavated prior to the stream relocation, with a berm left on the upstream end of each channel to prevent the streams from immediately diverting into the new channel. Large woody debris will be installed following channel excavation. Soil amendments will be installed as needed throughout the riparian corridor. The onsite soil amendments may be sourced from scraped topsoil. Imported topsoil or soil amendments may be used at the discretion of the landscape contractor.

Re-watering of the streams should occur during in-water work windows approved by regulatory agencies. If water is present in the stream channels immediately prior to the realignment, then nets will be installed at the upstream and downstream ends of existing stream sections to be de-watered and fish capture and relocation efforts will proceed as needed. The fish protection efforts will be completed using netting to capture fish and relocate them to non-impacted areas. The realigned stream channels will then be re-watered. Sediment control structures may be installed within the new stream channels to address water quality issues. The existing stream channels may be filled immediately following the re-watering of the realigned stream channels.

The project sequencing is anticipated to as follows:

- Pre-construction conferences and regulatory notifications;
- Pre-treatment of non-native invasive plant species;
- Install TESC measures;
- Remove debris and invasive plant material from the mitigation areas;
- Rough grade the stream restoration areas according to the approved grading plan;
- Remove existing culverts within the mitigation site, install new bottomless crossing;
- Rough grade inspection;
- Finish grade and prepare grounds for planting in all mitigation areas;
- Install LWD;
- Install streambed substrates;
- Install new box culvert connection between new Stream Z channel and existing, downgradient, piped Stream Z;
- Dewater existing stream channel and rewater new stream channel;
- Monitor site hydrology;

- Plant inspections;
- Install plant materials and seed disturbed soils for erosion control;
- Post-construction inspection and as-built survey; and
- Post-construction maintenance, monitoring, and annual reporting.

2.5.1 Pre-Construction Meetings and Post-Construction Inspection

Two pre-construction meetings are recommended to be held involving representatives from the Applicant, Project Manager or Contractor, and Project Scientist.. The first pre-construction meeting should occur prior to commencement of mitigation actions, and the second meeting should occur onsite after construction staking has been placed by professional surveyors. The overall purpose of the first pre-construction meeting should be to discuss the primary intent of the stream relocation and regulatory requirements; identify points of contact; establish communication lines between the Project Scientist, Project Manager or Contractor and landscaping personnel; review project scheduling; and address any questions or issues associated with the mitigation plan. The overall purpose of the second pre-construction meeting should be to discuss project implementation, protection of onsite habitat, construction BMPs, and identify invasive species management actions.

Post-construction inspection of all mitigation areas will be necessary to verify the installation conforms to the approved plan. This post-construction inspection effort will occur after completion of the stream relocation and all appropriate seeding and planting actions. The post-construction inspection will be documented in an As-Built (Year 0) Report. Any significant changes to the mitigation design will also be coordinated with regulatory staff as specified in regulatory approvals and presented in the As-Built Report. During the post-construction inspection, the Project Scientist will identify and mark long-term monitoring plots and photographic stations in the field that represent representative conditions of the stream relocation and other mitigation areas. The long-term monitoring locations will be GPS located and included in the As-Built Report.

2.6 Goals, Objectives, and Performance Standards

The goals and objectives for the proposed onsite and offsite, in-kind mitigation actions are based on establishing and enhancing stream areas to compensate for the loss of stream areas. Non-compensatory mitigation actions are proposed to provide additional ecological benefits at the mitigation site. These non-compensatory mitigation actions include the replacement of one undersized culvert with an upgraded culvert to improve fish passage, and enhancement of all onsite buffer areas. In addition, the stream relocation will significantly improve overall habitat conditions. The goals and objectives of the proposed mitigation actions are as follows.

"Cover" is used in this Mitigation Plan to mean the proportion of the ground surface that is covered by vegetation when viewed from above. Native recruits will be utilized in assessing performance standards unless otherwise specified for a particular performance standard. Dead or dying plants may be replaced, and replacement plants may be utilized in assessing performance standards, unless otherwise specified for a particular performance standard.

Goal 1 – Compensate for the loss of 592 linear feet the existing Stream Z channel by realigning Stream Z.

Objective 1.1 – Create 613 linear feet of new Stream Z channel.

Performance Standard 1.1.1 – The new Stream Z channel will be created according to the final approved design and documented in the As-Built Report.

Performance Standard 1.1.2 – Large woody debris in the new Stream Z channel will be installed according to the final approved design and documented in the As-Built Report.

Goal 2 – Voluntarily restore 463 linear feet of Stream Y channel by restoring Stream Y into a new stream channel.

Objective 2.1 – Restore 463 linear feet of Stream Y channel.

Performance Standard 2.1.1 – The new Stream Y channel will be created according to the final approved design and documented in the As-Built Report.

Performance Standard 2.1.2 – Large woody debris in the new Stream Y channel will be installed according to the final approved design and documented in the As-Built Report.

Goal 3 – Establish and enhance 70,998 square feet (1.62 acres) of riparian buffers for the newly restored Streams Y and Z to protect the streams and to provide improvements in buffer functions over existing degraded buffer conditions.

Objective 3.1 – Establish 74,796 square feet (1.717 acres) of riparian buffer that is vegetated with native woody plant cover to create diverse horizontal and vertical vegetation structure and wildlife habitat.

Performance Standard 3.1.1 – In Year 1, survival of installed woody vegetation will be 100 percent in the riparian buffer areas.

Performance Standard 3.1.2 – Native woody plant species will cover at least 15 percent of the mitigation areas at the end of Year 2, 25 percent cover at the end of Year 3, 35 percent cover at the end of Year 5, 50 percent cover at the end of Year 7, and 65 percent by the end of Year 10.

Performance Standard 3.1.3 – In all monitoring years, the riparian buffer area will contain at least 2 species of native trees and 3 species of native shrubs.

Objective 3.2 – Effectively control and/or eliminate non-native invasive species in riparian buffer areas.

Performance Standard 3.2.1 – Non-native invasive plants will not make up more than 20 percent cover during all monitoring years. Non-native invasive plants are plants listed by the Washington State Noxious Weed Board.

Goal 4 – Protect stream processes and fish passage within the new Stream Z channel.

Objective 4.1 – Ensure the new bottomless culvert crossing of Stream Z and the new box culvert connection between the new Stream Z and the existing piped Stream Z allow for unobstructed flows.

Performance Standard 4.1.1 – The bottomless culvert crossing of Stream Z and the box culvert connection to the existing piped Stream Z will be installed according to the final approved design and documented in the As-Built Report.

Performance Standard 4.1.2 – Unobstructed streamflow conveyance through the bottomless culvert crossing of Stream Z will be observed in all monitoring years.

2.7 Plant Materials and Installation

2.7.1 Plant Materials

All plant materials to be used for the restoration actions will be nursery grown stock from a reputable, local source. Only native species are to be used; no hybrids or cultivars will be allowed. Plant material provided will be typical of their species or variety; if not cuttings they will exhibit normal, densely developed branches and vigorous, fibrous root systems. Plants will be sound, healthy, vigorous plants free from defects, and all forms of disease and infestation.

Container stock shall have been grown in its delivery container for not less than six months but not more than two years. Plants shall not exhibit rootbound conditions. Under no circumstances shall container stock be handled by their trunks, stems, or tops. Seed mixture used for hand or hydroseeding shall contain fresh, clean, and new crop seed mixed by an approved method. The mixture is specified in the plan set.

Fertilizer will be in the form of Agriform plant tabs or an approved like form. Mulch or coir rings may be installed around woody vegetation as determined to be necessary for plant survivability by the landscape contractor.

2.7.2 Plant Scheduling, Species, Density, and Location

Plant installation should occur as close to conclusion of clearing and grading activities as possible to limit erosion and limit the temporal loss of function provided by the onsite habitat. All plantings should occur between September 1 and May 1 to ensure plants do not dry out after installation, or temporary irrigation measures may be necessary. All plantings will be installed according to the procedures detailed in the following subsections and as outlined on the site plans in Appendix A.

2.7.3 Quality Control for Planting Plan

All plant material should be inspected by the landscape contractor or Project Biologist upon delivery. Plant material not conforming to the specifications above will be rejected and replaced by the landscape contractor. Rejected plant materials shall be immediately removed from the site.

The landscape contractor should provide the Project Biologist with documentation of plant material that includes the supplying nursery contact information, location of genetic source, plant species, plant quantities, and plant sizes.

2.7.4 Product Handling, Delivery, and Storage

All seed should be delivered in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. This material should be stored in a manner to prevent wetting and deterioration. All precautions customary in good trade practice shall be taken in preparing plants for moving. Workmanship that fails to meet industry standards will be rejected. Plants will be packed, transported, and handled with care to ensure protection against injury and from drying out. If plants cannot be planted immediately upon delivery they should be protected with soil, wet peat moss, or in a manner acceptable to the Project Biologist. Plants and mulch not installed immediately upon delivery shall be secured on the site to prevent theft or tampering. No plant shall be bound with rope or wire in a manner that could damage or break the branches. Plants transported on open vehicles should be secured with a protective covering to prevent windburn.

2.7.5 Preparation and Installation of Plant Materials

The landscape contractor shall verify the location of all elements of the mitigation plan with the responsible Project Biologist prior to installation. The responsible Project Biologist reserves the right to adjust the locations of landscape elements during the installation period as appropriate. If obstructions are encountered that are not shown on the drawings, planting operations will cease until alternate plant locations have been selected by and/or approved by the Project Biologist.

Circular plant pits with vertical sides will be excavated for all container stock. The pits should be at least 2 times the width of the rootball, and the depth of the pit should accommodate the entire root system. Please refer to planting detail in Appendix A.

Broken roots should be pruned with a sharp instrument and rootballs should be thoroughly soaked prior to installation. Set plant material upright in the planting pit to proper grade and alignment. Water plants thoroughly midway through backfilling and add Agriform tablets or similar. Water pits again upon completion of backfilling. No filling should occur around trunks or stems. Do not use frozen or muddy mixtures for backfilling. Form a ring of soil around the edge of each planting pit to retain water and install a 3- to 4-inch layer of mulch around the base of each container plant if determined to be necessary by the landscape contractor.

Topsoil, mulch, compost, or other amendments may be installed to ensure plant survivability at the discretion of the landscape contractor.

2.7.6 Temporary Irrigation Specifications

While the native species selected for the habitat restoration actions are hardy and typically thrive in northwest conditions and the proposed actions are planned in areas with sufficient hydroperiods for the species selected, some individual plants might perish due to dry conditions. Therefore, irrigation or regular watering may be provided as necessary for the duration of the first two growing seasons while the native plantings become established. If used, irrigation will be discontinued after two growing seasons. Irrigation is recommended two times per week. Frequency and amount of irrigation will be dependent upon climatic conditions and may require more or less frequency watering than two times per week.

2.7.7 Invasive Plant Control and Removal

Invasive species to be removed include reed canarygrass and all listed noxious weeds. To ensure non-native invasive species do not expand following the habitat restoration actions, non-native invasive plants within the entire mitigation area will be pretreated with a root-killing herbicide approved for

use in aquatic sites (i.e., Rodeo) a minimum of two weeks prior to being cleared and grubbed from the restoration areas. A second application is strongly recommended in areas with dense cover of non-native, invasive species. The pre-treatment with herbicide should occur prior to all planned restoration actions, and spot treatment of surviving non-native invasive vegetation should be performed again each fall prior to senescence for a minimum of five years.

2.8 Maintenance & Monitoring Plan

Conceptual Maintenance and Monitoring Plans are described below in accordance with PMC 21.06.630 and anticipated conditions from other regulatory agencies. The Applicant is committed to compliance with the conceptual mitigation plan and overall success of the project. As such, the Applicant will continue to maintain the project, keeping the site free from non-native invasive vegetation and trash. Maintenance frequency may be altered depending on the success of the mitigation site as evaluated during the monitoring visits.

The mitigation actions will require continued monitoring and maintenance to ensure the mitigation actions are successful. Therefore, the mitigation site will be monitored for a period of 10 years with formal inspections by a qualified Project Scientist. An As-Built (Year 0) inspection will occur within 30 days of the completion of plant installation. The maintenance/monitoring period will begin upon completion of an as-built plan and certification from the Project Scientist certifying the mitigation was installed per the mitigation plan. Formal monitoring events will be scheduled during Years 1, 2, 3, 5, 7, and 10. Close-out assessment with also be conducted in Year 10.

Monitoring will consist of percent cover measurements and stem counts at permanent monitoring stations, walk-through surveys to identify invasive species presence and dead or dying enhancement plantings, photographs taken at fixed photo points, wildlife observations, and general qualitative habitat and wetland function observations. Data collected during monitoring visits will be appropriate for the performance standards of the relevant monitoring year. The permanent monitoring stations will be established such that the mitigation site is representatively sampled. Circular sample plots, approximately 30 feet in diameter (706 square feet), will be centered at each monitoring station. Sample plots will be located entirely within the proposed mitigation site. Sample plot shapes may need to be adjusted to ensure that sample plots do not cross the mitigation site boundaries; adjusted sample plot shapes should maintain the same area as the 30-foot-diameter circular sample plots. Mean survivorship and percent cover measurements from the sample plots will be used to estimate survivorship and percent cover across the mitigation site.

To determine survivorship, individual tree and shrub stems within the relevant circular sampling plots will be counted. Plants which grow several stems from a single base will be counted as one individual plant. These trees and shrubs will then be recorded as dead/dying or alive. To determine percent cover and species richness of woody vegetation, each species of tree or shrub within the approximately 30-foot-diameter circular sampling plots will be recorded and identified as native or invasive. Plants may be recorded by genus if species is unable to be determined at the time of the monitoring visit. Herbaceous vegetation will be sampled from a 10-foot diameter (78.5 square feet), established at the same location as the center of each tree and shrub sample plot. Herbaceous vegetation within the sampling plot will be recorded to at least the genus level and identified as native or invasive. A list of observed tree, shrub, and herbaceous genera or species, cover estimates, and wetland indicator status will be included within each monitoring report.

Non-native, invasive plant control will be performed throughout the monitoring period. Plants listed by the Washington Noxious Weed Board will be controlled to meet applicable performance standards. Herbicide applications will be made in accordance with the Washington Department of Agriculture pesticide application procedures unless prohibited by the City of Puyallup. Herbicides will be herbicides approved by the Washington State Department of Agriculture for use in aquatic areas and will only be applied by a licensed applicator in aquatic areas.

2.9 Reporting

Following the implementation of the mitigation actions, the responsible Project Scientist will prepare an As-Built (Year 0) Report and will be submitted to the City of Puyallup's project manager and appropriate agencies within 90 days following the post-construction monitoring event. Following each monitoring event, a monitoring report detailing the current ecological status of the mitigation actions, measurement of performance standards, and management recommendations will be prepared and submitted to the City of Puyallup and appropriate agencies within 90 days of each monitoring event to ensure full compliance with the mitigation plan, performance standards, and regulatory conditions of approval. Per PMC 21.06.630(2), monitoring reports are only required annually for the first three years following construction and at least upon the completion of the last monitoring year.

2.10 Contingency Plan and Long-Term Management Plan

If monitoring results indicate that performance standards are not being met, it may be necessary to implement all or part of the contingency plan. Careful attention to maintenance is essential in ensuring that problems do not arise. Should any portion of the site fail to meet the success criteria, a contingency plan will be developed. Such plans are adaptive and will be prepared on a case-by-case basis to reflect the failed mitigation characteristics. Contingency plans can include additional plant installation, erosion control, and plant substitutions including type, size, and location. The contingency measures outlined below can also be utilized in perpetuity to maintain the streams and buffers associated with the proposed mitigation site.

This project proposes 10 years of monitoring for the mitigation actions in compliance with the goals and performance standards outlined in Section 2.6 of this report. However, the agencies may request additional years of monitoring and formal reporting if the site has not met the goals and performance standards by Year 10.

Contingency/maintenance activities may include, but are not limited to:

1. Using plugs instead of seed for emergent vegetation coverage where seeded material does not become well-established;
2. Replacing plants lost to vandalism, drought, or disease, as necessary;
3. Replacing any plant species with a 20 percent or greater mortality rate after two growing seasons with the same species or native species of similar form and function;
4. Irrigating the mitigation areas only as necessary during dry weather if plants appear to be too dry, with a minimal quantity of water;
5. Reseeding and/or repair of mitigation areas as necessary if erosion or sedimentation occurs;
6. Spot treat non-native invasive plant species, and
7. Removing all trash or undesirable debris from all mitigation areas as necessary.

2.11 Financial Assurances

Per PMC 21.06.650, a mitigation surety is required ensure that mitigation is fully functional. The Applicant will provide a performance bond and monitoring and maintenance bond in an amount equal to 125 percent of the total estimated fair market cost of mitigation actions. Per PMC 21.06.650, the mitigation surety shall be based on a detailed itemized cost estimate of the mitigation activity including clearing and grading, plant materials, plant installation, irrigation, weed management, and other costs. The bond quantity worksheet will be provided for the Final Mitigation Plan.

2.12 Critical Area Protection

The mitigation areas will be placed in a separate tract or dedicated to the City as a permanent protective mechanism per PMC 21.06.610(7) and PMC 21.06.830. Critical area tracts shall be designated as native growth protection areas and shall be recorded on all documents of title of record for all affected lots and will be designated on the face of the plat or recorded drawing. Fencing and signage will also be provided per PMC 21.06.810 to reduce intrusion into the critical areas and prevent future impacts to the critical areas.

Chapter 3. Closure

The findings and conclusions documented in this report have been prepared for specific application for the East Town Crossing project. These findings and conclusions have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area. The conclusions and recommendations presented in this assessment report are professional opinions based on an interpretation of information currently available to us and are made within the operation scope, budget, and schedule of this project. No warranty, expressed or implied, is made. In addition, changes in government codes, regulations, or laws may occur. Due to such changes, our observations and conclusions applicable to this assessment may need to be revised wholly or in part in the future.

Chapter 4. References

Barnard, R. J., J. Johnson, P. Brooks, K. M. Bates, B. Heiner, J. P. Klavas, D.C. Ponder, P.D. Smith, and P. D. Powers. 2013. *Water Crossings Design Guidelines*. Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/hab/ahg/culverts.htm

City of Puyallup. 2023a. Final Development Team Review Letter – Preliminary Site Plan for East Town Crossing. Prepared June 20, 2023.

City of Puyallup. 2023b. Mitigated Determination of Non-Significance (MDNS). Prepared June 27, 2023.

City of Puyallup. 2023c. Permit Review Correction Letter (Permit Application #PRCCP20230970). Prepared August 31, 2023.

Habitat Technologies. 2021. *Wetland Delineation Report – East Town Crossing*. Prepared October 14, 2021.

Habitat Technologies. 2022. *Stream Corridor Restoration and Enhancement Program – East Town Crossing.* Revised November 14, 2022.

Hruby, T. 2014. *Washington State Wetland Rating System for Western Washington*: 2014 Update. (Publication #14-06-029). Olympia, WA: Washington Department of Ecology.

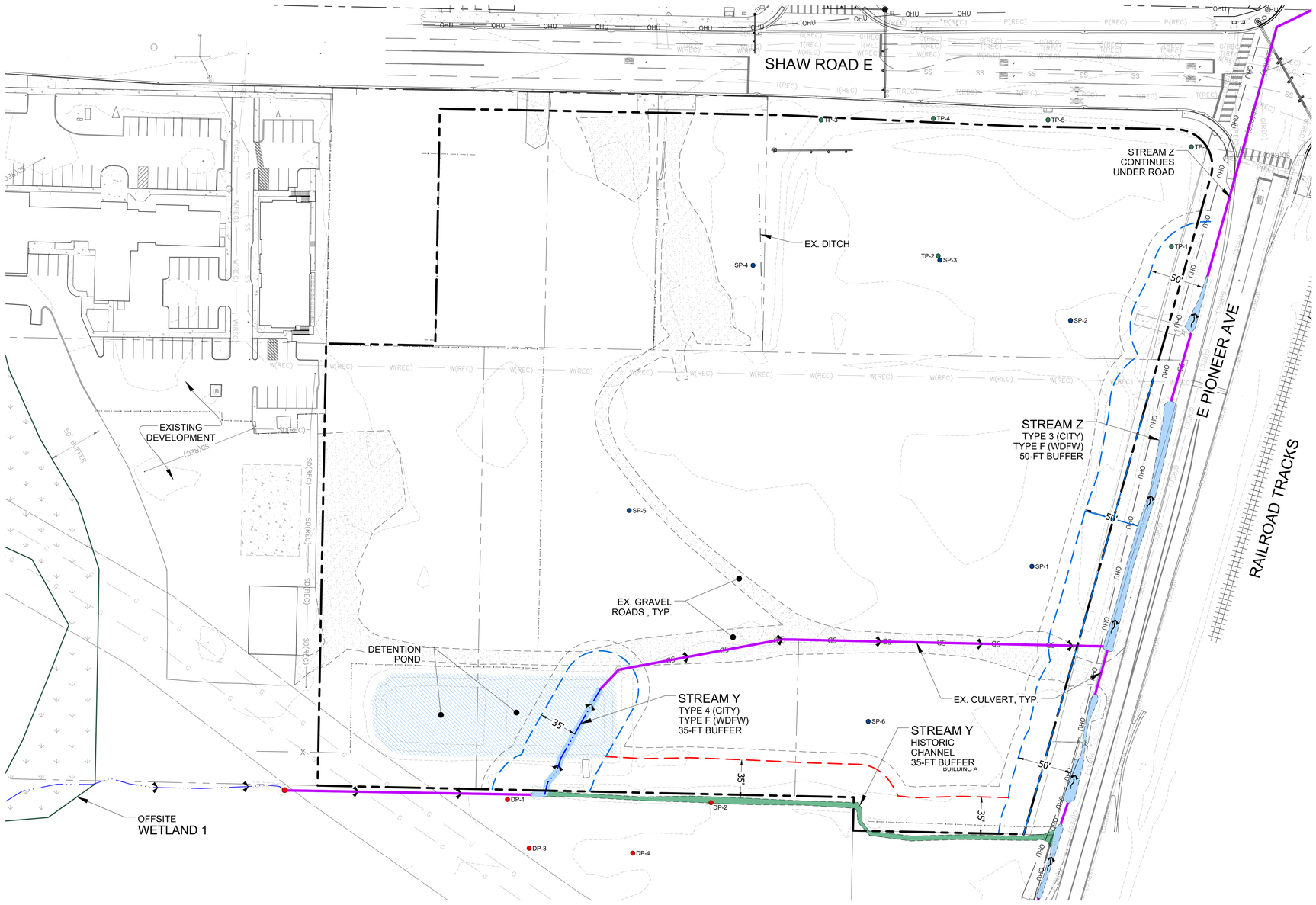
John Comis Associates. 2020. *Verification Report for the Wetland & Stream Delineations at East Town Crossing for the Abbey Road Group.* Prepared March 24, 2020.

