

Allen Townhomes

Construction Drainage Report

Prepared for

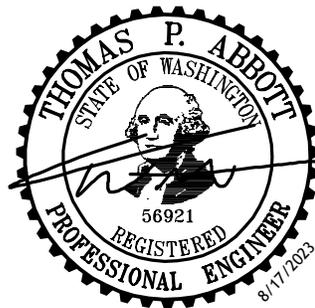
JM1 Holdings, LLC
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Lake Stevens, WA 98258

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August 2023

Job No: C21-213

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APPENDICES

#	Title
1	Project Overview
3	Resource Review
4	Site Hydrology

SECTION 1: PROJECT OVERVIEW

The proposed Allen Townhomes project is comprised of parcel numbers 31052400301000 and 31052400300900 and proposes the construction of 36 townhome unit lots with associated utilities, ROW, and open spaces on a 5-acre site. There are frontage improvements proposed on the site along 172nd St NE, and access to the site will be from 172nd St NE. The site is located within the SE ¼ of the SW ¼ of Section 24, Township 31 N, Range 05 E, W.M. The project address is 8927 172nd ST NE, Arlington, WA 98223-8989. See the Vicinity Map in Appendix 1 for visual representation of the subject property.

Existing Site

The parcel 31052400301000 is currently occupied by a single-family residence, multiple storage sheds, and associated vehicles. The parcel 31052400300900 is currently occupied by a single storage shed. All structures on site will be demolished or repaired/repurposed as part of the proposed development. The site is bordered to the north, east, and west by RHC (Residential High Capacity) zoned land and to the south by GC (General Commercial) zoned land. The project parcels are currently zoned RHC. Existing ground cover is a combination of trees, grass, roof, and gravel.

The project site includes a wetland area that is along the northeasterly portion of the site. In the existing condition, the site discharges into the onsite wetland. Buffer averaging is proposed in several locations. The development will exist within the bounds of the North Basin, South Basin and the Frontage Basin along 172nd St NE. There are two distinct Threshold Discharge Areas (TDAs) onsite that will require stormwater detention, the North and South TDA Basins. See Predeveloped and Developed Hydrology Maps in Appendix 4 for a visual representation of these basins.

Site soils are classified as Tokul gravelly medial loam (where about 74% of the project site area is at 0 to 8 percent slopes and about 26% is at 15 to 30 percent slopes). See the Soils Map in Appendix 3 for visual layout of soil type areas of the subject property. The existing site slopes are generally flat to moderate, with slight sloping from the southwest to the northeast. Due to till soils present onsite, the Geotechnical Engineer does not recommend infiltration for LID BMPs to be used onsite.

Proposed Development

The proposed Allen Townhomes project will develop 36 townhome units on the two parcels with associated utilities, driveways, ROW, landscaping, and open spaces. Stormwater will be mitigated via two separate detention and water quality treatment systems. Onsite development will disturb 2.36 acres of area that will be collected to the detention vaults for flow control. Water quality treatment of stormwater runoff will be provided either prior to or following detention, depending on the detention system onsite. Frontage improvements will impact an additional 0.25 acres within the 172nd St dedicated ROW.

Proposed Drainage System

This project is subject to the requirements of the 2019 Stormwater Management Manual for Western Washington (DOE Manual). In compliance with 2019 DOE Manual, all runoff from developed/disturbed surfaces must be collected, treated, and released to natural drainage courses unless it is dispersed or infiltrated.

Proposed pollution generating impervious surfaces (PGIS) will exceed the 5,000 SF threshold and thus basic water quality treatment will be provided via three water quality treatment structures that will treat stormwater runoff from roadways and driveways.

The site contains two separate TDAs that outfall to separate downstream systems. The disturbed area of the development is contained within the North Basin, South Basin, and Frontage Bypass Basin. The North TDA Basin will be mitigated separate for its own TDA while the South and Frontage Basins will be considered within separate TDA modeling for the South TDA Basin. The basins consist of developed roof,

landscape, sidewalk, pavement, and driveway. This project is required to meet flow control requirements for each TDA. Flow control requirements are achieved by two detention vaults in the north and south edges of the site. Developed condition stormwater associated with the site will be collected within the detention vaults then released to historic flowpaths. A small bypass area exists in the west end of the frontage that cannot be collected due to vertical constraints. The bypass area has been considered in the Frontage Bypass Basin modeling in WWHM. See Section 4.0 for additional discussion regarding proposed stormwater management and water quality treatment measures.