U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA). 2008. *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule.* Federal Register. Volume 73, Number 70 (33 CFR Parts 325 & 332, 40 CFR Part 230)

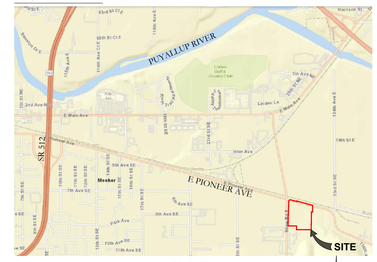
USACE. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Ver2.0),* ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-10-3. U.S. Army Engineer Research and Development Center. Vicksburg, Mississippi.

Washington Department of Fish and Wildlife (WDFW) 2002. Integrated Streambank Protection Guidelines. Available at https://wdfw.wa.gov/sites/default/files/publications/00046/wdfw00046.pdf (accessed March 21, 2023).

Appendix A – Proposed Site Plan Exhibits



VICINITY MAP



SOURCE: ESRI (ACCESSED 8/22/2022)

LOCATION

THE SE & NE ¼ OF SECTIONS 26 & 35,

TOWNSHIP 20N, RANGE 04E, WM

LAT: 47.184068° N LON: -122.254753° W

IN: PUYALLUP NEAR: ----

APPLICANT/OWNER

NAME: ASH DEVELOPMENT
ADDRESS: 1001 SHAW ROAD
PUYALLUP, WA 98371
CONTACT: GREG HELLE
PHONE: (253) 606-6799
E-MAIL: GREG.HELLE@ABSHERCO.COM

ENVIRONMENTAL CONSULTANT

SOUNDVIEW CONSULTANTS LLC
2907 HARBORVIEW DRIVE
GIG HARBOR, WA 98355
(253) 514-8952

SHEET INDEX

0 50 100 200

GRAPHIC SCALE
1"= 50'

PLAN LEGEND

- PROPERTY LINE
- DP-# DATA PLOT LOCATION (SOUNDVIEW CONSULTANTS)
- SP-# DATA PLOT LOCATION (HABITAT TECHNOLOGIES 10/14/2021)
- TP-# DATA PLOT LOCATION (JOHN COMIS ASSOCIATES, LLC 3/24/2020)
- EXISTING STREAM CENTERLINE
- APPROXIMATE STREAM ORDINARY HIGH WATER LINE (SURVEYED TOE OF BANK)
- EXISTING STREAM BUFFER
- 10-FT BUILDING SETBACK
- EXISTING CULVERT
- HISTORIC STREAM ORDINARY HIGH WATER LINE (OHW)
- HISTORIC STREAM BUFFER
- DITCH CENTERLINE
- EXISTING 2-FT CONTOURS

STREAM LEGEND

	EXISTING
STREAM Y OPEN CHANNEL	110 LF (724 SF)
STREAM Y IN CULVERT	471 LF
STREAM Z OPEN CHANNEL	465 LF (3,009 SF)
STREAM Z IN CULVERT	127 LF

NOTE
1. OFFSITE WETLAND 1 DELINEATION COMPLETED BY JOHN COMIS ASSOCIATES, LLC IN REPORT DATED MARCH 24, 2020.
2. CITY STREAM TYPING COMPLETED BY HABITAT TECHNOLOGIES IN REPORT DATED OCTOBER 14, 2021.
3. WDFW STREAM TYPING DETERMINED BY WDFW DURING JOINT SITE INVESTIGATION.

SOURCE: AHBL
TACOMA • SEATTLE • SPOKANE • TRI-CITIES
2215 North 30th Street, Suite 300 Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX www.ahbl.com WEB

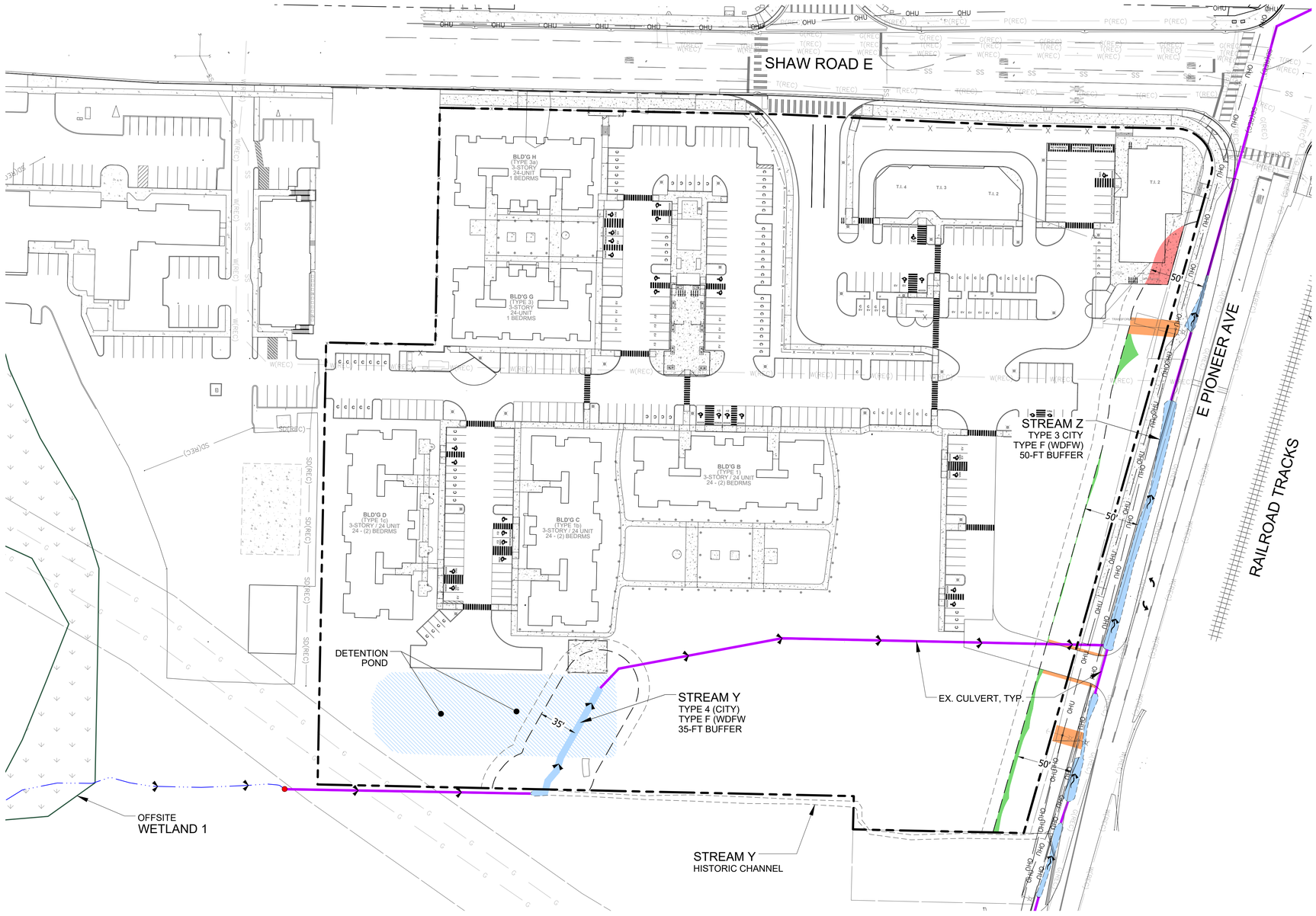
Soundview Consultants
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

EAST TOWN CROSSING
2902 E PIONEER AVE
PUYALLUP, WA 98374

PIERCE COUNTY PARCEL NUMBERS:
(0420264021, 0420264053, 0420264054, 0420351030, 0420351029, 0420351026, & 0420351066

DATE: 3/14/2024
JOB: 2544.0001
BY: MW
SCALE: AS SHOWN
SHEET: 1.0

PROPOSED SITE PLAN (PHASE I)



0 50 100 200

GRAPHIC SCALE
1"= 50'

PLAN LEGEND

- PROPERTY LINE
- EXISTING STREAM CENTERLINE
- EXISTING STREAM ORDINARY HIGH WATER LINE (OHW)
- EXISTING CULVERT
- STREAM BUFFER
- 10-FT BUILDING SETBACK

IMPACTS & MITIGATION LEGEND

TEMPORARY BUFFER AVERAGING

STREAM BUFFER DECREASE	866 SF
STREAM BUFFER INCREASE	1,030 SF
NET BUFFER GAIN	164 SF

TEMPORARY GRADING IMPACTS

STREAM BUFFER IMPACTS FOR DRIVEWAY & UTILITY INSTALLATION (TO BE RESTORED WITH NATIVE UPLAND GRASS SEED MIX)	1,345 SF

PLANT SCHEDULE

SEED MIXES (www.riverrefugeseed.com)		Area (sf): / WL Status	1,345 / Buffer Plantings
Native Upland Grass Mix #9	**20 lbs/acre**		(Qty)
Elymus glaucus	Blue wildrye	30%	
Bromus carinatus	California brome	25%	
Hordeum brachyantherum	Meadow barley	10%	
Festuca roemeri	Roemer's fescue	10%	
Deschampsia elongata	Slender hairgrass	10%	
Agrostis exarata	Spike bentgrass	5%	
Deschampsia cespitosa	Tufted hairgrass	5%	
Festuca rubra var. rubra	Red fescue	5%	
		Total (lbs):	1

1 - Scientific names and species identification taken from *Flora of the Pacific Northwest, 2nd Edition (Hitchcock and Cronquist, Ed. by Giblin, Ledger, Zika, and Olmstead, 2018).*

SOURCE: AHBL
TACOMA • SEATTLE • SPOKANE • TRI-CITIES
2215 North 30th Street, Suite 300 Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX www.ahbl.com WEB

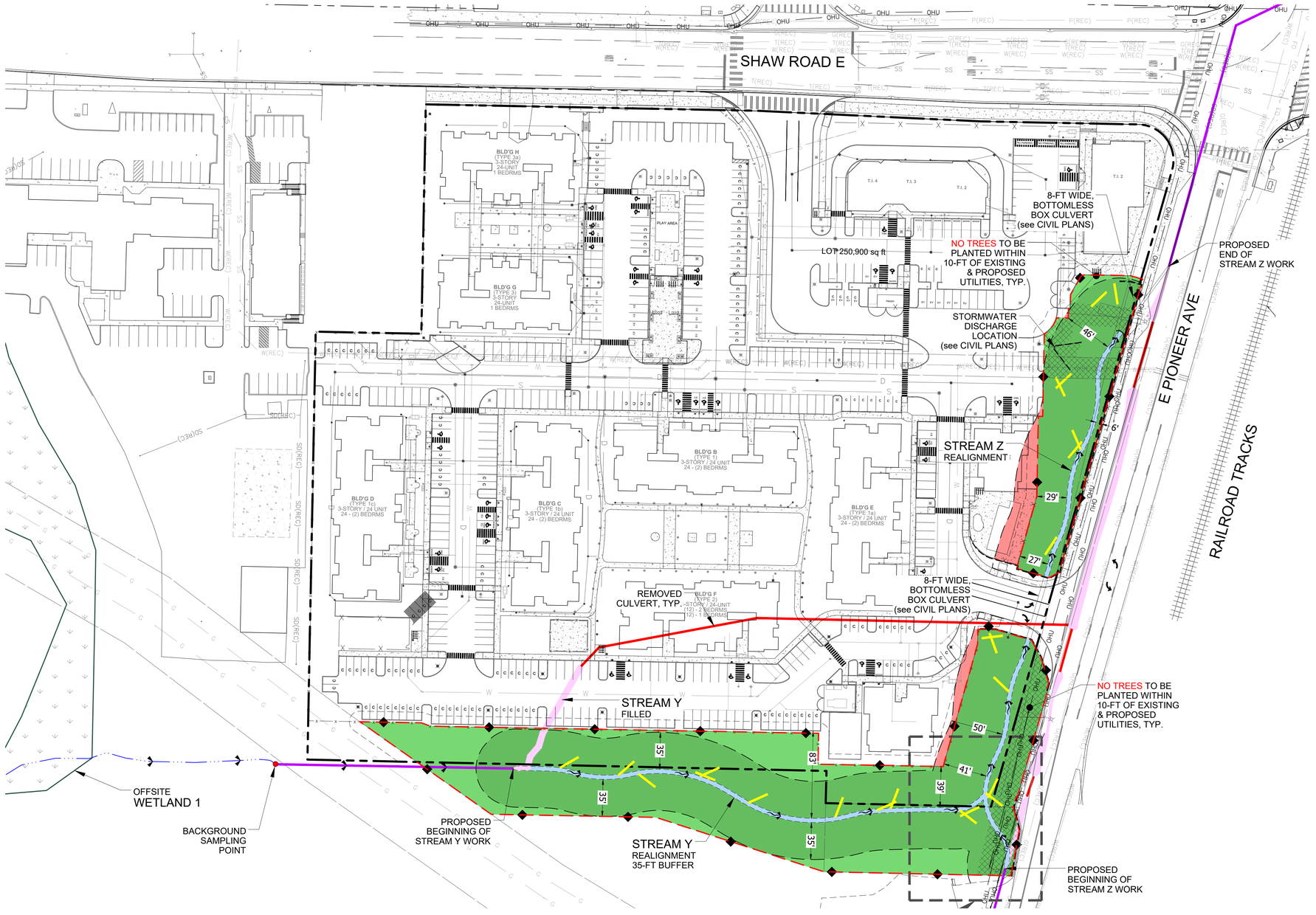
Soundview Consultants
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

EAST TOWN CROSSING
2902 E PIONEER AVE
PUYALLUP, WA 98374

PIERCE COUNTY PARCEL NUMBERS:
0420264021, 0420264053, 0420264054, 0420351030, 0420351029, 0420351026, & 0420351066

DATE: 3/14/2024
JOB: 2544.0001
BY: MW
SCALE: AS SHOWN
SHEET: 2.0

PROPOSED SITE PLAN, IMPACTS & MITIGATION (PHASE II)



0 50 100 200

GRAPHIC SCALE
1"= 50'

PLAN LEGEND

- PROPERTY LINE
- EXISTING STREAM CENTERLINE
- PROPOSED STREAM ORDINARY HIGH WATER LINE (OHW)
- STANDARD STREAM BUFFER
- EXISTING / RETAINED CULVERT
- PROPOSED CULVERT
- STREAM FILL
- REMOVED CULVERT

IMPACTS & MITIGATION LEGEND

STREAM BUFFER DECREASE	3,594 SF
STREAM BUFFER INCREASE	14,566 SF
STREAM BUFFER RESTORATION/ENHANCEMENT (INCLUDES AREAS OF STREAM FILL WITHIN PROPOSED BUFFERS)	60,230 SF

- POST-CONSTRUCTION STREAM BUFFER/ CRITICAL AREA FENCE
- 10-FT BUILDING SETBACK
- CRITICAL AREA SIGN (24 SIGNS)
- LARGE WOODY DEBRIS (see SHEET 3.0)

STREAM LEGEND

	EXISTING	PROPOSED
STREAM Y OPEN CHANNEL	110 LF (724 SF)	463 LF (1,836 SF)
STREAM Y IN CULVERT	471 LF	0 LF
STREAM Z OPEN CHANNEL	465 LF (3,009 SF)	475 LF (1,897 SF)
STREAM Z IN CULVERT	127 LF	138 LF

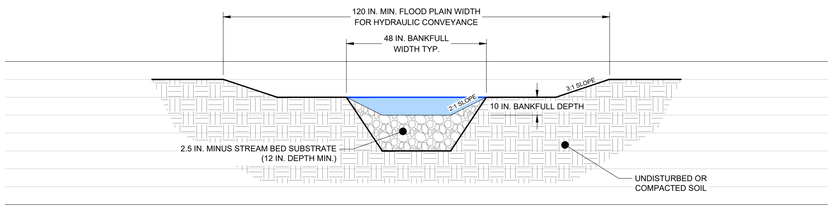
SOURCE: AHBL
TACOMA - SEATTLE - SPOKANE - TRI-CITIES
2215 North 30th Street, Suite 300 Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX www.ahbl.com WEB

Soundview Consultants
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

EAST TOWN CROSSING
2902 E PIONEER AVE
PUYALLUP, WA 98374

PIERCE COUNTY PARCEL NUMBERS: 0420264021, 0420264053, 0420264054, 0420351030, 0420351029, 0420351026, & 0420351066

DATE: 3/14/2024
JOB: 2544.0001
BY: MW
SCALE: AS SHOWN
SHEET: 2.1

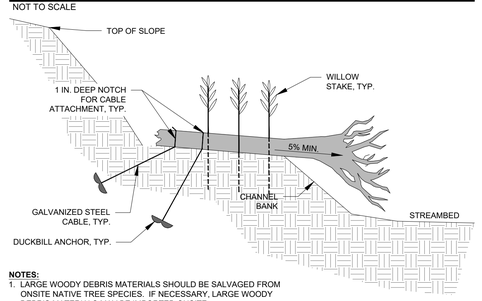


STREAMS Y & Z - PROPOSED CROSS SECTION, TYP.

SCALE: 1"=2'

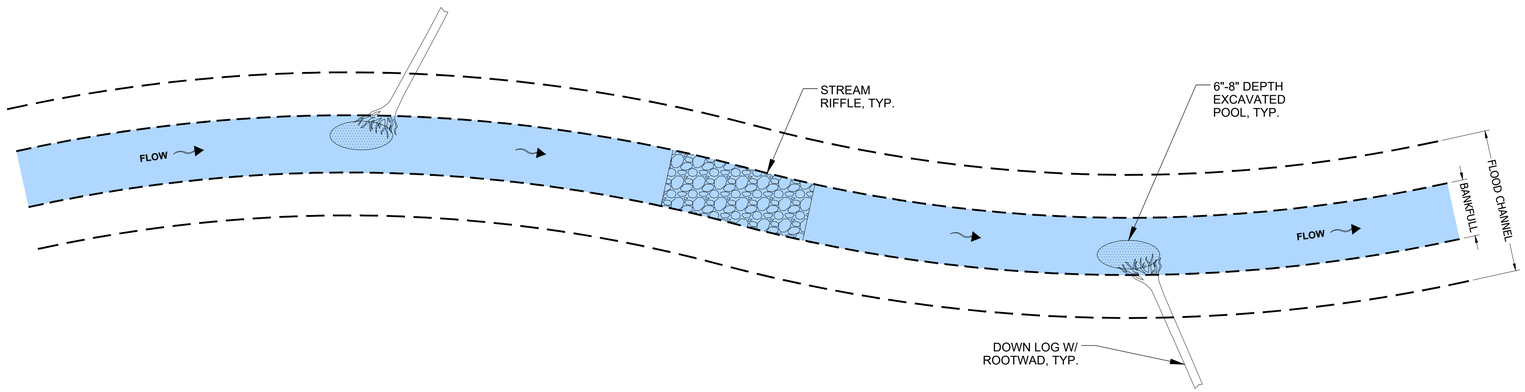
LWD INSTALLATION CROSS-SECTION (TYPICAL)

NOT TO SCALE



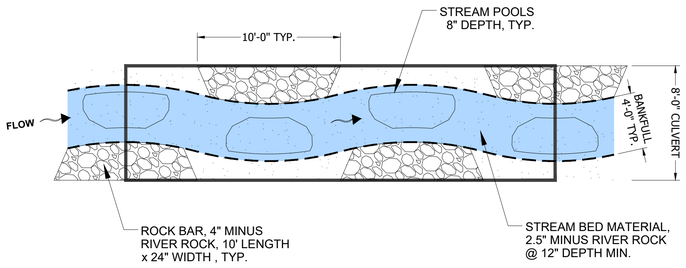
NOTES:

1. LARGE WOODY DEBRIS MATERIALS SHOULD BE SALVAGED FROM ONSITE NATIVE TREE SPECIES. IF NECESSARY, LARGE WOODY DEBRIS MATERIALS MAY BE IMPORTED ONSITE.
2. IMPORTED LOGS AND OTHER WOODY MATERIALS SHALL BE OF DOUGLAS-FIR, WESTERN REDCEDAR, OR OTHER SPECIES APPROVED BY THE PROJECT SCIENTIST.
3. LARGE WOODY DEBRIS SHALL HAVE ROOTWAD STILL ATTACHED. ROOT SPREAD SHALL HAVE RELATIVELY EVEN SPREAD WITH A MINUMUM DIAMETER OF TWO (2) TO THREE (3) FEET. ROOTWADS SHALL BE CLEANED PRIOR TO PLACEMENT.
4. FASTEN WOODY DEBRIS USING MINIMUM OF 2 GALVANIZED STEEL CABLES (DUCKBILL ANCHORS) PER PIECE OF LARGE WOODY DEBRIS.



STREAMS Y & Z - PROPOSED PLAN VIEW, TYP.

SCALE: 1"=5'



CULVERT DETAIL - PLAN VIEW, TYP.

SCALE: 1"=5'

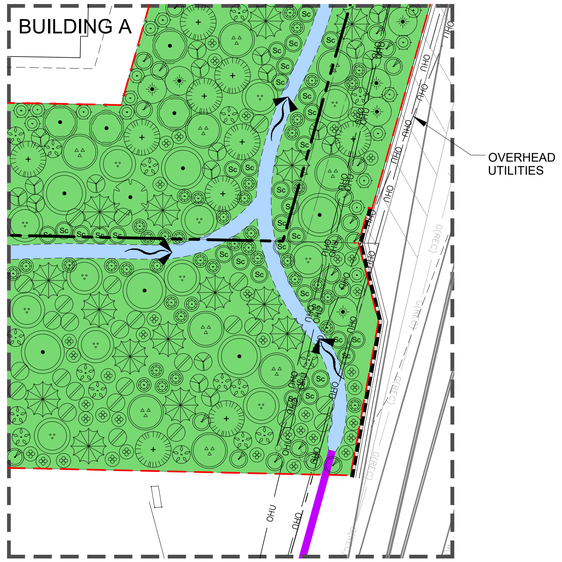
SOURCE: AHBL
TACOMA • SEATTLE • SPOKANE • TRI-CITIES
2215 North 30th Street, Suite 300 Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX www.ahbl.com WEB

Soundview Consultants
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

EAST TOWN CROSSING
2902 E PIONEER AVE
PUYALLUP, WA 98374

PIERCE COUNTY PARCEL NUMBERS:
0420264021, 0420264053, 0420264054, 0420351030,
0420351029, 0420351026, & 0420351066

DATE: 3/14/2024
JOB: 2544.0001
BY: MW
SCALE: AS SHOWN
SHEET: 2.2



PLANTING TYPICAL
SCALE: 1"=20'

PLANT & HABITAT FEATURE SCHEDULE

			Area (sf):	74,796				
			Cov'g (%):	100				
			Trees (%):	50				
			Shrubs (%):	50				
Scientific Name	Common Name	WL Status	Buffer Plantings	Spacing (min.)	Height (min.)	Size (min.)	Planting Area	
TREES			(Qty)					
Acer macrophyllum	bigleaf maple	FACU	36	10 ft	3 ft	2 gal	Dry	
Frangula purshiana (Rhamnus p.)	cascara	FAC	6	10 ft	3 ft	1 gal	Dry	
Prunus emarginata	bitter cherry	FACU	27	10 ft	3 ft	2 gal	Dry	
Pseudotsuga menziesii	Douglas fir	FACU	54	10 ft	3 ft	2 gal	Dry	
Salix scouleriana	Scouler's willow	FAC	216	5 ft	4 ft	Stakes	Dry	
Thuja plicata	western redcedar	FAC	95	10 ft	3 ft	2 gal	Moist - on hummock	
		Total:	**434**					
SHRUBS			(Qty)					
Acer circinatum	vine maple	FAC	78	10 ft	4 ft	2 gal	Dry/Moist	
Amelanchier alnifolia	serviceberry	FACU	31	8 ft	3 ft	2 gal	Dry	
Cornus stolonifera	red-osier dogwood	FACW	173	4 ft	3 ft	1 gal	Moist/Wet	
Corylus cornuta var. californica	western hazlenut	FACU	56	10 ft	2 ft	2 gal	Moist	
Holodiscus discolor	oceanspray	FACU	133	5 ft	2 ft	1 gal	Dry	
Oemleria cerasiformis	Indian plum	FACU	111	5 ft	2 ft	2 gal	Dry	
NO SYMBOL ***Polystichum munitum***	western swordfern	FACU	415	4 ft	1 ft	1 gal	Dry/Moist	
Rosa gymnocarpa	bald hip rose	FACU	104	4 ft	2 ft	1 gal	Dry/Moist	
Rubus spectabilis var. spectabilis	salmonberry	FAC	277	4 ft	2 ft	1 gal	Moist	
Sambucus racemosa var. racemosa	red elderberry	FACU	111	5 ft	2 ft	2 gal	Dry	
Symphoricarpos albus var. laevigatus	common snowberry	FACU	243	4 ft	2 ft	1 gal	Dry	
		Total:	**1732**					

SEED MIXES (www.riverrefugeseed.com)		**WL Status**	**Buffer Plantings**
Native Upland Grass Mix #9	**20 lbs/acre**		**(Qty)**
Elymus glaucus	Blue wildrye	30%	
Bromus carinatus	California brome	25%	
Hordeum brachyantherum	Meadow barley	10%	
Festuca roemeri	Roemer's fescue	10%	
Deschampsia elongata	Slender hairgrass	10%	
Agrostis exarata	Spike bentgrass	5%	
Deschampsia cespitosa	Tufted hairgrass	5%	
Festuca rubra var. rubra	Red fescue	5%	
		Total (lbs):	**35**

Habitat Structures	**(Qty)**	**Requirements**
Large Woody Debris	**23 Pieces**	**For salvaged large woody debris:** 35.31 cubic feet of large woody debris material mnimum. **For imported large woody debris:** 12 foot length minimum, 10 inch diameter minimum, with 2-3 foot minimum diameter rootwad attached.

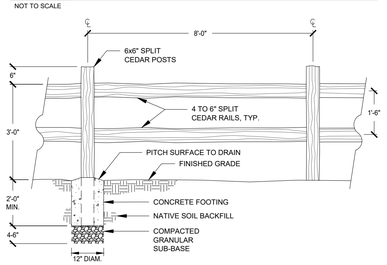
1 - Scientific names and species identification taken from *Flora of the Pacific Northwest, 2nd Edition (Hitchcock and Cronquist, Ed. by Giblin, Ledger, Zika, and Olmstead, 2018).*
2 - Over-sized container plants are suitable for replacement pending Wetland Scientist approval.
3 - Alternate native plant species may be substituted or added with Wetland Scientist approval.
4 - All disturbed and bare soil areas in the buffer to be seeded with a native grass seed mix.
5 - Shrub calculations based upon 5-ft average spacing.
6 - Tree calculations based upon 10-ft average spacing.
7 - *Polystichum munitum* to be planted in groups of 3 to 5 around the base of newly planted trees.

STREAMBED SUBSTRATE TABLE

STREAMBED SUBSTRATE SIZE	STREAM (REACH)	FEATURE	LENGTH (LF)	CROSS-SECTIONAL AREA OF GRAVEL (SF)	VOLUME OF GRAVEL (CF)
2.5 IN. MINUS	STREAM Y	CHANNEL & POOLS	463	2.98	1379.7
	STREAM Z	CHANNEL & POOLS	475	2.98	1415.5
			TOTAL 2.5 IN. MINUS GRAVEL (CF):		**2795.2**
			(CUBIC YARDS)		**104**
4 IN. MINUS	CULVERTS	ROCK BARS & POOLS	138	3	414.0
			TOTAL 4 IN. MINUS GRAVEL (CF):		**414.0**
			(CUBIC YARDS)		**16**

SPLIT RAIL FENCE DETAIL

NOT TO SCALE

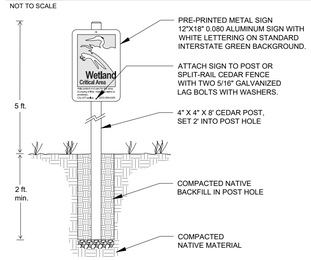


NOTES:

1. POSTS AND RAILINGS PRE-CUT FOR ASSEMBLY.
2. 3-RAIL DESIGNS ARE PERMITTED.
3. FENCE SHALL BE PLACED AT APPROVED BUFFER EDGE.
4. ALTERNATIVE WILDLIFE FRIENDLY FENCE DESIGNS ALLOWED WITH CITY OF PUYALLUP APPROVAL

CRITICAL AREA SIGN DETAIL

NOT TO SCALE

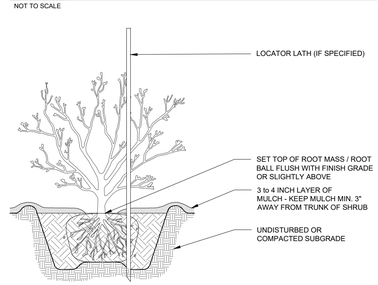


CRITICAL AREA BOUNDARY SIGN NOTES:

1. THE BOUNDARY AT THE OUTER EDGE OF THE CRITICAL AREA OR BUFFER SHALL BE IDENTIFIED WITH SIGNS OR MARKERS TO CLEARLY INDICATE THE LOCATION OF THE CRITICAL AREA.
2. FENCING AND SIGNS SHALL BE MAINTAINED IN GOOD CONDITION SO AS TO BE VISIBLE AND UNOBSCURED.
3. PRE-PRINTED METAL SIGN AVAILABLE THROUGH:
   ZUMAR INDUSTRIES
   PHONE: 1-800-426-7967.
   WEBSITE: WWW.ZUMAR.COM

TREE AND SHRUB PLANTING DETAIL (TYPICAL)

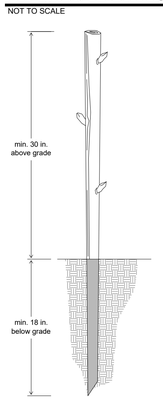
NOT TO SCALE



NOTES:
1. PLANT SHRUBS OF THE SAME SPECIES IN GROUPS OF 3 to 9 AS APPROPRIATE, OR AS SHOWN ON PLAN. AVOID INSTALLING PLANTS IN STRAIGHT LINES TO ACHIEVE A NATURAL-LOOKING LAYOUT.
2. EXCAVATE PIT TO FULL DEPTH OF ROOT MASS AND 2 X ROOT MASS DIAMETER. SPREAD ROOTS TO FULL WIDTH OF CANOPY. SCARIFY SIDES OF PIT.
3. MIDWAY THROUGH PLANTING ADD AGROFORM TABLET AND WATER THOROUGHLY.
4. BACKFILL TO BE COMPACTED USING WATER ONLY.
5. WATER IMMEDIATELY AFTER INSTALLATION.

LIVE STAKE PLANTING DETAIL (TYPICAL)

NOT TO SCALE



STORAGE OF LIVE STAKES:
ALL WOODY PLANT CUTTINGS COLLECTED MORE THAN 12 HR PRIOR TO INSTALLATION, MUST BE CAREFULLY BOUND, SECURED, AND STORED OUT OF DIRECT SUNLIGHT AND SUBMERGED IN CLEAN FRESH WATER FOR A PERIOD OF UP TO TWO WEEKS.

OUTDOOR TEMPERATURES MUST BE LESS THAN 50 DEGREES F AND TEMPERATURE INDOORS AND IN STORAGE CONTAINERS MUST BE BETWEEN 34 AND 50 DEGREES F.

IF THE LIVE STAKES CANNOT BE INSTALLED DURING THE DORMANT SEASON, CUT DURING THE DORMANT SEASON AND HOLD IN COLD STORAGE AT TEMPERATURES BETWEEN 33 AND 39 DEGREES F FOR UP TO 2 MONTHS.

NOTES:
1. LIVE STAKES TO BE A MIN. 1/2 INCH DIAMETER; MIN. 48 INCH LENGTH.
2. USE 1/2 INCH MIN. DIAMETER REBAR OR ROCK BAR TO MAKE PILOT HOLE WHEN PLANTING IN DENSE OR GRAVELY SOILS TO A MIN. DEPTH OF 18 INCHES.
3. MANUALLY INSERT LIVE STAKE INTO PILOT HOLE TAPERED END UP AND TEMP SOIL AROUND BASE. CUTTINGS SHOULD BE INSERTED TO A DEPTH OF AT LEAST 18 INCHES. LEAVE A MIN. OF 30" OF THE CUTTING ABOVE GROUND SURFACE TO ALLOW FOR SUCCESSFUL FOLIAGE DEVELOPMENT.
4. MINUMUM TWO BUDS ABOVE GRADE.
5. SET LIVE STAKES WITH DEAD-BLOW HAMMER.
6. WATER IMMEDIATELY AFTER INSTALLATION.

SOURCE:
AHBL
TACOMA • SEATTLE • SPOKANE • TRI-CITIES
2215 North 30th Street, Suite 300 Tacoma, WA 98403
253.383.2422 TEL 253.383.2572 FAX www.ahbl.com WEB

Soundview Consultants
Environmental Assessment • Planning • Land Use Solutions
2907 HARBORVIEW DRIVE P. 253.514.8952
GIG HARBOR, WASHINGTON 98335 F. 253.514.8954
WWW.SOUNDVIEWCONSULTANTS.COM

EAST TOWN CROSSING
2902 E PIONEER AVE
PUYALLUP, WA 98374

PIERCE COUNTY PARCEL NUMBERS:
0420264021, 0420264053, 0420264054, 0420351030, 0420351029, 0420351026, & 0420351066

DATE:	3/14/2024
JOB:	2544.0001
BY:	MW
SCALE:	AS SHOWN
SHEET:	3.0

Appendix B – Photographs

Typical degraded conditions of Stream Z within ROW of East Pioneer Avenue

Typical conditions of Stream Y

Existing Stream Z crossing providing access from East Pioneer Avenue to site (source: Google Earth)

Appendix C – Qualifications

All determinations and supporting documentation, including this ***Conceptual Mitigation Plan*** prepared for the ***East Town Crossing*** project were prepared by, or under the direction of, Alex Murphy and Matt DeCaro of SVC. Technical assistance was provided by Ben Wright. In addition, report preparation was completed by Kyla Caddey, and final quality assurance/ quality control was completed by Laura Livingston.

Alex Murphy, AICP

Senior Environmental Planner & Project Manager
Professional Experience: 7 years

Alex Murphy is a Planner and Project Manager with a background in land use planning, site planning & design, permitting, and project management. He has over 7 years of experience working for local jurisdictions in the Intermountain West and Pacific Northwest with an emphasis on maximizing opportunities for culturally and environmentally sensitive projects.

Alex earned a Bachelor of Landscape Architecture degree from Utah State University. He is a Certified Planner through the American Institute of Certified Planners and has received formal training in climate adaptation planning for coastal communities from NOAA. Mr. Murphy currently assists in wetland, stream, and shoreline delineations and fish and wildlife habitat assessments; conducts environmental code analysis; and prepares environmental assessment and mitigation reports. He also manages development projects, supporting clients through the regulatory and planning process for various land use proposals.

Matt DeCaro

Principal
Professional Experience: 14 years

Matt DeCaro is a Principal and Senior Scientist with a diverse background in environmental planning, wetland science, stream ecology, water quality, tree assessments, site remediation, NEPA compliance, and project management. He manages a wide range of industrial, commercial, and multi-family residential projects throughout Western Washington, providing environmental permitting and regulatory compliance assistance for land use projects from their planning stages through entitlement and construction. His local expertise, diverse professional background, and positive relationships with regulatory personnel are integral components of his successful project outcomes.

Matt earned a Bachelor of Science degree with a focus in Environmental Science from the Evergreen State College in Olympia, Washington, with additional graduate-level coursework and research in aquatic restoration and salmonid ecology. Matt has received 40-hour wetland delineation training (*Western Mountains, Valleys, & Coast and Arid West Regional Supplements*) and regularly performs wetland, stream, and shoreline delineations. Matt has been formally trained in the use of the *2014 Washington State Wetland Rating System* and *Determination of Ordinary High Water Mark* by WSDOE, and he is a Pierce County Qualified Wetland Specialist and Wildlife Biologist. He has attended USFWS survey workshops for multiple threatened and endangered species, and he is a Senior Author of WSDOT Biological Assessments. Matt holds 40-hour HAZWOPER training and has managed Phase I Environmental Site Assessments, subsurface investigations, and contaminant remediation projects

throughout the Pacific Northwest. His diverse experience also includes NEPA compliance for federal permitting projects; noxious weed abatement; army ant research in the Costa Rican tropical rainforest; spotted owl surveys on federal and private lands; and salmonid spawning and migration surveys.

Ben Wright

Associate Principal and Senior Fisheries Biologist
Professional Experience: 20 years

Ben Wright is an Associate Principal and Senior Fisheries Biologist with a varied background in lake ecology, stream ecology, fisheries biology, water quality and climate science. Ben has 13 years of experience at the federal level providing technical assistance for both the development of infrastructure projects and management of aquatic resources. This technical assistance included providing oversight and design guidance on several restoration projects involving large woody debris installations, native riparian plantings, and stream channel relocations. He has experience developing biological assessments, water quality monitoring plans, and fisheries management plans. Ben has an additional 10 years of experience working on long-term ecological monitoring programs related to lakes, streams, water quality and climate. Ben currently works on permitting, design, construction guidance, and monitoring of several stream and wetland mitigation projects across western Washington.

Ben earned a Bachelor of Science degree in Genetics and Cell Biology with an emphasis in aquatic ecology from Washington State University and has a graduate certificate in Fisheries Management from Oregon State University. Ben's expertise includes endangered species monitoring, assessments and permitting, and NEPA documentation across disciplines gained during his work on federal highway projects. Ben also has experience in fish population assessments, utilizing genetic analysis, spawning escapement and movement studies. Ben has received formal training from the Washington State Department of Ecology in the Using the Revised 2014 Wetland Rating System for Western Washington, How to Determine the Ordinary High Water Mark, Navigating SEPA, How to Conduct a Forage Fish Survey and Puget Sound Costal Processes, Shoreline Modifications and Beach Restoration. Ben has completed 40-hour wetland delineation training for the Western Mountains, Valleys, & Coast and Arid West Regional Supplement. Most recently, Ben has completed a short course in River Sediment Dynamics from River Restoration Northwest.

Kyla Caddey, PWS, Certified Ecologist

Senior Environmental Scientist
Professional Experience: 8 years

Kyla Caddey is a Senior Environmental Scientist with a diverse background in stream and wetland ecology, wildlife ecology and conservation, wildlife and natural resource assessments and monitoring, and riparian habitat restoration at various public and private entities. Kyla has field experience performing in-depth studies in both the Pacific Northwest and Central American ecosystems which included various environmental science research and statistical analysis. Kyla has advanced expertise in federal- and state-listed endangered, threatened, and sensitive species surveys and assessment of aquatic and terrestrial systems throughout the Puget Sound region. She has completed hundreds of wetland delineations and has extensive knowledge and interest in hydric soil identification. As the senior writer, she provides informed project oversight and performs final quality assurance / quality control on various types of scientific reports for agency submittal, including: Biological

Assessments/Evaluations; Wetland, Shoreline, and Fish and Wildlife Habitat Assessments; Mitigation Plans, and Mitigation Monitoring Reports. She currently performs wetland, stream, and shoreline delineations and fish and wildlife habitat assessments; prepares scientific reports; and provides environmental permitting and regulatory compliance assistance to support a wide range of commercial, industrial, and multi-family residential land use projects.

Kyla earned a Bachelor of Science degree in Environmental Science and Resource Management from the University of Washington, Seattle with a focus in Wildlife Conservation and a minor in Quantitative Science. She has also completed additional coursework in Comprehensive Bird Biology from Cornell University. Ms. Caddey is a Certified Professional Wetland Scientist (PWS #3479) through the Society of Wetland Scientists and Certified Ecologist through the Ecological Society of America. She has received 40-hour wetland delineation training (Western Mtns, Valleys, & Coast and Arid West Regional Supplement), is a Pierce County Qualified Wetland Specialist and Wildlife Biologist, and is a USFWS-approved Mazama pocket gopher survey biologist. Kyla has been formally trained through the Washington State Department of Ecology, Coastal Training Program, and the Washington Native Plant Society in winter twig and grass, sedge, and rush identification for Western WA; Using the Credit-Debit Method in Estimating Wetland Mitigation Needs; How to Determine the Ordinary High Water Mark; Using Field Indicators for Hydric Soils; How to Administer Development Permits in Washington Shorelines; Puget Sound Coastal Processes; and Forage Fish Survey Techniques. Additionally, she has received formal training in preparing WSDOT Biological Assessments.

Laura Livingston

Senior Environmental Planner
Professional Experience: 9 years

Laura Livingston is an Environmental Planner with a background in water quality monitoring, invasive species monitoring, wildlife monitoring, wilderness stewardship, and erosion control projects. Laura has field experience working on natural resources projects, with an emphasis on stream and river projects, in the Northwest, Northeast, and Southwest United States. She has also worked on a variety of environmental science research, grant, and teaching projects requiring scientific writing, science communication, laboratory work, and statistical analysis. She currently performs ordinary high water delineations; conducts environmental code analysis; and prepares environmental assessment and mitigation reports, biological evaluations, and permit applications to support clients through the regulatory and planning process. Laura has a particular interest in shoreline projects and has prepared a variety of application materials to support projects within Shoreline Master Program jurisdictions.

Laura earned a Master of Science degree in Environmental Science from Washington State University, Pullman. She has received training from the Washington State Department of Ecology in How to Administer Shoreline Development Permits in Western Washington's Shorelines, Determining the Ordinary High Water Mark, the revised Washington State Wetland Rating System, Puget Sound Coastal Processes, How to Conduct a Forage Fish Survey, and Using the Credit-Debit Method for Estimating Mitigation Needs. Laura has also received training from the Washington State Department of Transportation in Biological Assessment Preparation for Transportation Projects and is listed by WSDOT as a junior author for preparing Biological Assessments. Laura is interested in stormwater management and has received a certificate in Low Impact Development Design from the Washington Stormwater Center.