Erosion/Sedimentation Control

Erosion control measures that will be utilized during construction will include a combination of silt fence, storm drain inlet protection, interceptor swales, and sediment ponds. See Section 2.0 for discussion of how SWPPP Elements are addressed.

Minimum Requirements

Per the 2019 DOE, Minimum Requirements 1-9 apply to the proposed development.

Minimum Requirement #1: Preparation of Stormwater Site Plans

A report along with the construction plans, to be submitted at a later date, satisfies the minimum requirement.

Minimum Requirement #2: Construction Stormwater Pollution Prevention

See Section 2 of this Report for the SWPPP BMP Elements, and the SWPPP (submitted as a separate document at a later date) for a complete discussion of erosion control BMP's and their use specific to the site.

Minimum Requirement #3: Source of Pollution

Permanent source control BMPs are not applicable for the subject site since the associated activities for the new residence do not fall within the types of facilities listed within Volume IV of the DOE Manual (Residential developments are not required to implement source control BMP's). BMPs for erosion and sedimentation control are specified in the Preliminary Construction Plans.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Flow from the site will preserve its natural drainage pattern from the southwest to the northeast as well as out to the west and north along SR-9. Runoff from both the north and south TDA basins eventually flows towards Prairie Creek, a tributary of Portage Creek, which then eventually discharges into the Stillaguamish River.

Minimum Requirement #5: On-Site Stormwater Management

The project will exceed the 10,000 SF impervious surface threshold and is required to provide an Onsite Stormwater BMP. Two TDAs exist on the site (the North and South Basins – see figure 3.0 and 4.0 for their delineation). Two detention vaults that are both controlled by flow control risers will be installed at the north and south edges of the site and will discharge at mitigated rates that will be dispersed into native vegetation in the wetland area on the north end of the site and into the city conveyance system at the southeast corner of the site.

Minimum Requirement #6: Runoff Treatment

As the project will exceed the 5,000 SF threshold of PGIS, the project is required to provide "basic" water quality treatment per the 2019 DOE manual. Two Perfilter water quality treatment units will treat runoff from PGIS surfaces downstream of each detention vault.

Minimum Requirement #7: Flow Control

Two detention vaults are proposed onsite to control flows and release at historic, mitigated rates for each of the North and South TDA Basins. Please see Section 4.0 for additional flow control modeling and parameters for detention sizing.

Minimum Requirement #8: Wetlands Protection

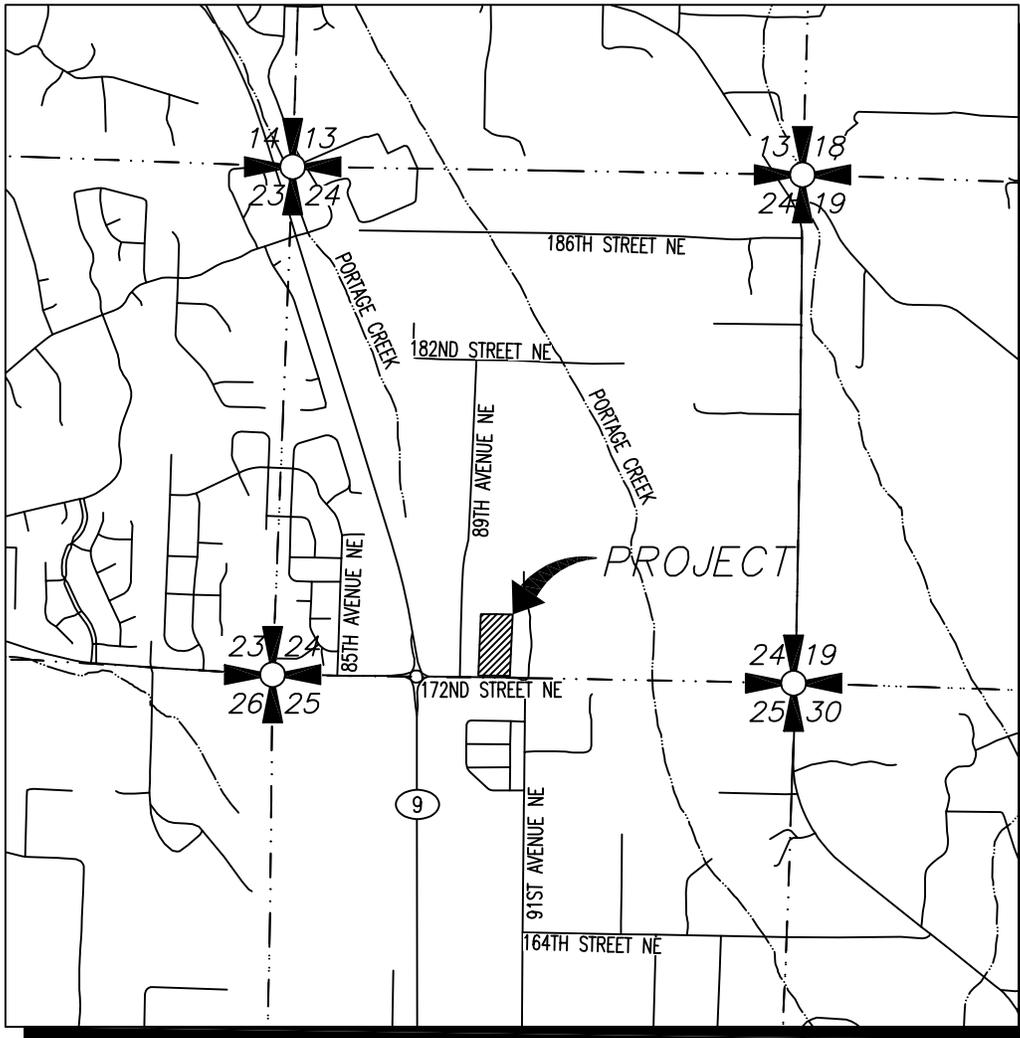
A wetland exists onsite that extends from the north property line towards the southeast corner of the site and has been given a 110' buffer. Averaging of the 110' buffer is proposed in several locations. The dispersion facility discharge from the north detention vault outfall is proposed within the outer 25% of the revised buffer. Please see sheet RD-01 of the plan set for location information. Wetland areas will not be disturbed during site construction and will be protected with silt fencing and other BMPs throughout construction.