Appendix C

Maintenance Report

Stormwater Facilities Maintenance Plan

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230723.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2024

Stormwater Facilities Maintenance Plan

PREPARED FOR:

Greg Helle
1001 Shaw Road
Puyallup, WA 98372

PROJECT:

East Town Crossing
2902 E Pioneer
Puyallup, WA 98372
2230723.10

PREPARED BY:

Christopher Watt
Project Engineer

REVIEWED BY:

Todd C. Sawin, PE, DBIA, LEED AP
Principal

DATE:

November 2024

I hereby state that this Stormwater Facilities Maintenance Plan for the East Town Crossing - Frontage project has been prepared by me or under my supervision and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that The City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

Table of Contents

Appendices

Appendix C Exhibits

- Exhibit C-1: Maintenance Checklist

1.0 Overall Project Summary

This Stormwater Facilities Plan accompanies the Site Development plans for the East Town Crossing project located on Tax Parcels 0420264021, 0420264053, 0420264054, 0420351066, 0420351030, 0420351029, 0420351026 in the City of Puyallup, Washington.

This Stormwater Facilities Maintenance Plan describes the requirements for operation and maintenance of the publicly owned stormwater system for the southern border of Pioneer and the eastern border of Shaw Rd that are adjacent to the onsite development of the East Town Crossing Project.

2.0 Owner Information

Remove this section.
[Storm Report; Pg 186 of 273]

All maintenance and operations of right-of-way stormwater facilities shall be the responsibility of the City of Puyallup.

As the owner and responsible maintenance organization, the City of Puyallup shall submit a brief Annual Inspection and Maintenance Report to Pierce County Public Works Department on or before **May 15** of each calendar year, to include the following:

- Name, address, and telephone number of the businesses, persons, or firms responsible for plan implementation, and the person completing the report.
- Time period covered by the report.
- A chronological summary of activities conducted to implement the Maintenance Plan. A photocopy of the log sheet and applicable checklists (with any additional explanation needed) should normally suffice. For any activities conducted by paid parties, include a description of tasks and name of service provider and costs, or include copies of the invoices for services.
- An outline of planned activities for the coming year.

3.0 Description of the Drainage System and Facilities Serving the Right-Of-Way

The Right-of Way drainage system is split between Shaw Rd and Pioneer. A new stormfilter catch basin is proposed to replace an existing catch basin to collect, treat and convey stormwater for the Shaw Rd improvements. Shaw road improvements include driveway entrance, pavement restoration, street lighting, and shared use path. Combination inlets, gravel dispersion trench and compost amended vegetated filter strip are proposed to collect, disperse, and treat stormwater for the Pioneer improvements. Pioneer improvements include driveway entrance, pavement restoration, road widening, street lighting, and sidewalks.

Refer to Appendix A, Exhibit A-3 for the Proposed Site Map.

4.0 Right-Of-Way and Facility Management

4.1 Permeable Pavement

Permeable pavement is a paving system that allows rainfall to percolate through the surface into the underlying soil or an aggregate bed, where stormwater is stored and infiltrated to underlying soil, or removed by an overflow drainage system. All frontage sidewalks for the East Town Crossing project use pervious cement concrete, underlaid by 6” of permeable ballast. Operations

and maintenance of the pervious sidewalk shall conform to the City of Puyallup O&M standards for Permeable Pavement (See appendix C-1).

4.2 StormFilter Catch Basin

StormFilter Catch Basins are a type of media cartridge filter utilized to provide stormwater treatment. They are passive, and flow through systems comprised of one or more vaults that house rechargeable, media-filled cartridges. Stormwater passes through a filtering medium, which traps particulates and/or absorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way. The ETC Frontage Project replaces an existing Catch Basin along Shaw Rd with a StormFilter Catch Basin for the purposes of stormwater collection and treatment. Operations and maintenance of the StormFilter Catch Basin shall conform to the City of Puyallup O&M standards for Media Cartridge Filter and Catch Basin (See appendix C-1). Additionally, please comply to and use the Contech StormFilter Inspection and Maintenance Procedures included in appendix C-1.

4.3 Combination Inlet

A combination inlet is a structure used for the collection and conveyance of stormwater, similar to a traditional catch basin. Using a combination inlet allows for a shallower cover over the conveyance pipe, and the structure does not have any sump. The structure is shaped to fit within a stretch of roadside curb. The ETC frontage project used the Neenah Combination Inlet (R-3165) to collect and convey stormwater from Pioneer. Operations and maintenance of the Combination Inlet shall conform to the City of Puyallup O&M standards for Catch Basin (See appendix C-1).

4.4 Gravel Dispersion Trench

Gravel dispersion trenches are gravel filled trenches used to spread runoff over vegetated areas. Gravel dispersion trenches are used in the ETC Frontage Project along Pioneer to disperse runoff collected from the combination inlets before release over the compost amended vegetated filter strip (CAVFS). Operations and maintenance of the gravel dispersion trench shall conform to the City of Puyallup O&M standards for Downspout Dispersion Trench (See appendix C-1).

4.5 Compost Amended Vegetated Filter Strip

Compost amended vegetated filter strips (CAVFS) are utilized to treat stormwater runoff. They are linear strips of grass or other vegetation that remove sediment and oils from stormwater by filtering it. Stormwater is treated as it runs across the filter. Compost amended soil provides important stormwater functions including water infiltration; nutrient, sediment, and pollutant absorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. Operations and maintenance of the CAVFS shall conform to the City of Puyallup O&M standards for Filter Strip, Compost-Amended Soil, and Vegetation (See appendix C-1).

5.0 Source Control

Onsite waste will consist of oil, grease (and other fluids from cars and trucks), sediment, and small quantities of fertilizers and pesticides. The following actions should be taken so that pollution generated onsite will be minimized:

- Warning signs (e.g., “Dump No Waste – Drains to Groundwater”) shall be painted or embossed on or adjacent to all storm drain inlets. They shall be repainted as needed.

- Parking lots shall be swept when necessary to remove debris.
- Vehicle maintenance, washing, mixing of pesticides, or any other activities that would contribute high concentrations of pollution to the stormwater conveyance system should not be performed in the parking lot.

6.0 Instructions for Person Maintaining Stormwater System

Appendix C Exhibits contains stormwater facility maintenance checklists. Plan to complete these checklists for all system components per the following schedule:

- Monthly from October through April;
- Once in late summer (preferably September); and
- After any major storm events (items marked “S” only).

Remove this section.
[Storm Report; Pg 188 of 273]

Using photocopies of the attached pages, check off the problems that are noted each time the item is inspected. Document comments on problems found and the corrective action taken. The inspection checklist sheets should be kept on file and used to prepare the annual report required by Pierce County, due on or before **May 15** of each year. Use the Pierce County suggested inspection frequency at the left of each item as an inspection guide.

For questions, contact Pierce County Surface Water Management.

7.0 Conclusion

This analysis is based on data and records either supplied to or obtained by AHBL, Inc. These documents are referenced within the text of the analysis. The analysis has been prepared utilizing procedures and practices within the standard accepted practices of the industry. We conclude that if this plan is implemented, the owner can expect the stormwater conveyance system to function as designed.

AHBL, Inc.

Christopher Watt
Project Engineer

CJW

November 2024

Q:\2023\2230752\10_CIV\NON_CAD\REPORTS\SSP - Frontage Memo\Maintenance Report\20241122 Rpt (Maint Plan Frontage) 2230752.10.docx

Appendix C Exhibits

- Exhibit C-1: Maintenance Checklist

Permeable Pavement

Permeable pavement is a paving system which allows rainfall to percolate through the surface into the underlying soil or an aggregate bed, where stormwater is stored and infiltrated to underlying soil, or removed by an overflow drainage system.

Facility elements that are typically associated with permeable pavement include:

- Wearing course: The surface layer of any permeable pavement system is the wearing course. Categories of wearing courses include:
    - Porous asphalt: A flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate. However, the fine material (sand and finer) is reduced or eliminated, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Pervious concrete: A rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Interlocking concrete paver blocks: Solid, precast, manufactured modular units. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Aggregate Pavers (or Pervious Pavers): Modular precast paving units made with uniformly sized aggregates and bound with Portland cement concrete using a high strength adhesive. Unlike concrete paver blocks, these pavers are permeable. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Open-celled paving grid with gravel: Concrete or plastic grids that are filled with permeable aggregate. The system can be installed on an open-graded aggregate base.
    - Open-celled paving grid with grass: Concrete or plastic grids that are filled with a mix of sand, gravel, and topsoil for planting vegetation. The cells can be planted with a variety of non-turf forming grasses or low-growing groundcovers. The system can be installed on an open-graded aggregate base.

- Inlet (optional): While permeable pavement facilities often manage only the rain falling directly on the pavement surface, they may also be designed to accept stormwater runoff from additional areas (e.g., adjacent impervious areas, nearby rooftops). Runoff can be directed to the facility by two main methods:
    - Sheet flow to the surface: Surface areas of the facility receiving runoff contributions will likely be prone to clogging due to sediment inputs, particularly in areas of concentrated inflow. These areas should be carefully inspected and corrective maintenance should be performed as necessary to maintain the function of the pavement at these sites. In addition, the source of the sediment loads should be evaluated to determine if modifications to features in the drainage area landscape (e.g., stabilization of adjacent planted areas) would help to prevent clogging.
    - Piped flow into the aggregate base: Pipes dispersing water into the aggregate bed should be designed with cleanout access to allow pipe maintenance. Runoff that is piped into the aggregate base should be pretreated for sediment removal (e.g., screens, sumps) to protect the subbase from sedimentation and clogging. The pretreatment system must be maintained to remove accumulated sediment.
- Aggregate Base / Storage Reservoir: Stormwater passes through the wearing course to an underlying aggregate storage reservoir where it is stored prior to infiltration into the underlying soil. This aggregate bed also provides the structural function of supporting design loads (e.g., vehicle loading) for flexible pavement systems. To allow inspection of the aggregate course, some facilities have an observation port (typically installed during construction) that allows monitoring of the water levels in the aggregate bed to determine if the facility is draining properly.
- Overflow: Unless designed to provide full infiltration of stormwater, permeable pavement facilities have an overflow. Facility overflow can be provided by subsurface slotted drain pipe(s) (elevated in the aggregate bed) routed to an inlet or catch basin structure or by lateral flow through the storage reservoir to a daylighted drainage system.
- Underdrain with flow restrictor (optional): A slotted drain pipe with flow restrictor assembly may be installed at the bottom of or elevated within the aggregate storage reservoir. Permeable pavement facilities with underdrains and flow restrictors operate as underground detention systems with some infiltration.
- Signage or pavement marking can also be used to identify permeable pavement as a stormwater BMP and inform maintenance crews and the general public about protecting the facility's function (e.g., no stockpiling of soils or mulch on pavement surface).

Key Operations and Maintenance Considerations

- Installations can be monitored for adequate or designed minimum infiltration rates by observing drainage immediately after heavier rainstorms for standing water or infiltration tests using ASTM C1701.
- The following practices are recommended to maintain proper function of porous pavement systems:
    - Do not use of sealant on porous asphalt
    - Protect from construction site runoff with proper temporary erosion and sediment controls and flow diversion measures
    - Modifying utility cut procedures for permeable pavements - Protocols should recommend restoring permeable pavement section in-kind, where feasible, and require restoring permeable pavement section in-kind where replacement with conventional pavement would impact overall facility function. Utility cuts should be backfilled with the same aggregate base used under the permeable paving to allow continued conveyance of stormwater through the base, and to prevent migration of fines from the standard base aggregate to the more open graded permeable base material (Diniz, 1980). Replacing permeable pavement with conventional pavement is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function.
- A critical component of a successful maintenance program is regular removal of sediment, debris, and excessive moss from the facility surface to prevent clogging of the permeable wearing course. Surrounding landscaped areas should be inspected regularly and possible sediment sources controlled immediately.
- Protect the surface from stockpiles of landscaping materials (e.g., mulch, soil, compost).
- Clean permeable pavement surfaces to maintain infiltration capacity at least once or twice annually following recommendations below.
    - Porous asphalt and pervious concrete
        - Clean surfaces using suction, sweeping with suction or high-pressure wash and suction (sweeping alone is minimally effective). Hand held pressure washers are effective for cleaning void spaces and appropriate for smaller areas such as sidewalks.
        - Small utility cuts can be repaired with conventional asphalt or concrete if small batches of permeable material are not available or are too expensive.
    - Permeable pavers
        - The Interlocking Concrete Paving Institute (ICPI) recommends cleaning if the measured infiltration rate falls below 10 inches per hr.

        - Use sweeping with suction when surface and debris are dry 1-2 times annually (see next bullet for exception). Apply vacuum to a paver test section and adjust settings to remove all visible sediment without excess uptake of aggregate from paver openings or joints. If necessary, replace No 8, 89 or 9 stone to specified depth within the paver openings. Washing or power washing should not be used to remove debris and sediment in the openings between the pavers.
        - For badly clogged installations, wet the surface and vacuum aggregate to a depth that removes all visible fine sediment and replace with clean aggregate.
        - If necessary, use No 8, 89 or 9 stone for winter traction rather than sand (sand will accelerate clogging).
        - Replace broken pavers as necessary to prevent structural instability in the surface.
    - Plastic or Concrete grid systems
        - Remove and replace top course aggregate if clogged with sediment or contaminated (vacuum trucks for stormwater collection basins can be used to remove aggregate).
        - Remove and replace grid segments where three or more adjacent rings are broken or damaged.
        - Replenish aggregate material in grid as needed.
        - For grass installations, use normal turf maintenance procedures except do not aerate. Use very slow release fertilizers if needed.
- Modify typical snow removal procedures, such as:
    - Using a snow plow with skids or rollers to slightly raise the blade above permeable pavers or open-celled paving grid systems to prevent loss of top course aggregate and damage to paver blocks or grids.
    - Avoiding stockpiling plowed snow (i.e., dirty snow) directly on top of permeable pavement.
    - Use deicers in moderation (e.g., salt, molasses-based and chemical deicers) if needed.

Maintenance Standards

The table below provides the minimum required maintenance standards for permeable pavement components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities receiving high sediment loads (e.g., sanding) or facilities subject to extended wet, shady conditions where moss may accumulate.

Permeable Pavement			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
Permeable Pavements (all)	Material Deposited on Pavement	Runoff from adjacent pervious areas deposits soil, mulch, or sediment on paving.	Soil, mulch, or sediment from adjacent areas has been removed from permeable pavement and measures taken to prevent further deposition of soil/ mulch material from adjacent areas on permeable pavement.
	Vegetative Debris	Accumulation of organic debris and leaf litter. Vegetation related fallout clogs or will potentially clog voids.	Vegetative debris removed and sources trimmed/ pruned as appropriate to reduce further debris accumulation. Water infiltrates per design function.
Porous Asphalt or Pervious Concrete	Surface Clogged	Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate). Infiltration rate testing using ASTM C1701 indicates an infiltration rate of 10 inches per hour or less.	Surface has been cleaned/ cleared of sediment, debris, vegetation or other material and water infiltrates per design function.
	Sediment on Surface	Sediment present at the surface of the pavement.	Source of sediment has been identified and addressed, if possible. Surface of pavement is free of sediment.
	Moss Growth on Pavement	Moss growth inhibits infiltration or poses slip safety hazard.	Moss removed such that there is not a slip safety hazard and pavement infiltrates per design function.
	Pavement Damaged	Major cracks or trip hazards and concrete spalling and raveling.	Cracks or other damage to pavement repaired to grades and tolerances per design specifications; infiltration functions per design.
Interlocking Concrete Paver Blocks and Aggregate Pavers	Surface Clogged	Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate).). Infiltration rate testing using ASTM C1701 indicates an infiltration rate of 10 inches per hour or less.	Surface has been cleaned/ cleared of sediment, debris, vegetation or other material and water infiltrates per design function.
	Settlement	Settlement of pavement surface (may indicate other problems).	Pavement restored to finished grades per design specifications and record drawings. Surface drainage function restored.
	Sediment on Surface	Sediment present at the surface of the pavement.	Surface of pavement is free of sediment and infiltrates per design function.
	Moss Growth on Pavement	Moss growth inhibits infiltration or poses slip safety hazard.	Moss removed such that there is not a slip safety hazard and pavement infiltrates per design function.
	Pavers Missing/ Damaged	Paver block(s) are missing or damaged.	Paver blocks repaired or replaced per design specifications and record drawings.
	Loss of Aggregate	Loss of aggregate material between paver blocks.	Aggregate replaced per design specifications and paver manufacturer's recommendations.

Permeable Pavement			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
	Settlement	Surface has settled in a manner that poses a safety hazard or inhibits infiltration.	Pavers restored to finished grades per design specifications and record drawings.
Open-Celled Paving Grid With Gravel	Aggregate Clogged	Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate).	Aggregate has been cleaned/ cleared of sediment, debris, vegetation or other material and water infiltrates per design function.
	Paving Grid Missing/ Damaged	Paving grid missing or damaged.	Paving grid replaced or restored per design specifications and record drawings.
	Settlement	Settlement of pavement surface (may indicate other problems).	Pavement restored to finished grades per design specifications and record drawings.
	Loss of Aggregate	Loss of aggregate in paving grid.	Aggregate replaced per design specifications.
Open-Celled Paving Grid With Grass	Aggregate Clogged	Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate).	Surface has been rehabilitated per manufacturer's recommendations and water infiltrates per design function.
	Paving Grid Missing/ Damaged	Paving grid missing or damaged.	Paving grid and grass surface replaced or restored per design specifications and record drawings.
	Settlement	Settlement of pavement surface (may indicate other problems).	Pavement restored to finished grades per design specifications and record drawings.
	Poor Grass Coverage	Poor grass coverage in paving grid.	Grass coverage restored per design specifications and manufacturer's recommendations.
Inlets/ Outlets/ Pipes	Inlet/ Outlet Pipe Damaged	Pipe is damaged.	Damaged pipe has been repaired/ replaced and flow capacity functions per design.
	Inlet/ Outlet Pipe Clogged	Pipe is clogged.	Pipe has been cleared and flow capacity functions per design.
	Underdrain Pipe Clogged	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period).	Pipe has been cleared and infiltration rate/ flow capacity of system functions per design.
	Raised Subsurface Overflow Pipe Clogged	Plant roots, sediment or debris reducing capacity of underdrain.	Pipe has been cleared and infiltration rate/ overflow capacity of system functions per design specifications.
	Outlet Structure Clogged	Sediment, vegetation, or debris reducing capacity of outlet structure.	Blockage has been cleared and outlet structure functions at full capacity per design.
	Erosion at Overflow	Native soil is exposed or other signs of erosion damage are present at discharge point.	Erosion has been repaired and eroded area stabilized.

Permeable Pavement			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
Observation Port	Water Visible in Storage Aggregate	Water remains in the storage aggregate longer than anticipated by design after the end of a storm.	Cause or ponding investigated and addressed as needed to bring facility into conformance with design function.

Media Cartridge Filters

Media cartridge filters are passive, flow-through, stormwater treatment systems. They are comprised of one or more vaults that house rechargeable, media-filled filter cartridges. Stormwater passes through a filtering medium, which traps particulates and/or adsorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way.

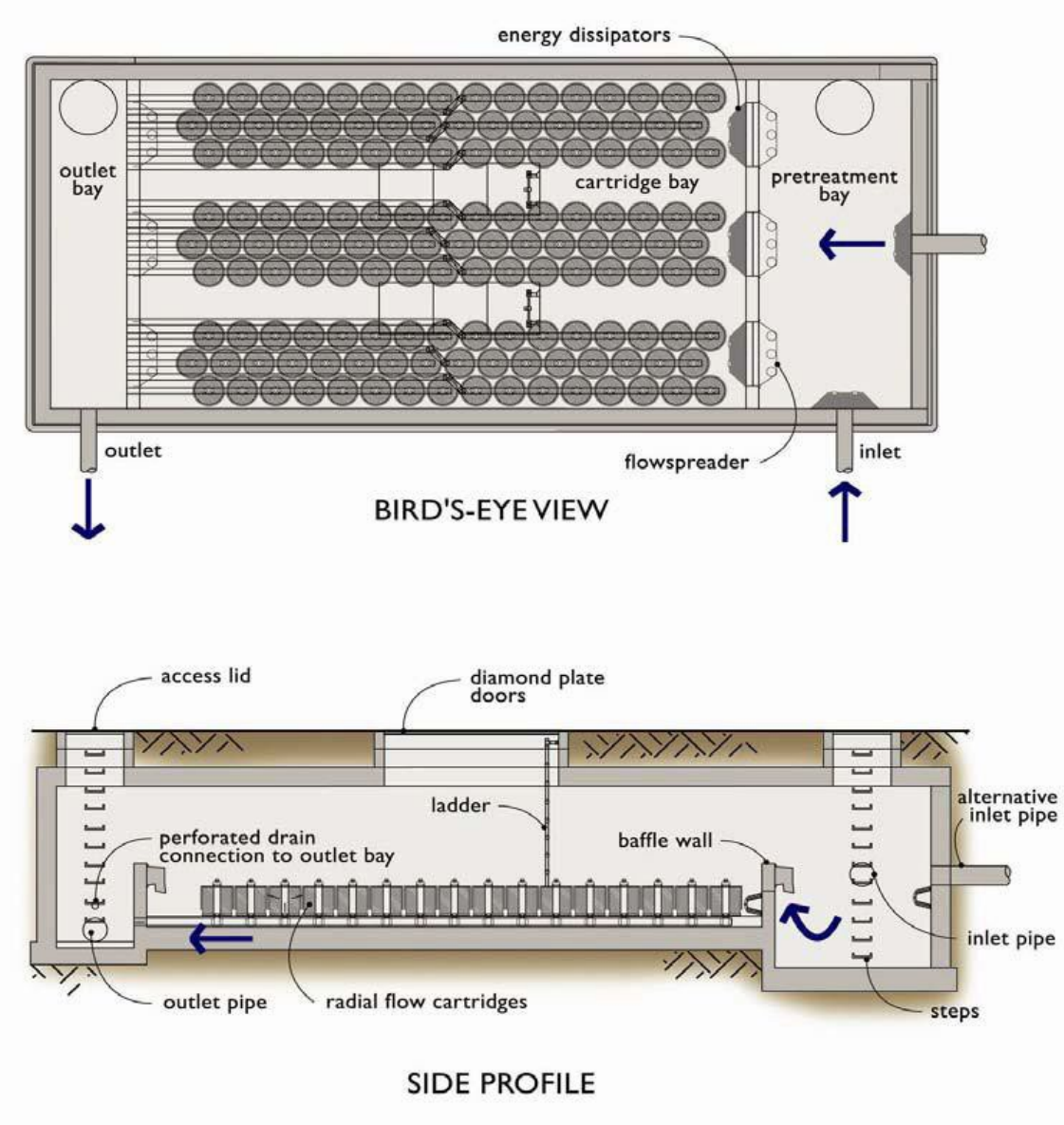
The filter media can be housed in cartridge filters enclosed in concrete vaults or catch basins. Structures will have vault doors or manhole lids (older designs) for maintenance access. Various types of filter media are available from system manufacturers.

StormFilter® units are an example of a proprietary manufactured media cartridge filter system. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a manufactured media filter system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe

Media Cartridge Filter Vault with Accumulated Sediment



Key Operations and Maintenance Considerations

- The most common tool for cleaning media cartridge filters is a truck with a tank and vacuum hose (e.g.Vactor® truck) to remove sediment and debris from the vault.
- Media cartridge filters are enclosed spaces where harmful chemicals and vapors can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by an individual trained and certified to work in hazardous confined spaces.
- Cartridges require replacement when the individual cartridges no longer meet the specifications for pollutant removal.

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into vault.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
Forebay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 1/3 of available sump.	All sediment removed from storage area.
Media Filter Vault	Sediment Accumulation on Top Media Filters (Cartridges)	Sediment depth exceeds 0.25-inches (on top of filter cartridges).	No sediment deposits which would impede permeability of the compost media. No sediment deposits on top of cartridges. (Sediment on cartridges likely indicates that cartridges are plugged and require maintenance.)
	Sediment Accumulation in Vault	Sediment depth exceeds 4 inches in chamber. Look for other indicators of clogged cartridges or overflow.	No sediment deposits in vault bottom of first chamber. Cartridges have been checked and replaced or serviced as needed.
	Trash and Debris Accumulation	Trash and debris accumulated in vault.	No trash or debris in vault.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris has been removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced to design specifications.
	Cover/lid not in place	Cover/lid is missing or only partially in place. Any open manhole requires immediate maintenance.	Manhole access covered.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.

	Frame and/or Top Slab	Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles Damaged	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to design specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets design specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media Clogging	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges have been replaced and drawdown time and overflow frequency are per design standards.
	Short Circuiting	Flows do not properly enter filter cartridges.	Flows are properly entering filter cartridges. Cartridges have been replaced if necessary.
	Filter Cartridges Submerged	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.	Filter media have been checked and replaced if needed and vault drains down within 24 of a storm event. (If cartridges are plugged with oil, additional treatment or source control BMP may be needed.)

CONTECH®
ENGINEERED SOLUTIONS

OPERATION AND MAINTENANCE

CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit. The steel CBSF is offered both as a standard and as a deep unit for additional internal overflow and sediment capacity.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. Steel and concrete units can accept surface and piped influent for roof leaders or similar applications.

The steel, concrete and plastic CBSF units have capacities of 4, 8 and 2 cartridges, respectively. Internal overflow capacity varies by system type from 0.5 cfs for the plastic, 1.3 cfs for the concrete and 1.0 or 1.8 cfs for the steel unit.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas or other non-traffic-bearing applications.

The steel CBSF consists of a sumped inlet chamber and cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed into the cartridge chamber through a port between the baffle and the overflow weir.

The concrete and plastic units operate similarly minus the presence of the inlet chamber or deep sump.

Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed to the outlet chamber and discharged to the outlet pipe on the downstream side of the overflow weir.

When influent flows exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that have little available hydraulic head. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF. The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re piping the storm system.

© 2020 Contech Engineered Solutions, a Quikrete Company

CatchBasin StormFilter™

Maintenance Guidelines

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight 100 lbs. each) or plastic grating.
3. Turn cartridge(s) approximately ¼ turn counter-clockwise to disconnect from pipe manifold.
4. Remove cartridge(s) from catch basin by hand or with appropriate hoisting equipment.
5. Remove accumulated sediment via vactor truck from all interior chambers.
6. Rinse interior of both bays and vactor remaining water and sediment.
7. Install fresh cartridge(s), by rotating ¼ turn clockwise, taking care not to damage cartridge connectors.
8. Replace cover(s).
9. Dispose of accumulated debris and spent media in accordance with local regulations.
10. Return used, empty cartridges to Contech for refurbishing.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure once the top cap and hood are removed. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance.

Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to Contech as appropriate.

Refurbished cartridges are available from Contech on an exchange basis. Contact the maintenance department of Contech at 513-645-7770 for more information.

Onsite maintenance is estimated at 26 minutes once setup for a single cartridge unit. Add approximately 5 minutes for each additional cartridge.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance.
3. Use of larvicides containing Bacillus thuringiensis israelensis (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer's recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit https://www.amvac.com/products/summit-bti-briquets.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following: https://anrcatalog.ucanr.edu/pdf/8125.pdf.

© 2020 Contech Engineered Solutions, a Quikrete Company

CONTECH®
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
   b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

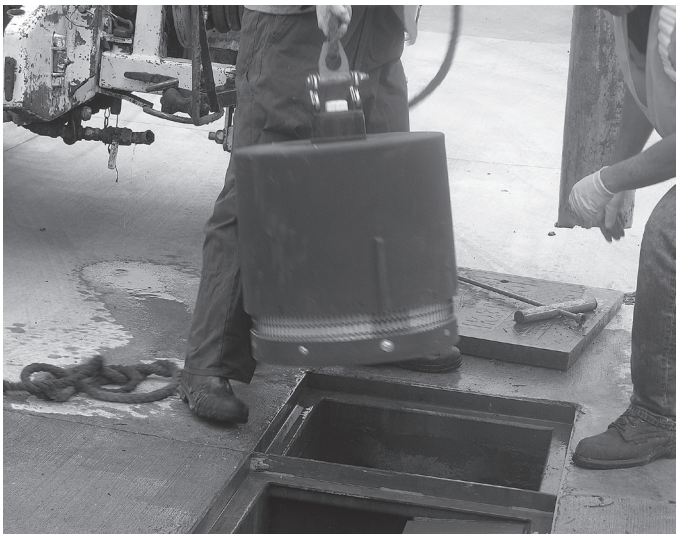
Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.



Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

RECYCLED PAPER

CONTECH®
ENGINEERED SOLUTIONS

© 2020 CONTECH ENGINEERED SOLUTIONS LLC, A QUIKRETE COMPANY

800-338-1122

www.ContechES.com

All Rights Reserved. Printed in the USA.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122.

Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

NOTHING IN THIS CATALOG SHOULD BE CONSTRUED AS A WARRANTY. APPLICATIONS SUGGESTED HEREIN ARE DESCRIBED ONLY TO HELP READERS MAKE THEIR OWN EVALUATIONS AND DECISIONS, AND ARE NEITHER GUARANTEES NOR WARRANTIES OF SUITABILITY FOR ANY APPLICATION. CONTECH MAKES NO WARRANTY WHATSOEVER, EXPRESS OR IMPLIED, RELATED TO THE APPLICATIONS, MATERIALS, COATINGS, OR PRODUCTS DISCUSSED HEREIN. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND ALL IMPLIED WARRANTIES OF FITNESS FOR ANY PARTICULAR PURPOSE ARE DISCLAIMED BY CONTECH. SEE CONTECH'S CONDITIONS OF SALE (AVAILABLE AT WWW.CONTECHES.COM/COS) FOR MORE INFORMATION.

Catch Basin

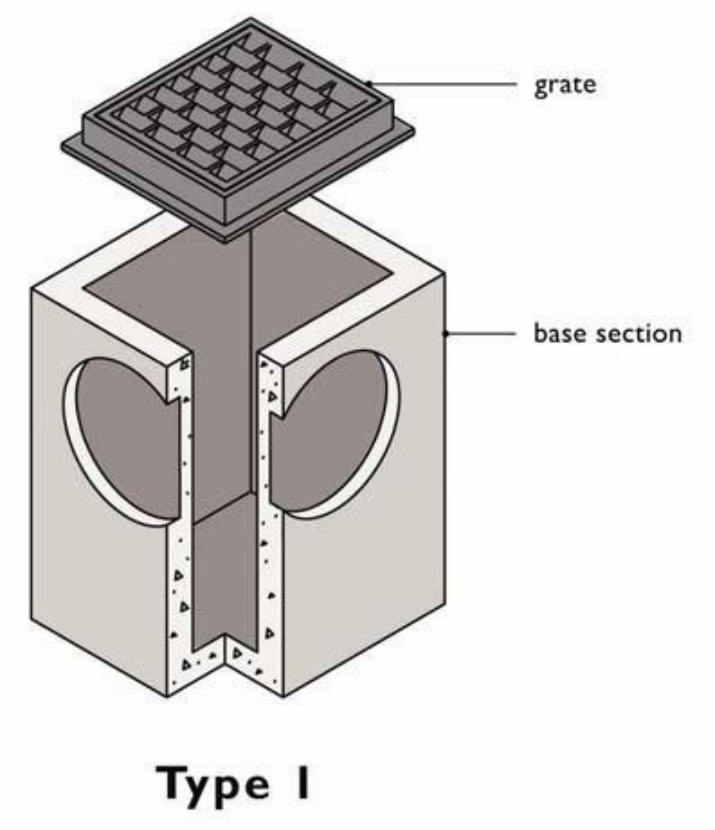
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under "Manhole" in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

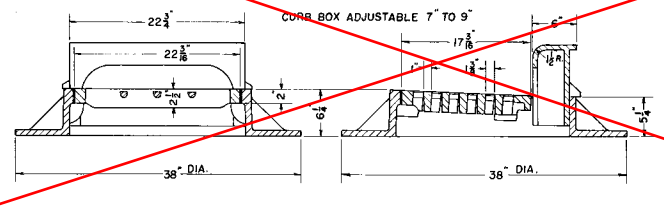
Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. • Identify and remove source	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread. One or more bolts are missing.	Mechanism opens with proper tools. All bolts are seated and no bolts are missing. Cover is secure.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

Supplied By:
TRENCHDRAIN SUPPLY
877-903-7246
www.trenchdrainsupply.com

R-3161
Combination Inlet Frame, Grate, Curb Box

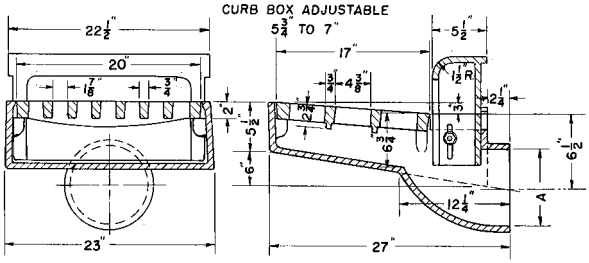
Heavy Duty



CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3161	S	1.3	4.7

R-3165
Combination Inlet Frame, Grate, Curb Box

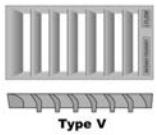
Heavy Duty



Furnished standard with Ductile Iron grate.
For use where conditions do not permit catch basin under inlet.
Drainage is to catch basin behind curb.
Available with 8", 10" or 12" rear outlet – specify when ordering.

CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3165	A	1.4	4.5
R-3165	V	1.2	4.5

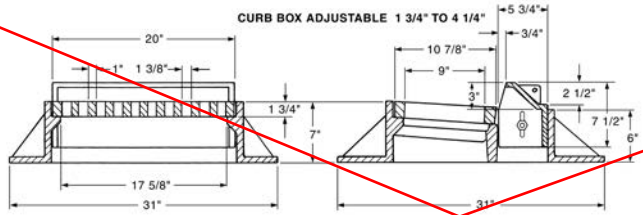
Standard Grate (shown): Type A
Alternate Grate(s):

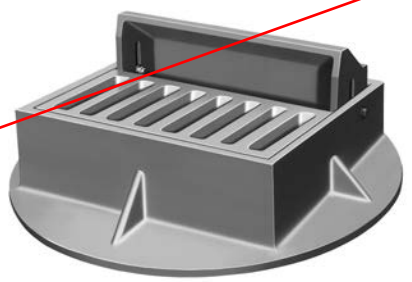

Type V

Available Curb Boxes: 1-1/2" open (shown), 3" open
Available with Curb Plate

R-3169
Combination Inlet Frame, Grate, Curb Box

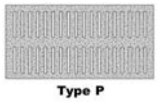
Heavy Duty

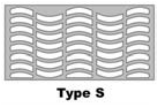




CATALOG NUMBER	GRATE TYPE	SQ. FT. OPEN	WEIR PERIMETER LINEAL FEET
R-3169	B	0.7	3.5
R-3169	P	0.2	3.5
R-3169	S	0.5	3.5

Standard Grate (shown): Type B
Alternate Grate(s):


Type P


Type S

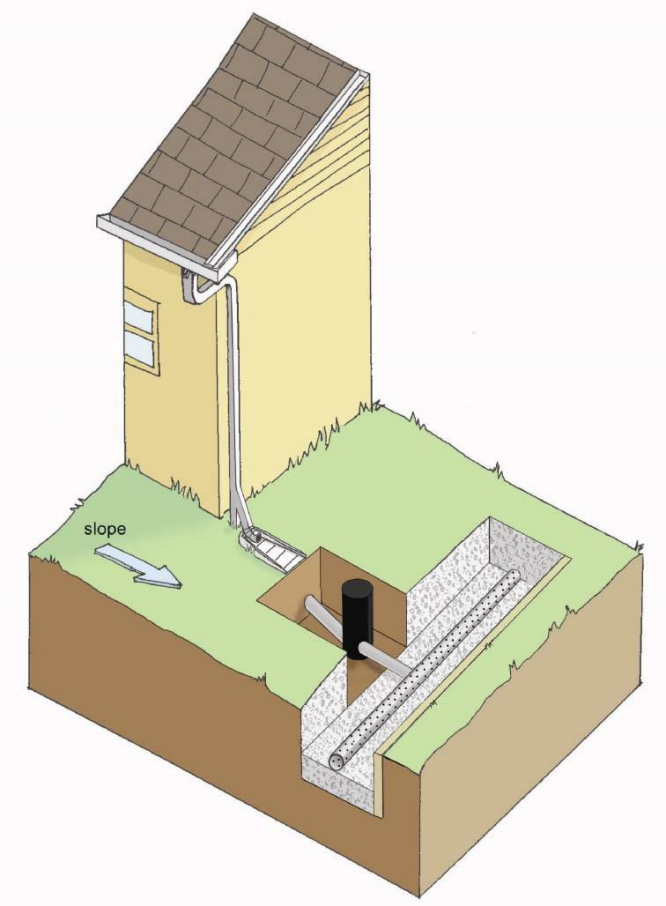
CLICK HERE to return to the Table of Contents

Downspout Dispersion Trench

Downspout dispersion trench systems consist of gravel-filled trenches, which serve to spread roof runoff over vegetated pervious areas.

Facility objects that are typically associated with downspout dispersion trench include:

- Dispersion trench: Gravel-filled trenches used to spread stormwater runoff from a downspout drain over a vegetated pervious area. Downspout drains are routed to a trench via a perforated or slotted pipe. The trench typically includes a notched grade board or other device to distribute flow equally along the length of the trench.
- Dispersal area: Stormwater is dispersed to an area vegetated with well-established lawn or pasture, landscaping with well-established groundcover, or native vegetation with natural groundcover. The required vegetated flow path is 50 feet for splash blocks and concentrated dispersion, 25 feet when using a dispersion trench and varies for sheet flow dispersion.



Schematic Downspout Dispersion using Dispersion Trench

Key Operations and Maintenance Considerations

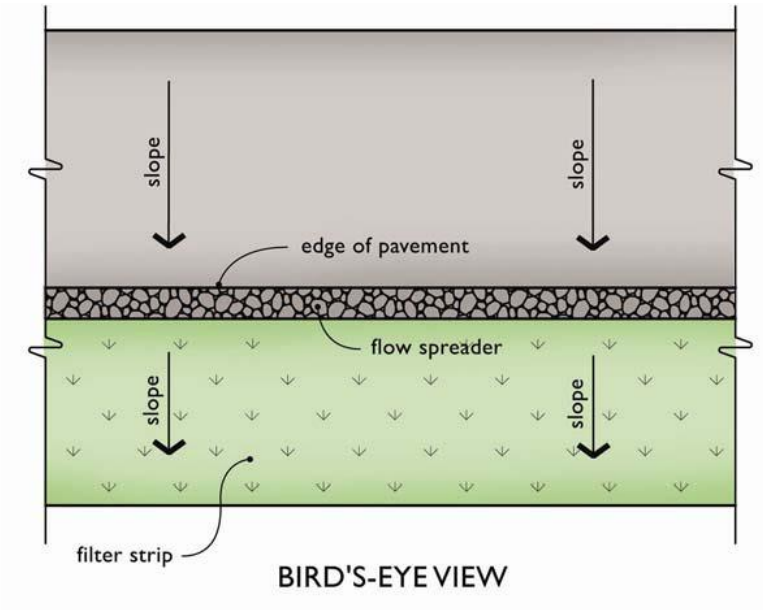
- For dispersion practices to be effective, the dispersion area must remain covered with dense, well-established vegetation. Site uses should protect vegetation and avoid compaction.
- A notched grade board at a dispersion trench must be maintained at a level grade to prevent concentrated flow. Downspout drains are directed to the trench via a storage sump that must be maintained to remove accumulated sediment.
- The groundcover for the extent of the flow in any dispersal area must be maintained to be dense enough to help disperse and infiltrate flows and to prevent erosion.
- The most common tools for cleaning these systems are hand tools to redistribute material disturbed by concentrated flows and a hose to flush downspouts.

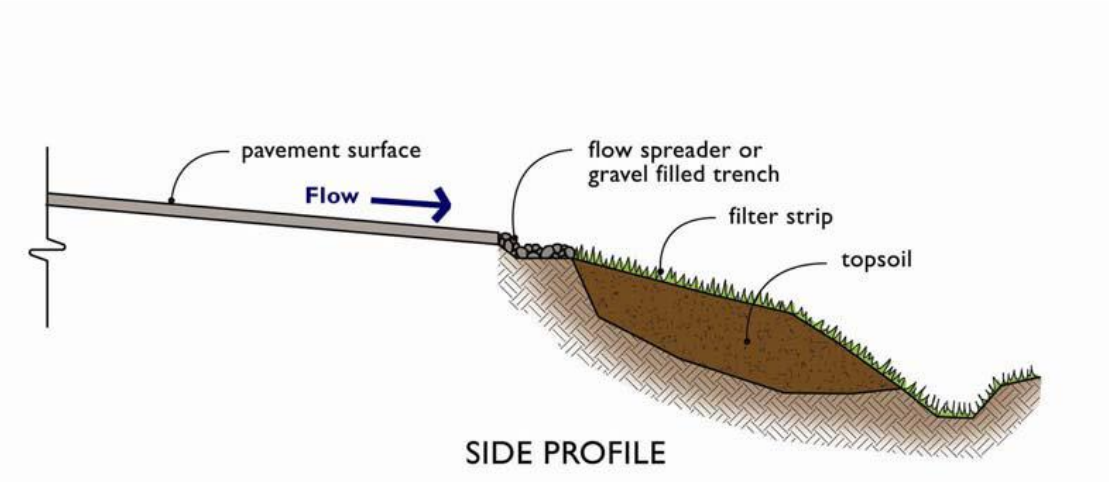
Downspout Dispersion Trench			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
General	Pests	Signs of pest infestations (IPM protocol threshold(s) are exceeded), including rodent holes or mounds that disturb dispersion flow paths.	Pests are not present or engaged in activities that present a significant public health risk or compromise to the intended design function of the facility. Pests that have exceeded acceptable thresholds have been addressed using appropriate IPM measures.
Dispersion Trench	Concentrated Discharge	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” from edge of trench; intent is to prevent erosion damage).	Water is discharging as a sheet flow and any disruptive material (e.g. trash, debris, sediment accumulation) has been removed from trench surface.
	Surface of Trench	Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow from facility. Vegetation/moss present on drain rock surface impedes sheet flow from facility.	Surface of drain rock is free of trash, debris, and sediment accumulation. Rock surface is open, free of vegetation buildup, and drains freely.
	Damage to or Trash/Sediment Accumulation Around Pipes	Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc. Pipe from sump to trench or drywell has accumulated sediment or is plugged. Cracked, collapsed, broken, or misaligned drain pipes.	Trash, debris, and sediment is cleared from dispersion trench components (gutters, pipes, etc.). Pipes are free of damage or defects that hinder system from functioning according to design.
Storage Sump	Sediment in Sump	Sediment in the sump.	Sediment not present in sump. Sediment has also been removed from adjacent components (inlet/outlet pipes, etc.) to prevent immediate re-accumulation.
	Access Lid Not Working	Cannot be easily opened; buried; or cover missing.	Access lid present and functioning per design standards.
	Erosion	Erosion of the pond’s side slopes and/or scouring of the pond bottom, which exceeds 6-inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
Rock Pad	General	Only one layer of rock exists above native soil in area 6 square feet or larger, or any exposure of native soil. Soil erosion in or adjacent to rock pad.	Rock pad has been repaired or replaced to meet design standards.