Minimum Requirement #9: Operation and Maintenance

See Operations and Maintenance in Section 6 of this report.

Appendix 1: Project Overview

1. Figure 1.0 – Vicinity Map
2. Figure 2.0 – Existing Conditions Map
3. Proposed Development Map



VICINITY MAP

SCALE: 1"=2000'

Drawing: P:\CIVIL\2021\C21-213 Allen Townhomes\Drawings\Exhibits\C21213E-VM_20220816.dwg Plotted: Sep 15, 2022 - 3:31pm

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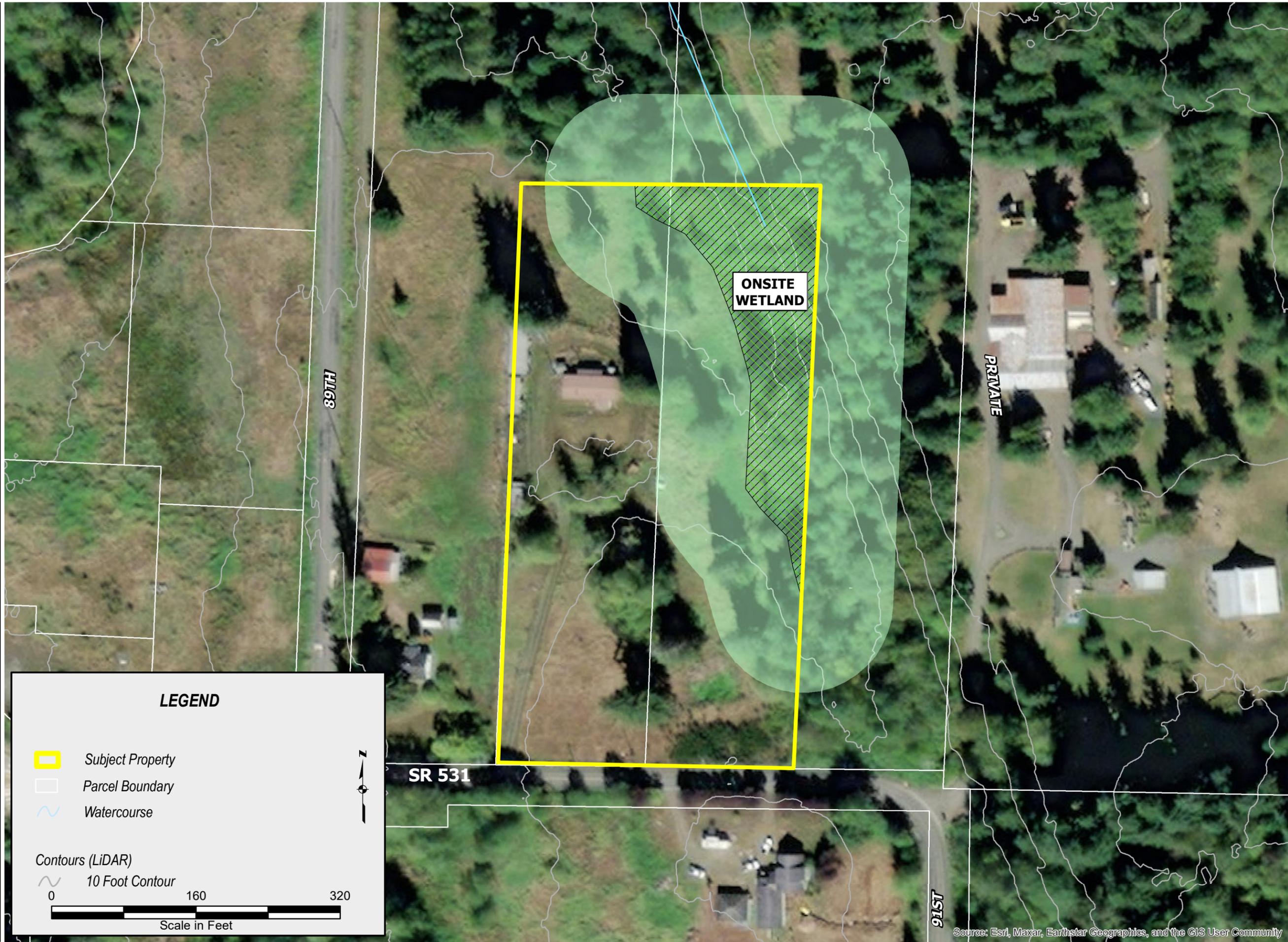
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ALLEN TOWNHOMES