Downspout Dispersion Trench			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
			Note: table spans multiple pages.
Dispersal Area	Erosion or Sediment Accumulation	Erosion (gullies/ rills) greater than 2 inches deep in dispersal area. Accumulated sediment or debris to extent that blocks or channelizes flow path.	Cause of erosion has been eliminated and the damaged area has been repaired and stabilized.
	Standing Water After Storm Event	Standing surface water in dispersion area remains for more than 3 days after the end of a storm event.	Standing water drains within 72 hours of a storm event.
	Transition Zone Erosion and Sizing	Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than two feet of width.	Transition zone meets design criteria and does not exhibit erosion or other evidence of concentrated flows.
	Poor Vegetation Cover	Poor vegetation cover such that erosion is occurring.	Vegetation has been properly watered and established to meet facility design specifications.
	Excessive Vegetation Cover	Vegetation inhibits dispersed flow along flow path.	Vegetation has been weeded, trimmed, pruned, or thinned to meet facility design criteria.

Filter Strip

A filter strip is a linear strip of grass that removes sediment and oils from stormwater by filtering it. Stormwater is treated as it runs across the filter. Usually, filter strips are placed along the edge of linear paved areas such as parking lots and roads. Where designed filter strips are installed, road shoulders should only be graded to maintain level flow off the road.





Key Operations and Maintenance Considerations

- For filtration to be effective, the filter strip area must remain covered with well-established vegetation. Site uses should protect vegetation and avoid compaction.
- Inspect the filter strip frequently, especially after intense rainfall events and runoff events of long duration. Small breaks in the sod and small erosion channels quickly become large problems.
- Inspect flow spreader area for clogging and remove built-up sediment.
- Minimize the development of erosion channels within the filter. Even small channels may allow much of the runoff from the field to bypass the filter. These areas should be repaired and reseeded immediately to help ensure proper flow of runoff through the filter.
- Reseed or interseed bare areas of the filter. Since it may be difficult to re-establish vegetation in an established filter strip, the use of mulch or sod can help to reduce some problems.
- Mow and remove cuttings as required to maintain moderate vegetation height. Mowing two to three times per year may be necessary. The vegetation should not be mowed closer than 6 inches. More frequent mowing may be needed to prevent thatch buildup and smothering of vegetation. To avoid destruction of wildlife nesting areas, delay mowing until after mid-July. Fall mowing of the filter no closer than 6 inches will provide adequate winter habitat for wildlife.
- Control trees, brush and noxious weeds in the filter using either mechanical means or approved IPM practices.
- The most common tools for maintenance of filter strips are mowers and hand tools to remove built up debris at the edge of the filter strip and restore evenly distributed flow across the strip.

Filter Strip			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Grass is free of accumulated sediment. Slope is even and water flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10-inches); nuisance weeds and other vegetation starts to take over.	Vegetation is mowed to less than 3"-4" height. Nuisance vegetation has been removed such that flow is not impeded.
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Filter strip is free of trash and debris.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	Eroded/scoured areas have been repaired and facility filters stormwater per design function. (Ruts or bare areas less than 12 inches wide may be repaired filling damaged portion with crushed gravel; grass will creep in over the rock in time. For large bare areas [generally >12" wide], the filter strip should be re-graded and re-seeded. For smaller bare areas, over seed when bare spots are evident.)
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Spreader is level and clean so that flows are spread evenly over entire filter width.

Compost-Amended Soil

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition.

Compaction from construction can reduce the soil's natural ability to provide these functions. Compost-amended soils are intended to replace these lost functions by establishing a minimum soil quality and depth in the post-development landscape.

Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals. The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized.

Key Operations and Maintenance Considerations

- Replenish soil media as needed (as a result of erosion) and address compacted, poorly draining soils.
- Site uses should protect vegetation and avoid soil compaction. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.
- The table below provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Compost-Amended Soil			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Soil Media	Soils Waterlogged or Not Infiltrating	Soils become waterlogged, or otherwise do not appear to be infiltrating.	Soils have been aerated or amended such that infiltration occurs and soils to not remain completely saturated, per design specifications.
	Erosion/Scouring	Areas of potential erosion are visible, such as gullies or scouring.	Any eroded areas have been repaired, and sources of erosion addressed to prevent further soil erosion.
Vegetation	Vegetation in Poor Health	Less than 75% of planted vegetation is healthy with a generally good appearance.	At least 75% of planted vegetation is healthy with generally good appearance. Any conditions found that were deleterious to plant health have been corrected where possible. Routine maintenance schedule has been updated as necessary to ensure continued plant health and satisfactory appearance.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations.	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds Present	Other weeds (not listed on City/State noxious weed lists) are present on site.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.

Vegetation

Many stormwater facilities use vegetation as part of the functional design. Vegetation must be maintained to contribute to the function of the facility and to prevent damage to structural elements of the facility (e.g. earthen berms). Another reason to maintain vegetation is aesthetics.

Vegetation maintenance can include trimming, plant replacement, weeding, and pest control. Vegetation maintenance in native vegetation retention areas carries specific requirements.

Objectives for vegetation management in stormwater facilities:

- Maintain healthy plant communities
- Reduce or eliminate sources of pollution related to vegetation care
- Cover bare soil areas with plants
- Control Class A and Class B noxious weeds; control unlisted invasive plants where needed to achieve management objectives
- Tolerance for natural appearance and weeds that do not interfere with facility functions

Key Operations and Maintenance Considerations

- The vegetation management focus is establishing and maintaining healthy low-maintenance native plantings and sustaining the design function of vegetated filters such as biofiltration swales. This includes controlling invasive plants where appropriate, and planting cover on bare soils.
- Use plants appropriate to the facility type, as listed in the City of Puyallup's Engineering and Construction Standards Section 600.
- Consider the use of soil amendments such as compost before using fertilizer.
- Limit mulch use to covering bare soil while establishing plantings.
- When a chemical control method is chosen, carefully follow the manufacturer's label directions for use. When deciding on and using a chemical control, consider stormwater facilities and drainage systems as leading to water bodies and apply chemicals per the label directions for use over or near water.
- Allow a 5-foot buffer from mature established plantings to fence lines and access roads.
- Trees or shrubs that block access roads may be trimmed (or removed if within the access road) when access is required for maintenance by heavy equipment.
- Trees that pose a risk to stormwater structures due to root growth may be removed.

Use Only Appropriate Plants

Use plants that will thrive in the growing conditions of each facility. Growing conditions are affected by moisture, soil conditions, and light. Plants native to western Washington are preferred. Plant lists for biofiltration swales, bioretention systems, rain gardens, and other facility types are given in the City of Puyallup's Engineering and Construction Standards Section 600.

Integrated Pest Management

Landscape management decisions for controlling unwanted vegetation, diseases, and pests in stormwater facilities should follow Integrated Pest Management principles.

An IPM program might consist of the following steps:

Step 1: Correctly identify problem pests and understand their life cycle.

IPM starts with an understanding of the soil, water, natural resources, and human impacts on site. Identify and research the pest species, including basic physiology and best timing for control. Many pests are a problem during certain seasons or can only be treated in specific phases of the life cycle. Local pest identification help can be obtained from WSU Extension Master Gardeners or through online resources such as Washington State Noxious Weed Control Board and Washington Invasive Species Council.

Step 2: Establish tolerance thresholds for pests.

Every landscape has a population of some pest insects, weeds, and diseases. Once the pest has been identified and studied, determine if low levels of the pest are tolerable. Small numbers of certain pests may not be harmful. If this is the case, simply continue to monitor the pest population.

In other cases, the pest may require control. Examples include a pest population that is rapidly increasing in numbers, or an invasive weed that requires control according to state law. Early detection, rapid response (EDRR) plays an important role in the control of pests that are known to be a severe problem in other regions but not yet occurring in ours. In this instance, the tolerance threshold is zero; a quick response to eliminate a future ongoing pest problem is the safest and least expensive control.

Step 3: If pests exceed tolerance thresholds, choose a safe and effective control method.

IPM identifies physical, cultural, biological, and chemical control methods tailored specifically for the pest of concern and the site. Research the available options and choose a control method that is effective. Preferred control methods are economical, low risk to people, and mindful of environmental processes.

Physical control works on a pest directly: digging, hand-pulling, mowing, tilling, trapping, etc.

Cultural control changes the pest's environment: landscape fabric, mulch, soil amendments, altering the irrigation method or duration, crop rotation, crop covers, etc.

Biological control uses natural enemies: beneficial insects, managed grazing, bird boxes and perches, etc.

Chemical control is the use of pesticides: insect bait stations, synthetic and organic foliar herbicides, microbial-based insecticides, oils, soaps, etc.

These control methods should be looked at as tools in a toolbox; IPM selects the right tools for the job at hand. Both short-term control and long-term management is best achieved by using more than one tool. Often, implementing cultural control methods reduces the amount of physical and chemical control needed.

Step 4: Monitor and evaluate.

Observe and record the results of the control treatment. Evaluate the effectiveness. If necessary, modify maintenance practices to support a healthy landscape and prevent recurrence of the pest.

IPM emphasizes that pest control is not a one-time proposition; the pest control process should be viewed as a cycle that rotates through planning, control, and evaluation. As pest issues change over time, the IPM plan adapts.

- Proper planning and management decisions begin the IPM process. All control methods are considered during the information-gathering and planning process. Often a combination of methods is best.
- Cultural methods of vegetation and pest control are preferred.
- Mechanical means of vegetation and pest control are next in line of preference and are utilized where appropriate.
- Biological methods of vegetation and pest control are considered before chemical means, where they are appropriate.
- Botanical and synthetic pesticides are used in an appropriate manner when other control methods are deemed ineffective or not cost-efficient.

Annual Inspection Report

City of Puyallup – Stormwater BMP Facilities Inspection and Maintenance Log

Return Form to:
Stormwater Engineer/ City of Puyallup
333 South Meridian
Puyallup, WA 98371

Facility Name: _____

Address: _____

Begin Date: _____ End Date: _____

Date	BMP ID#	BMP facility Description	Inspected By	Cause for Inspection	Exceptions Noted	Notes / Actions Taken

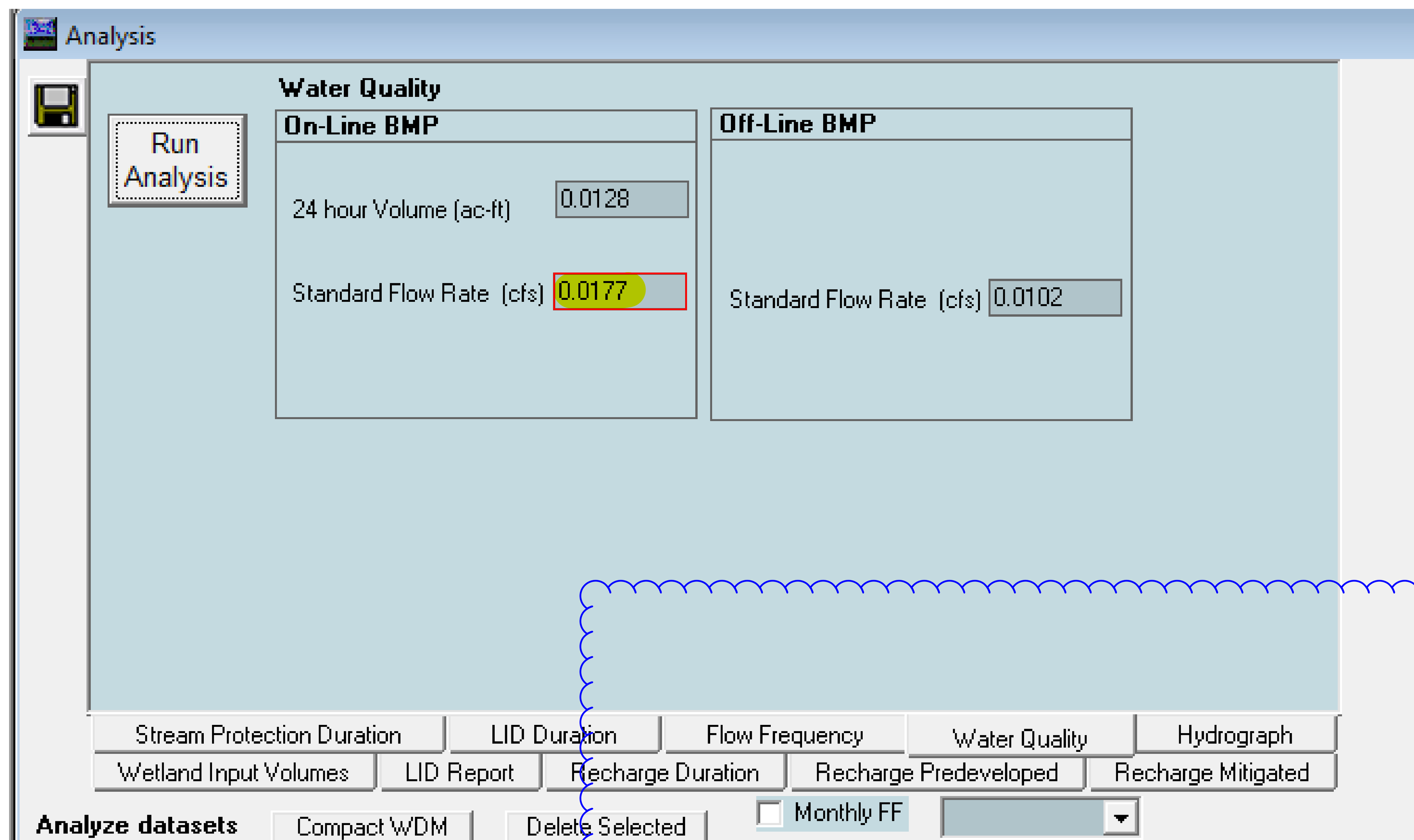
Instructions:

Record all inspections and maintenance for all treatment BMP's on this form. Use additional log sheets and/or attach extended comments or documentation as necessary. Submit a copy of the completed log with the Annual Independent Inspector Report to the City, and start a new log at that time. Checklists provided should be used prior to filling out this form. If you have any questions on how to complete your inspection, please contact City staff.

BMP ID #- always use ID# from the Operation and Maintenance Manual.
Inspected by- Note all Inspections and maintenance on this form, including the required independent annual inspection.
Cause for Inspection- Note if the inspection is routine, pre-rainy season, post storm, annual, or in response to a noted problem or complaint.
Exceptions Noted- Note any condition that requires correction or indicates a need for maintenance.
Notes / Actions Taken- Describe any maintenance done and need for follow up.

Appendix D

Drainage Calculations



WATER QUALITY FLOW RATE = 0.0177 CFS

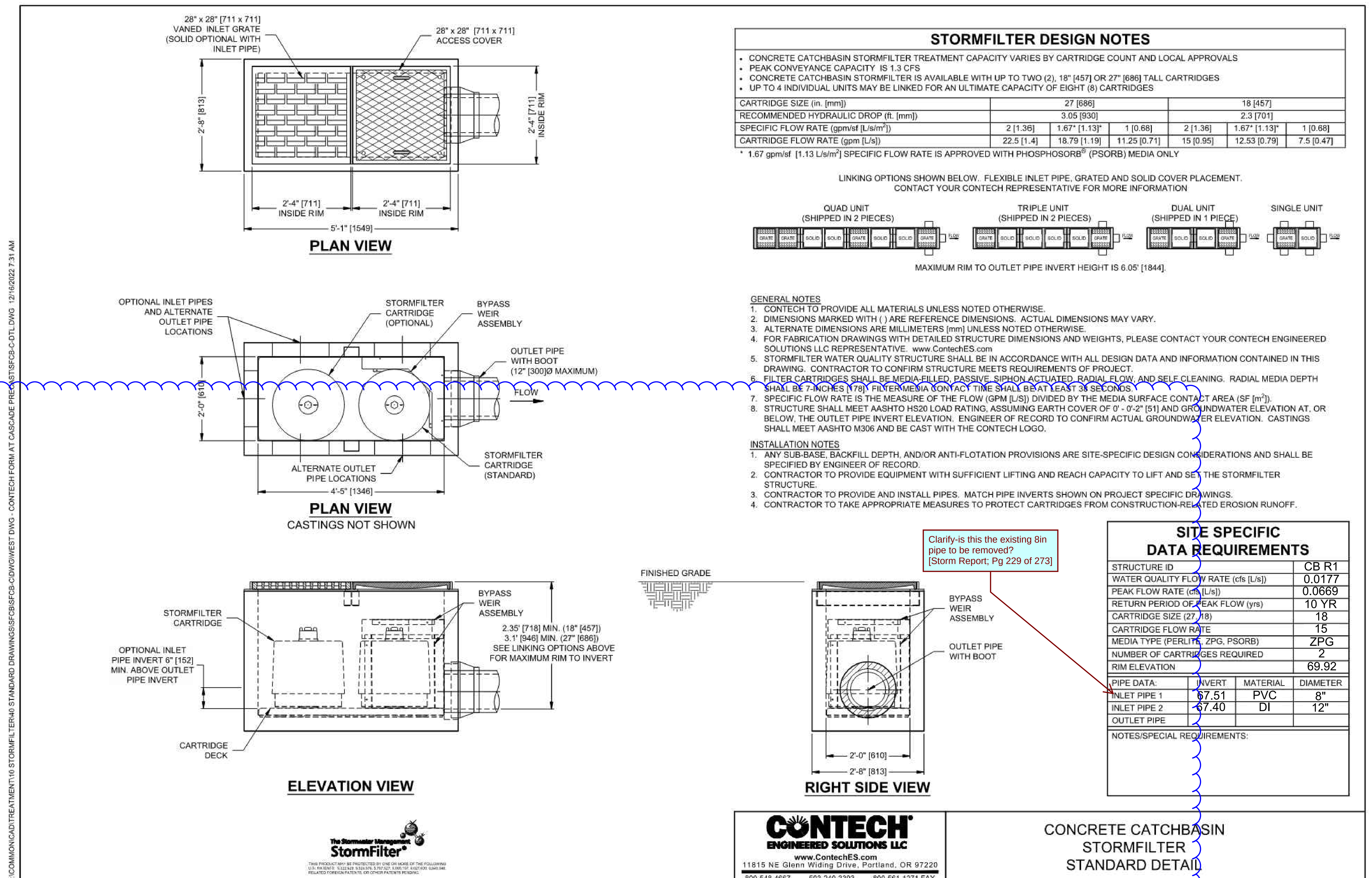
1 CFS = 448.8 GPM

WATER QUALITY FLOW RATE = 0.0177 CFS * 448.8 (GPM/CFS)

WATER QUALITY FLOW RATE = 8 ~~CFS~~ GPM

PER GULD REQUIREMENT (NEXT PAGE) THE FLOW RATE PER CARTRIDGE IS 7.5 GPM FOR 18" CARTRIDGES.

TWO CARTRIDGES ARE TO BE PROPOSED TO TREAT THE REQUIRED RUNOFF.



STORMFILTER DESIGN NOTES

- CONCRETE CATCHBASIN STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCAL APPROVALS
- PEAK CONVEYANCE CAPACITY IS 1.3 CFS
- CONCRETE CATCHBASIN STORMFILTER IS AVAILABLE WITH UP TO TWO (2), 18" [457] OR 27" [686] TALL CARTRIDGES
- UP TO 4 INDIVIDUAL UNITS MAY BE LINKED FOR AN ULTIMATE CAPACITY OF EIGHT (8) CARTRIDGES

CARTRIDGE SIZE (in. [mm])	27 [686]			18 [457]		
RECOMMENDED HYDRAULIC DROP (ft. [mm])	3.05 [930]			2.3 [701]		
SPECIFIC FLOW RATE (gpm/sf [L/s/m²])	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]
CARTRIDGE FLOW RATE (gpm [L/s])	22.5 [1.4]	18.79 [1.19]	11.25 [0.71]	15 [0.95]	12.53 [0.79]	7.5 [0.47]

* 1.67 gpm/sf [1.13 L/s/m²] SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

LINKING OPTIONS SHOWN BELOW. FLEXIBLE INLET PIPE, GRATED AND SOLID COVER PLACEMENT. CONTACT YOUR CONTECH REPRESENTATIVE FOR MORE INFORMATION

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	CB R1
WATER QUALITY FLOW RATE (cfs [L/s])	0.0177
PEAK FLOW RATE (cfs [L/s])	0.0669
RETURN PERIOD OF PEAK FLOW (yrs)	10 YR
CARTRIDGE SIZE (27, 18)	18
CARTRIDGE FLOW RATE	15
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG
NUMBER OF CARTRIDGES REQUIRED	2
RIM ELEVATION	69.92

PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1	67.51	PVC	8"
INLET PIPE 2	67.40	DI	12"
OUTLET PIPE			

NOTES/SPECIAL REQUIREMENTS:

AHBL
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 · 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 · 206.267.2425 TEL

WQ CALCS FOR STORMFILTER

EAST TOWN CROSSING

D-1

WASHINGTON STATE DEPARTMENT OF ECOLOGY

September 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

For

CONTECH Engineered Solutions
Stormwater Management StormFilter®
With ZPG Media at 1 gpm/sq ft media surface area

Ecology's Decision:

Based on the CONTECH Engineered Solutions' (CONTECH) application submissions, Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter® (StormFilter):

1. **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
   - **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
   - **Sized at a hydraulic loading rate of 1 gpm/ft^2 of media surface area, per Table 1, and**
   - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

Table 1. StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	12	18	27
Cartridge Flow Rate (gpm/cartridge)	5	7.5	11.3

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**
   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **This designation has no expiration date, but Ecology may amend or revoke it.**

<u>Ecology's Conditions of Use</u>:

The StormFilter with ZPG media shall comply with the following conditions:

1. **Design, install, operate, and maintain the StormFilter with ZPG media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**

2. **Install StormFilter systems to bypass flows exceeding the water quality treatment rate. Additionally, high flows will not re-suspend captured sediments. Design StormFilter systems in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified.**

3. **Owners must follow the design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual.**

4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**

5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

    - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with ZPG media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
    - **Accumulated vault sediment depths exceed an average of 2 inches, or**
    - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
    - **Standing water remains in the vault between rain events, or**
    - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **CONTECH shall maintain readily available reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**
- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).