VICINITY MAP



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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ALLEN TOWNHOMES
EXISTING CONDITIONS MAP

NAD 1983 HARN
 STATEPLANE WASHINGTON
 NORTH FIPS 4601 FEET
 REVISION:
 JOB NUMBER: C21-213
 DRAWING NAME: C21-213-1.0
 DESIGNER: NMARTIN
 DRAWING BY: NMARTIN
 DATE: 7/11/2022
 SCALE: AS SHOWN
 JURISDICTION: ARLINGTON

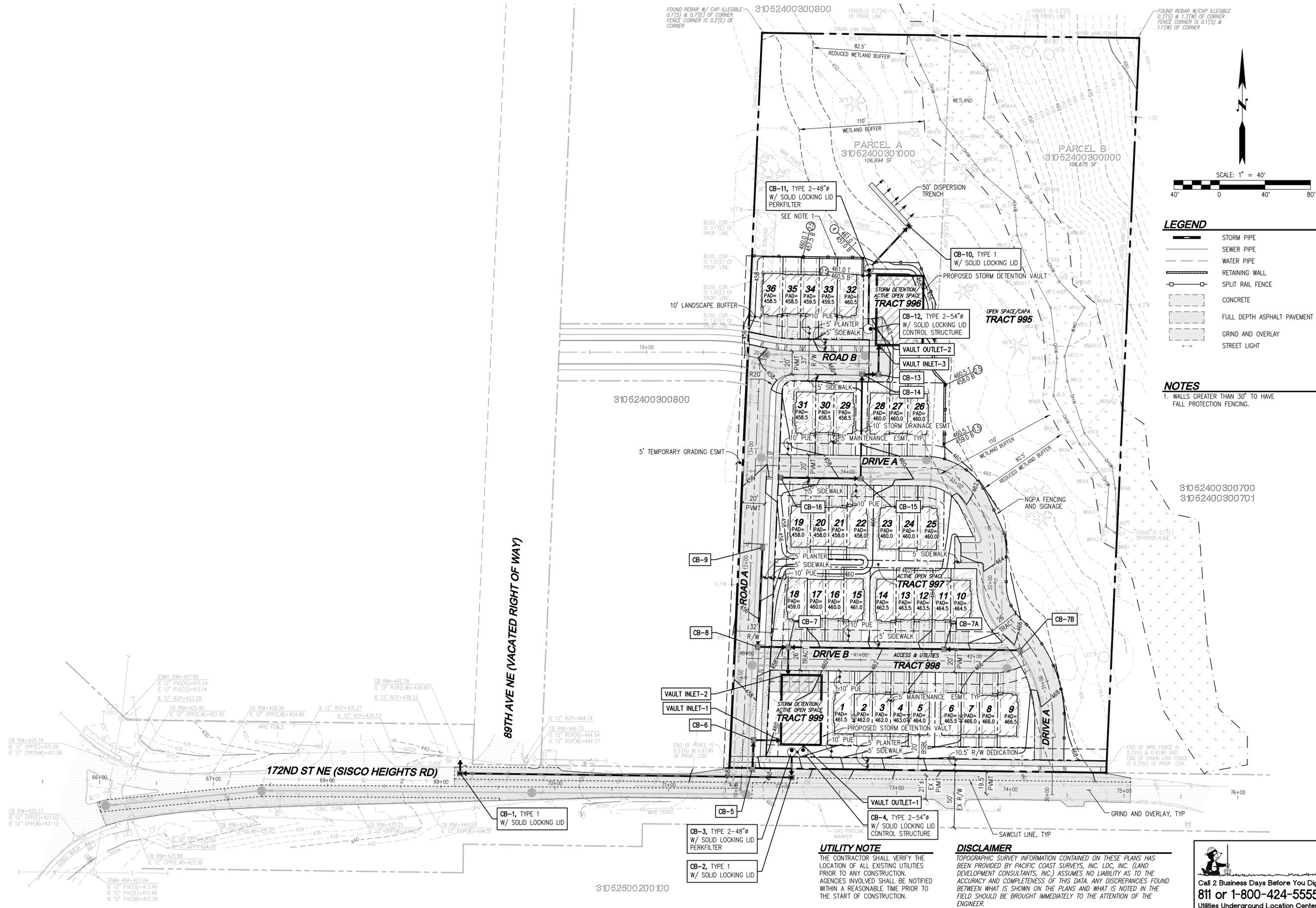
FIGURE:
2.0

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SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (KING COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.



LEGEND

- STORM PIPE
- SEWER PIPE
- WATER PIPE
- RETAINING WALL
- SPLIT RAIL FENCE
- CONCRETE
- FULL DEPTH ASPHALT PAVEMENT
- GRIND AND OVERLAY
- STREET LIGHT

NOTES

- WALLS GREATER THAN 30' TO HAVE FALL PROTECTION FENCING.

UTILITY NOTE

THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES PRIOR TO ANY CONSTRUCTION. AGENCIES INVOLVED SHALL BE NOTIFIED WITHIN A REASONABLE TIME PRIOR TO THE START OF CONSTRUCTION.

DISCLAIMER

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Call 2 Business Days Before You Dig
811 or 1-800-424-5555
Utilities Underground Location Center

NO.	DATE	DESCRIPTION

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JM1 HOLDINGS, LLC.

ALLEN TOWNHOMES

PRELIMINARY ROAD, STORM DRAINAGE AND GRADING PLAN



JOB NUMBER: C21-213
DRAWING NAME: C21213P-RD-PL
DESIGNER: TPA
DRAFTING BY: BJN
DATE: 10-10-22
SCALE: 1"=40'