- **Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.**

- **Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).**

Approved Alternate Configurations

Peak Diversion StormFilter

1. The Peak Diversion StormFilter allows for off-line bypass within the StormFilter structure. Design capture flows and peak flows enter the inlet bay which contains an internal weir. The internal weir allows design flows to enter the cartridge bay through a transfer hole located at the bottom of the inlet bay while the unit routs higher flows around the cartridge bay.
2. To select the size of the Peak Diversion StormFilter unit, the designer must determine the number of cartridges required and size of the standard StormFilter using the site-specific water quality design flow and the **StormFilter Design Flow Rates per Cartridge** as described above.
3. New owners may not install the Peak Diversion StormFilter at an elevation or in a location where backwatering may occur.

Applicant: Contech Engineered Solutions

Applicant's Address: 11835 NE Glenn Widing Dr.
Portland, OR 97220

Application Documents:

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) *Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering Report (TEER) by Stormwater Management Inc*., October 29, 2004
Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

1. Complete the data validation report.
2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
3. Provide a recommendation of the appropriate technology use level.
4. Work with Ecology to post recommend relevant information on Ecology's website.
5. Provide additional testing recommendations, if needed."
6. This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).
- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG™ at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."
- "Peak Diversion StormFilter" is a technical document demonstrating the Peak Diversion StormFilter system complies with the Stormwater Management Manual for Western Washington Volume V Section 4.5.1.

Above-listed documents noted as "public" are available by contacting CONTECH.

Applicant's Use Level Request:

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft^2 of media surface area in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE).*

Applicant's Performance Claim:

The combined data from the two field sites reported in the TER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG™ media and a hydraulic loading rate of 1 gpm/ft^2 of media surface area meets Ecology performance goals for Basic Treatment.

Ecology's Recommendations:

Based on the weight of the evidence and using its best professional judgment, Ecology finds that:

- StormFilter, using ZPG™ media and operating at a hydraulic loading rate of no more than 1 gpm/ft^2 of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment (TSS removal) performance goals. Contech demonstrated this is through field and laboratory testing performed in accordance with the approved protocol. StormFilter is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

Findings of Fact:

- Influent TSS concentrations and particle size distributions were generally within the range of what Ecology considers "typical" for western Washington (silt-to-silt loam).
- Contech sampled thirty-two (32) storm events at two sites for storms from April 2003 to March 2004, of which Contech deemed twenty-two (22) as "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If we exclude the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average

influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.

- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, the field results generally reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that the evaluators operated the I-5 Lake Union at 50%, 100%, and 125% of design flow*.
- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.

Technology Description:

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter can treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

Operation:

The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains percolates through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

This document includes a bypass schematic for flow rates exceeding the water quality design flow rate on page 8.

StormFilter Configurations:

Contech offers the StormFilter in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, drywell, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, piping directs stormwater through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater ponds and percolates horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where piping directs it into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump discharges through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where you anticipate heavy grit loads, pretreatment by settling may be necessary.

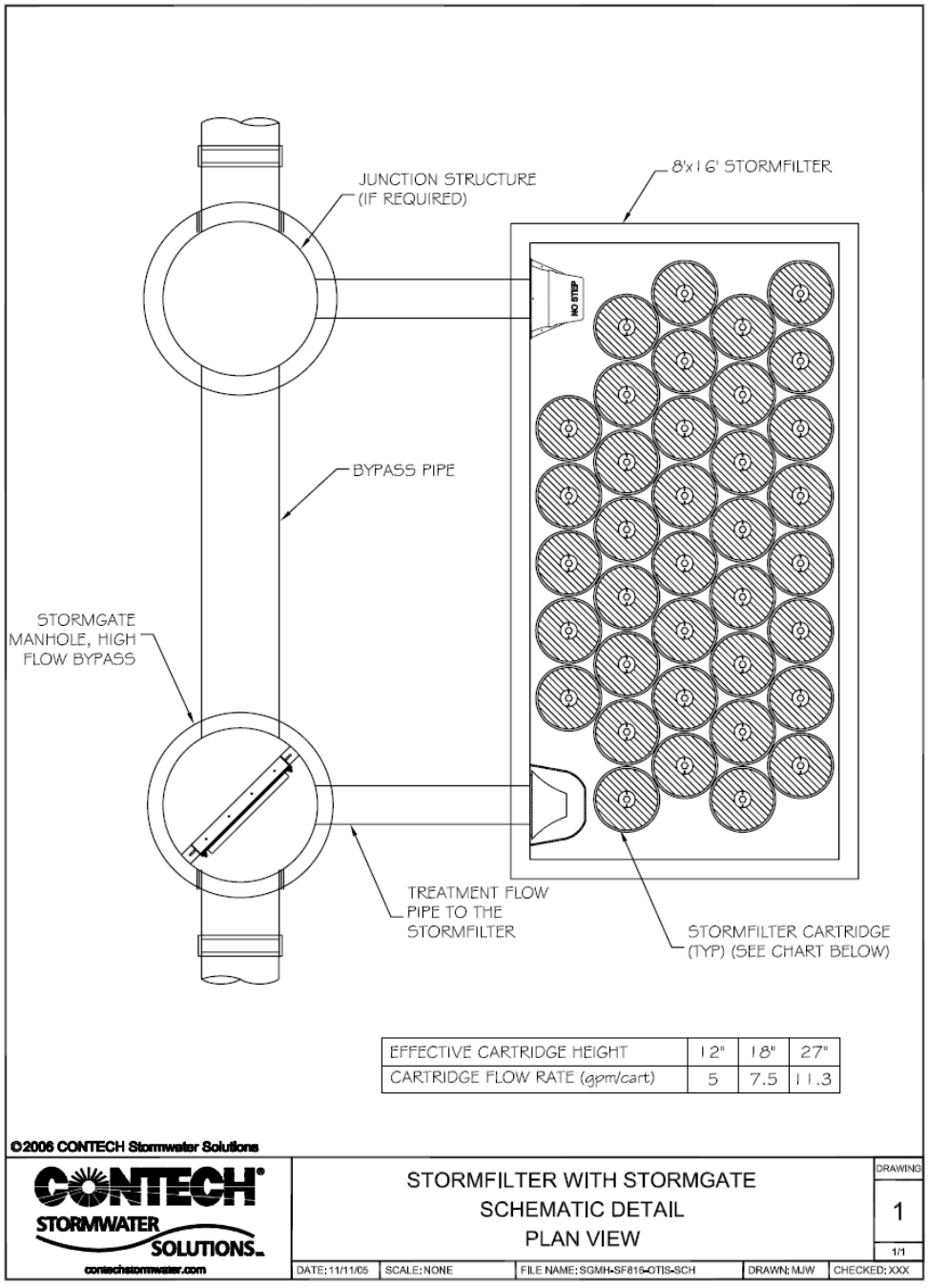


Figure 1. Stormwater Management StormFilter Configuration with Bypass

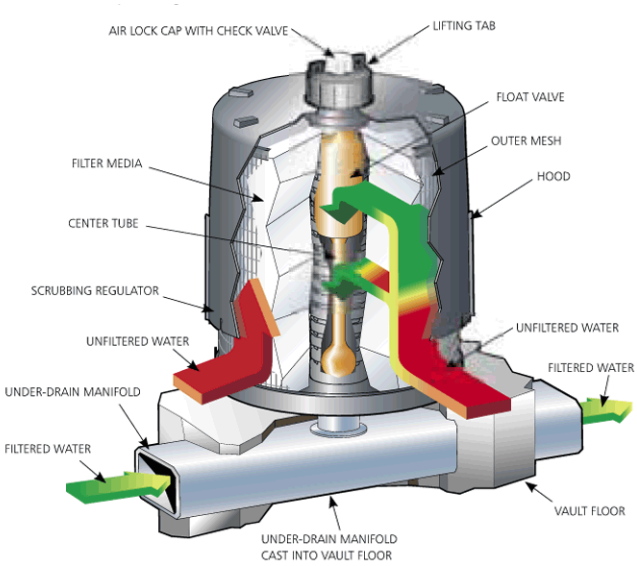


Figure 2. The StormFilter Cartridge

Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. Water displaces the air in the cartridge and it purges from beneath the filter hood through the one-way check valve located in the cap. Once water fills the center tube there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the under-drain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, water filters through the entire filter cartridge throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air quickly flows beneath the hood through the scrubbing regulators, causing energetic bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as

specified in the CONTECH *Product Design Manual*, operators may adjust the flow rate through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

Recommended research and development:

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, CONTECH recommends the following actions:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

Contact Information:

Applicant Contact: Sean Darcy
Contech Engineered Solutions
11835 NE Glenn Widing Drive
Portland, OR, 97220
503-258-3105
sdarcy@conteches.com

Applicant Web link http://www.conteches.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology Contact: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
Jan 2005	Original Use Level Designation
Dec 2007	Revision
May 2012	Maintenance requirements updated
November 2012	Design Storm and Maintenance requirements updated
January 2013	Updated format to match Ecology standard format
September 2014	Added Peak Diversion StormFilter Alternate Configuration

Figure D-2: CAVFS Sizing

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: 20241121 - CAVFS
Site Name:
Site Address:
City:

Report Date:	12/16/2024
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2024/06/28
Version:	4.3.1

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.3673
Pervious Total	0.3673
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.3673

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 1	POC 1

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.3673
Impervious Total	0.3673
Basin Total	0.3673

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
CAVFS 1 Surface 1	CAVFS 1 Surface 1	POC 1

Routing Elements
Predeveloped Routing

Mitigated Routing

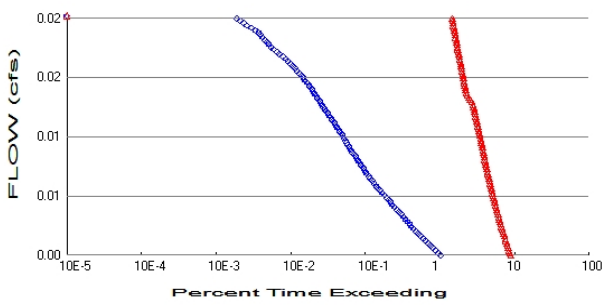
CAVFS 1

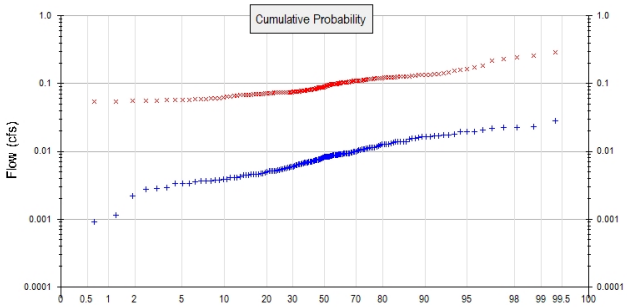
CAVFS Length:	300.00 ft.
CAVFS Width:	2.00 ft.
Gravel thickness:	2 ft.
Material thickness of CAVFS layer:	2.333 ft.
Slope of CAVFS layer:	0.25 ft.
	Outlet Control
Overflow Height:	0.5 ft.
Overflow width:	150 in.

Project shows 300 ft in length and 2 ft in width, matching WWHM values

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.3673
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.3673

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.008299
5 year	0.012769
10 year	0.015353
25 year	0.018151
50 year	0.019951
100 year	0.021513

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.090024
5 year	0.121034
10 year	0.144064
25 year	0.176138
50 year	0.202284
100 year	0.230444

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.007	0.093
1903	0.005	0.116
1904	0.009	0.130
1905	0.004	0.066
1906	0.002	0.071
1907	0.013	0.104
1908	0.009	0.086
1909	0.009	0.092
1910	0.013	0.111
1911	0.008	0.081

1912	0.028	0.216
1913	0.013	0.066
1914	0.003	0.258
1915	0.005	0.061
1916	0.008	0.116
1917	0.003	0.056
1918	0.009	0.088
1919	0.007	0.056
1920	0.008	0.078
1921	0.009	0.068
1922	0.009	0.088
1923	0.007	0.075
1924	0.004	0.093
1925	0.005	0.057
1926	0.008	0.097
1927	0.006	0.080
1928	0.006	0.075
1929	0.013	0.128
1930	0.008	0.140
1931	0.008	0.074
1932	0.006	0.081
1933	0.007	0.075
1934	0.017	0.118
1935	0.008	0.073
1936	0.007	0.072
1937	0.011	0.106
1938	0.007	0.074
1939	0.001	0.075
1940	0.008	0.127
1941	0.005	0.097
1942	0.011	0.105
1943	0.006	0.121
1944	0.012	0.183
1945	0.009	0.125
1946	0.005	0.072
1947	0.004	0.083
1948	0.018	0.103
1949	0.015	0.135
1950	0.004	0.065
1951	0.006	0.060
1952	0.023	0.172
1953	0.021	0.163
1954	0.007	0.089
1955	0.006	0.060
1956	0.003	0.056
1957	0.011	0.075
1958	0.022	0.109
1959	0.014	0.097
1960	0.004	0.075
1961	0.014	0.245
1962	0.007	0.084
1963	0.004	0.055
1964	0.004	0.133
1965	0.016	0.099
1966	0.005	0.065
1967	0.007	0.068
1968	0.007	0.070
1969	0.007	0.091

1970	0.011	0.096
1971	0.016	0.114
1972	0.011	0.290
1973	0.014	0.143
1974	0.008	0.116
1975	0.017	0.154
1976	0.009	0.123
1977	0.004	0.062
1978	0.015	0.122
1979	0.004	0.087
1980	0.009	0.076
1981	0.008	0.110
1982	0.004	0.071
1983	0.014	0.104
1984	0.006	0.104
1985	0.010	0.079
1986	0.008	0.069
1987	0.016	0.088
1988	0.010	0.075
1989	0.009	0.073
1990	0.010	0.073
1991	0.008	0.123
1992	0.011	0.126
1993	0.011	0.122
1994	0.016	0.097
1995	0.004	0.059
1996	0.018	0.081
1997	0.007	0.071
1998	0.009	0.102
1999	0.001	0.078
2000	0.007	0.108
2001	0.004	0.068
2002	0.012	0.136
2003	0.010	0.080
2004	0.009	0.118
2005	0.016	0.138
2006	0.005	0.067
2007	0.006	0.111
2008	0.009	0.075
2009	0.006	0.076
2010	0.005	0.115
2011	0.005	0.054
2012	0.007	0.114
2013	0.005	0.074
2014	0.004	0.075
2015	0.007	0.102
2016	0.003	0.057
2017	0.013	0.161
2018	0.023	0.105
2019	0.022	0.128
2020	0.007	0.096
2021	0.011	0.111
2022	0.005	0.102
2023	0.010	0.136
2024	0.019	0.227
2025	0.009	0.060
2026	0.014	0.083
2027	0.005	0.099

2028	0.004	0.046
2029	0.009	0.083
2030	0.017	0.106
2031	0.006	0.057
2032	0.003	0.057
2033	0.005	0.058
2034	0.005	0.075
2035	0.019	0.110
2036	0.010	0.071
2037	0.003	0.079
2038	0.009	0.099
2039	0.001	0.121
2040	0.005	0.088
2041	0.006	0.100
2042	0.020	0.124
2043	0.009	0.119
2044	0.012	0.091
2045	0.008	0.073
2046	0.010	0.079
2047	0.007	0.109
2048	0.010	0.100
2049	0.009	0.124
2050	0.006	0.085
2051	0.009	0.145
2052	0.005	0.074
2053	0.009	0.082
2054	0.011	0.132
2055	0.005	0.081
2056	0.004	0.103
2057	0.006	0.069
2058	0.008	0.088
2059	0.014	0.115

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0279	0.2900
2	0.0229	0.2579
3	0.0225	0.2445
4	0.0223	0.2270
5	0.0221	0.2158
6	0.0208	0.1831
7	0.0196	0.1716
8	0.0194	0.1627
9	0.0193	0.1610
10	0.0179	0.1541
11	0.0177	0.1452
12	0.0174	0.1433
13	0.0170	0.1395
14	0.0169	0.1379
15	0.0164	0.1360
16	0.0164	0.1358
17	0.0163	0.1349
18	0.0158	0.1326
19	0.0155	0.1317
20	0.0154	0.1299
21	0.0153	0.1282
22	0.0139	0.1280

23	0.0138	0.1268
24	0.0138	0.1259
25	0.0138	0.1253
26	0.0137	0.1244
27	0.0135	0.1243
28	0.0130	0.1234
29	0.0129	0.1233
30	0.0128	0.1224
31	0.0128	0.1216
32	0.0126	0.1212
33	0.0125	0.1205
34	0.0119	0.1189
35	0.0118	0.1184
36	0.0115	0.1183
37	0.0114	0.1162
38	0.0114	0.1157
39	0.0112	0.1156
40	0.0112	0.1149
41	0.0110	0.1147
42	0.0108	0.1139
43	0.0107	0.1138
44	0.0107	0.1108
45	0.0104	0.1107
46	0.0103	0.1107
47	0.0102	0.1101
48	0.0099	0.1098
49	0.0099	0.1094
50	0.0098	0.1085
51	0.0096	0.1081
52	0.0096	0.1063
53	0.0094	0.1060
54	0.0093	0.1051
55	0.0093	0.1049
56	0.0093	0.1039
57	0.0093	0.1037
58	0.0092	0.1036
59	0.0092	0.1033
60	0.0092	0.1027
61	0.0091	0.1019
62	0.0091	0.1019
63	0.0090	0.1017
64	0.0089	0.1002
65	0.0088	0.0996
66	0.0088	0.0995
67	0.0088	0.0994
68	0.0088	0.0990
69	0.0088	0.0973
70	0.0086	0.0970
71	0.0086	0.0969
72	0.0085	0.0967
73	0.0084	0.0964
74	0.0084	0.0958
75	0.0083	0.0935
76	0.0083	0.0927
77	0.0083	0.0916
78	0.0082	0.0908
79	0.0082	0.0905
80	0.0081	0.0886

81	0.0081	0.0884
82	0.0078	0.0884
83	0.0078	0.0882
84	0.0077	0.0879
85	0.0077	0.0878
86	0.0076	0.0867
87	0.0075	0.0863
88	0.0074	0.0854
89	0.0074	0.0844
90	0.0073	0.0834
91	0.0073	0.0833
92	0.0072	0.0831
93	0.0071	0.0818
94	0.0070	0.0815
95	0.0070	0.0814
96	0.0070	0.0811
97	0.0069	0.0809
98	0.0069	0.0803
99	0.0069	0.0799
100	0.0069	0.0793
101	0.0067	0.0789
102	0.0066	0.0786
103	0.0066	0.0783
104	0.0065	0.0780
105	0.0064	0.0763
106	0.0064	0.0759
107	0.0063	0.0754
108	0.0063	0.0754
109	0.0061	0.0754
110	0.0060	0.0754
111	0.0059	0.0750
112	0.0059	0.0750
113	0.0058	0.0748
114	0.0058	0.0747
115	0.0056	0.0747
116	0.0055	0.0745
117	0.0054	0.0745
118	0.0054	0.0744
119	0.0052	0.0741
120	0.0052	0.0737
121	0.0052	0.0734
122	0.0052	0.0734
123	0.0051	0.0728
124	0.0051	0.0725
125	0.0051	0.0720
126	0.0050	0.0716
127	0.0049	0.0715
128	0.0047	0.0709
129	0.0047	0.0708
130	0.0046	0.0705
131	0.0046	0.0697
132	0.0045	0.0695
133	0.0045	0.0685
134	0.0045	0.0681
135	0.0045	0.0677
136	0.0045	0.0677
137	0.0043	0.0671
138	0.0041	0.0660

139	0.0041	0.0658
140	0.0041	0.0649
141	0.0039	0.0647
142	0.0038	0.0621
143	0.0038	0.0608
144	0.0037	0.0603
145	0.0037	0.0598
146	0.0036	0.0597
147	0.0036	0.0593
148	0.0036	0.0583
149	0.0034	0.0574
150	0.0033	0.0572
151	0.0033	0.0569
152	0.0029	0.0566
153	0.0028	0.0563
154	0.0028	0.0560
155	0.0022	0.0559
156	0.0011	0.0548
157	0.0009	0.0542
158	0.0006	0.0458

Duration Flows

The Duration Matching Failed

Flow Control has been mitigated by onsite stormwater system

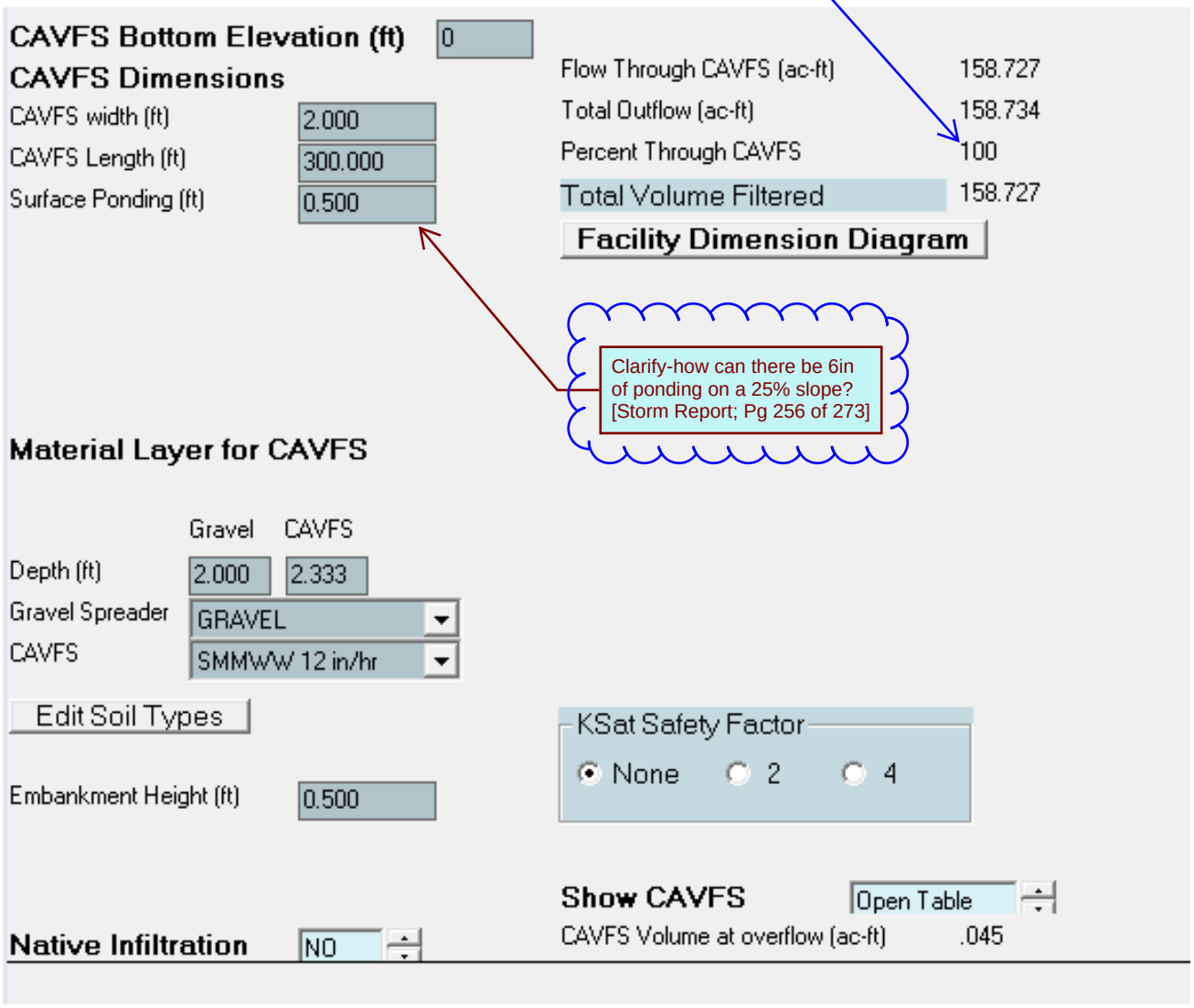
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0041	56841	492733	866	Fail
0.0043	52415	478939	913	Fail
0.0045	48370	467471	966	Fail
0.0046	44614	456169	1022	Fail
0.0048	41229	445255	1079	Fail
0.0049	38238	434673	1136	Fail
0.0051	35473	424258	1196	Fail
0.0053	32963	414231	1256	Fail
0.0054	30520	404480	1325	Fail
0.0056	28426	394785	1388	Fail
0.0057	26493	385588	1455	Fail
0.0059	24747	377112	1523	Fail
0.0061	23135	369467	1597	Fail
0.0062	21678	361932	1669	Fail
0.0064	20315	354453	1744	Fail
0.0065	19069	347307	1821	Fail
0.0067	17850	340271	1906	Fail
0.0069	16720	333346	1993	Fail
0.0070	15606	326587	2092	Fail
0.0072	14620	319939	2188	Fail
0.0073	13717	313623	2286	Fail
0.0075	12881	307307	2385	Fail
0.0077	12099	301490	2491	Fail
0.0078	11385	296172	2601	Fail
0.0080	10654	290853	2729	Fail
0.0081	9989	285757	2860	Fail
0.0083	9357	280660	2999	Fail
0.0085	8753	275784	3150	Fail
0.0086	8199	270909	3304	Fail
0.0088	7723	266034	3444	Fail
0.0089	7241	261380	3609	Fail
0.0091	6792	256782	3780	Fail
0.0093	6415	252184	3931	Fail
0.0094	6111	247807	4055	Fail
0.0096	5828	243486	4177	Fail
0.0097	5551	239386	4312	Fail
0.0099	5265	235674	4476	Fail
0.0101	5011	232018	4630	Fail
0.0102	4790	228528	4770	Fail
0.0104	4536	225037	4961	Fail
0.0105	4343	221658	5103	Fail
0.0107	4159	218279	5248	Fail
0.0109	3939	215010	5458	Fail
0.0110	3713	211852	5705	Fail
0.0112	3537	208583	5897	Fail
0.0113	3364	205426	6106	Fail
0.0115	3227	202379	6271	Fail
0.0117	3086	199387	6461	Fail
0.0118	2964	196340	6624	Fail
0.0120	2850	193459	6788	Fail
0.0121	2738	190412	6954	Fail
0.0123	2615	187476	7169	Fail
0.0124	2483	184429	7427	Fail
0.0126	2363	181382	7675	Fail

0.0128	2267	178390	7868	Fail
0.0129	2165	175398	8101	Fail
0.0131	2060	172573	8377	Fail
0.0132	1951	169858	8706	Fail
0.0134	1840	167144	9083	Fail
0.0136	1749	164429	9401	Fail
0.0137	1659	161770	9751	Fail
0.0139	1579	159221	10083	Fail
0.0140	1510	156673	10375	Fail
0.0142	1446	154180	10662	Fail
0.0144	1368	147809	10804	Fail
0.0145	1297	140995	10870	Fail
0.0147	1242	134402	10821	Fail
0.0148	1182	127809	10812	Fail
0.0150	1130	123931	10967	Fail
0.0152	1081	122325	11315	Fail
0.0153	1026	120663	11760	Fail
0.0155	979	119001	12155	Fail
0.0156	922	117394	12732	Fail
0.0158	871	115787	13293	Fail
0.0160	819	114236	13948	Fail
0.0161	771	112685	14615	Fail
0.0163	722	111244	15407	Fail
0.0164	668	109693	16421	Fail
0.0166	629	108197	17201	Fail
0.0168	592	106702	18023	Fail
0.0169	550	105150	19118	Fail
0.0171	508	103765	20426	Fail
0.0172	476	102325	21496	Fail
0.0174	429	100829	23503	Fail
0.0176	393	99389	25289	Fail
0.0177	363	97948	26982	Fail
0.0179	330	96563	29261	Fail
0.0180	300	95289	31763	Fail
0.0182	281	94015	33457	Fail
0.0184	264	92851	35170	Fail
0.0185	248	91577	36926	Fail
0.0187	233	90303	38756	Fail
0.0188	218	89140	40889	Fail
0.0190	205	87976	42915	Fail
0.0192	186	86702	46613	Fail
0.0193	163	85539	52477	Fail
0.0195	142	84320	59380	Fail
0.0196	129	83156	64462	Fail
0.0198	117	81993	70079	Fail
0.0200	105	80885	77033	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

100% of water is treated by the CAVFS



Model Default Modifications

Total of 0 changes have been made.

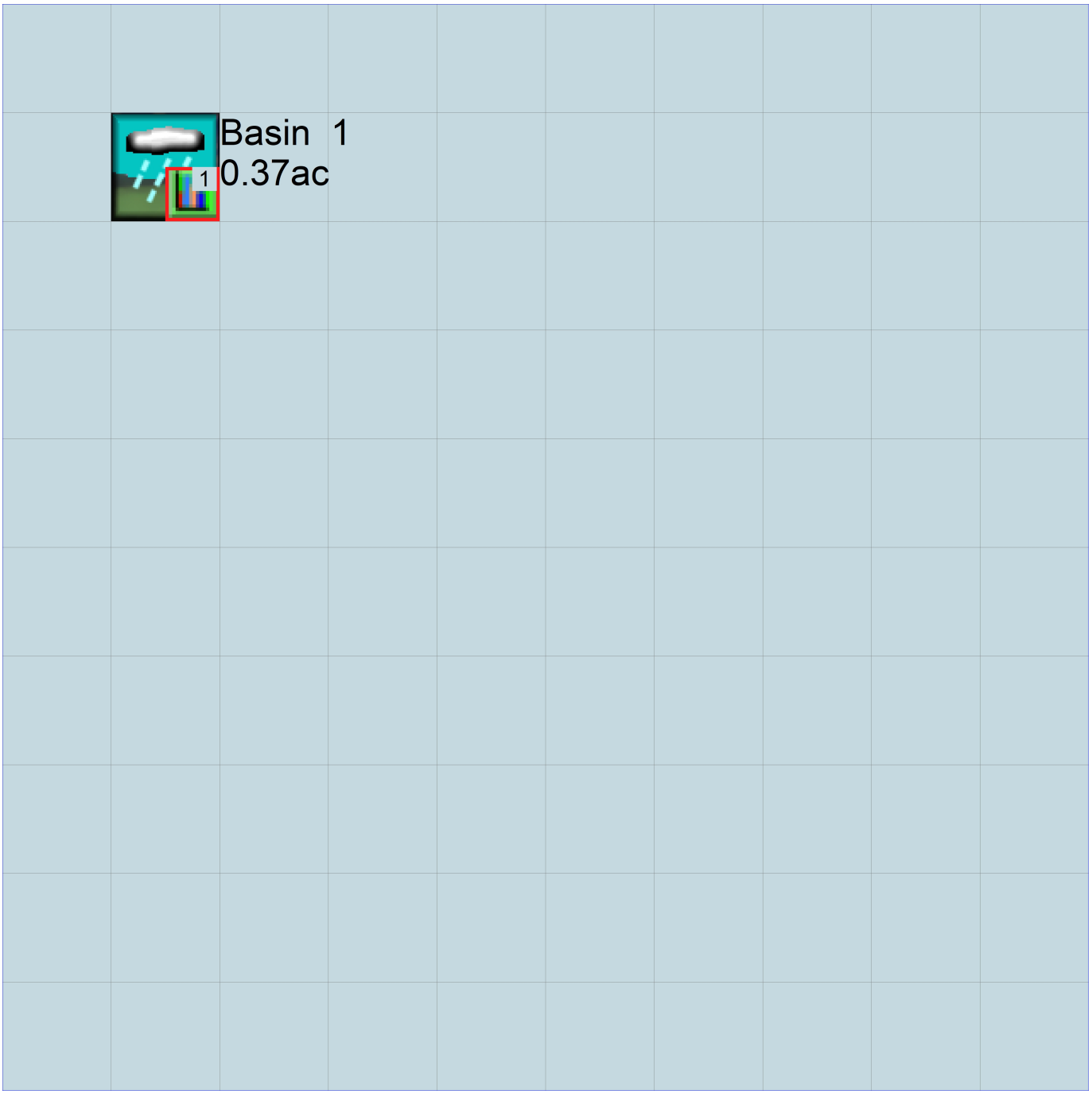
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   20241121 - CAVFS.wdm
MESSU       25   Pre20241121 - CAVFS.MES
            27   Pre20241121 - CAVFS.L61
            28   Pre20241121 - CAVFS.L62
            30   POC20241121 - CAVFS1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                      0.3673     COPY   501     12
PERLND  10                      0.3673     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1             IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   20241121 - CAVFS.wdm
MESSU       25   Mit20241121 - CAVFS.MES
            27   Mit20241121 - CAVFS.L61
            28   Mit20241121 - CAVFS.L62
            30   POC20241121 - CAVFS1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        CAVFS  1 Surface 1          MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                          in  out           ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS       AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
```

```
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   1                      0.3673     RCHRES   1      5

******Routing******
IMPLND   1                      0.3673     COPY     1     15
RCHRES   1                           1     RCHRES   2      8
RCHRES   2                           1     COPY   501     16
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                        in  out                             ***
    1     CAVFS  1 Surface-005    3    1    1    1   28    0    1
    2     CAVFS  1                1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  0  0  0  0        2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->      ***
    1              1      0.01       0.0       0.0       0.0       0.0
    2              2      0.06       0.0       0.0       0.0       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
```

```
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   74    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.016067  0.000000  0.000000
  0.054945  0.016067  0.000366  0.000000
  0.109890  0.016067  0.000733  0.000000
  0.164835  0.016067  0.001099  0.000000
  0.219780  0.016067  0.001465  0.000000
  0.274725  0.016067  0.001832  0.000000
  0.329670  0.016067  0.002198  0.000000
  0.384615  0.016067  0.002565  0.000000
  0.439560  0.016067  0.002931  0.002006
  0.494505  0.016067  0.003297  0.003023
  0.549451  0.016067  0.003664  0.004284
  0.604396  0.016067  0.004030  0.005802
  0.659341  0.016067  0.004396  0.007593
  0.714286  0.016067  0.004763  0.009668
  0.769231  0.016067  0.005129  0.012042
  0.824176  0.016067  0.005496  0.014223
  0.879121  0.016067  0.005862  0.014915
  0.934066  0.016067  0.006228  0.017920
  0.989011  0.016067  0.006595  0.021258
  1.043956  0.016067  0.006961  0.024941
  1.098901  0.016067  0.007327  0.028978
  1.153846  0.016067  0.007694  0.033381
  1.208791  0.016067  0.008060  0.038159
  1.263736  0.016067  0.008427  0.043324
  1.318681  0.016067  0.008793  0.048884
  1.373626  0.016067  0.009159  0.054851
  1.428571  0.016067  0.009526  0.061233
  1.483516  0.016067  0.009892  0.068040
  1.538462  0.016067  0.010258  0.074411
  1.593407  0.016067  0.010625  0.075429
  1.648352  0.016067  0.010991  0.083112
  1.703297  0.016067  0.011358  0.091250
  1.758242  0.016067  0.011724  0.099852
  1.813187  0.016067  0.012090  0.108930
  1.868132  0.016067  0.012457  0.118497
  1.923077  0.016067  0.012823  0.128565
  1.978022  0.016067  0.013189  0.139154
  2.032967  0.016067  0.013593  0.150289
  2.087912  0.016067  0.013997  0.162023
  2.142857  0.016067  0.014401  0.174537
  2.197802  0.016067  0.014804  0.213327
  2.252747  0.016067  0.015208  0.275815
  2.307692  0.016067  0.015612  0.326354
  2.362637  0.016067  0.016015  0.326354
  2.417582  0.016067  0.016419  0.326354
  2.472527  0.016067  0.016823  0.326354
  2.527473  0.016067  0.017227  0.326354
  2.582418  0.016067  0.017630  0.326354
  2.637363  0.016067  0.018034  0.326354
  2.692308  0.016067  0.018438  0.326354
  2.747253  0.016067  0.018842  0.326354
  2.802198  0.016067  0.019245  0.326354
  2.857143  0.016067  0.019649  0.326354
  2.912088  0.016067  0.020053  0.326354
  2.967033  0.016067  0.020456  0.326354
  3.021978  0.016067  0.020860  0.326354
```

```
  3.076923  0.016067  0.021264  0.326354
  3.131868  0.016067  0.021668  0.326354
  3.186813  0.016067  0.022071  0.326354
  3.241758  0.016067  0.022475  0.326354
  3.296703  0.016067  0.022879  0.326354
  3.351648  0.016067  0.023282  0.326354
  3.406593  0.016067  0.023686  0.326354
  3.461538  0.016067  0.024090  0.326354
  3.516484  0.016067  0.024494  0.326354
  3.571429  0.016067  0.024897  0.326354
  3.626374  0.016067  0.025301  0.326354
  3.681319  0.016067  0.025705  0.326354
  3.736264  0.016067  0.026108  0.326354
  3.791209  0.016067  0.026512  0.326354
  3.846154  0.016067  0.026916  0.326354
  3.901099  0.016067  0.027320  0.326354
  3.956044  0.016067  0.027723  0.326354
  4.000000  0.016067  0.034789  0.326354
  END FTABLE  2
  FTABLE      1
   21    6
     Depth      Area    Volume  Outflow1  Outflow2  Outflow3  Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.016067  0.000000  0.000000  0.000000  0.000000
  0.027473  0.016067  0.000442  0.000000  0.326354  0.000000
  0.054945  0.016067  0.000883  0.000000  0.326354  0.000000
  0.109890  0.016067  0.001766  0.491289  0.326354  0.000000
  0.164835  0.016067  0.002648  8.246154  0.326354  0.000000
  0.219780  0.016067  0.003531  20.70681  0.326354  0.000000
  0.274725  0.016067  0.004414  36.48120  0.326354  0.000000
  0.329670  0.016067  0.005297  54.97849  0.326354  0.000000
  0.384615  0.016067  0.006180  75.84432  0.326354  0.000000
  0.439560  0.016067  0.007063  98.83508  0.326354  0.000000
  0.494505  0.016067  0.007945  123.7699  0.326354  0.000000
  0.549451  0.016067  0.008828  127.8243  0.326354  0.000000
  0.604396  0.016067  0.009711  130.8409  0.326354  0.000000
  0.659341  0.016067  0.010594  134.8035  0.326354  0.000000
  0.714286  0.016067  0.011477  139.5228  0.326354  0.000000
  0.769231  0.016067  0.012360  144.8919  0.326354  0.000000
  0.824176  0.016067  0.013242  150.8393  0.326354  0.000000
  0.879121  0.016067  0.014125  157.3130  0.326354  0.000000
  0.934066  0.016067  0.015008  164.2726  0.326354  0.000000
  0.989011  0.016067  0.015891  171.6855  0.326354  0.000000
  1.000000  0.016067  0.016067  179.5248  0.326354  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1002 STAG     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1003 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
```

```
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                         COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

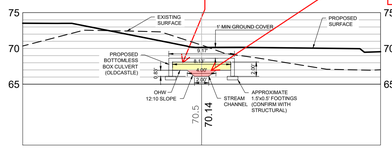
This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by : Clear Creek Solutions, Inc. 2005-2024; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

CULVERT CAPACITY DIMENSIONS: 8.13' x 1.17'

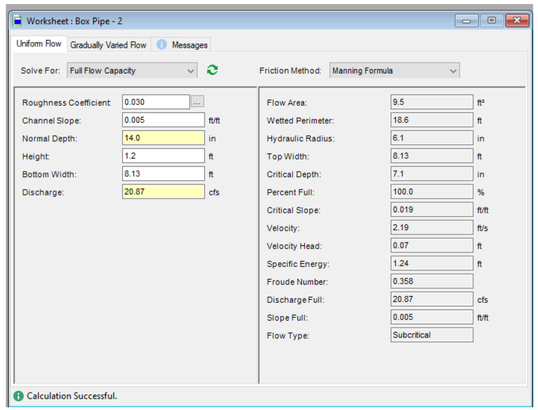
STREAM BED CAPACITY DIMENSIONS: 10" DEPTH, 2 FT BOTTOM WIDTH, 1.2 H:V SIDE SLOPES.



1 HPA APPROVED CULVERT 1 CROSS-SECTION

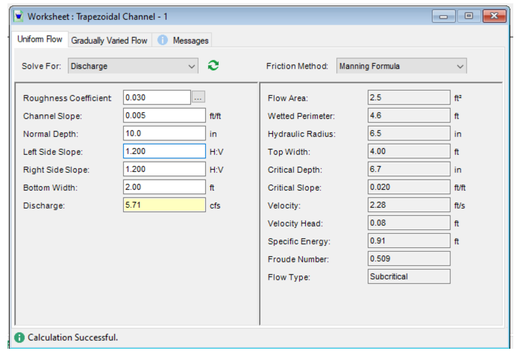
SCALE 1"=10'

CULVERT CAPACITY CACLUATED USING FLOW MASTER:



CULVERT CAPACITY = 20.87 CFS

STREAM BED CAPACITY CACLUATED USING FLOW MASTER:



STREAM BED CAPACITY = 5.71 CFS

BASED ON HYDRAULIC MODELING FROM AN OUTSIDE CONSULTANT THE 100-YR STORM FLOW IS APPROXIMATELY 14.7 CFS.

THE CAPACITY OF THE PROPOSED STREAMBED AND CULVERT IS 26.58 CFS. THE PROPOSED CAPACITY IS GREATER THAN THE 100-YR FLOW, THEREFORE THE CULVERT IS SUFFICIENTLY SIZED TO CONVEY THE 100-YR STORM.

AHBL
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

CULVERT FLOW CAPACITY

EAST TOWN CROSSING

D-3