JURISDICTION: ARLINGTON

Drawing: P:\City\2021\c21-213 allen townhomes\Drawings\Preliminary\C21213P-RD-PL.dwg Plotted: Aug 15, 2023 - 2:01pm

SECTION 2: TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

SWPPP Design Elements

A Stormwater Pollution Prevention Plan (SWPPP) will be provided prior to construction. The SWPPP report is modeled under the guidelines of Volume II, Section 3 of the 2019 Stormwater Management Manual for Western Washington. Construction SWPPP Elements #1 through #13 are addressed below.

Element #1 – Mark Clearing Limits

All clearing limits will be delineated with high visibility plastic fence and/or silt fence. See sheets ER-01 of the preliminary plans for locations and details.

Element #2 – Establish Construction Access

Stabilized construction accesses will be installed as shown on the preliminary plans. See sheets ER-01 and ER-02 of the construction plans for locations and details.

Element #3 – Control Flow Rates

Detention of construction period runoff will be provided by means of a sediment pond located at the northern portion of the site. See sheets ER-01 of the preliminary plans for location and details for flow and sediment control BMP's.

Element #4 – Install Sediment Controls

Silt fence, catch basin protection, and the temporary sediment pond will be utilized to contain sediments within the project's clearing limits. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #5 – Stabilize Soils

Exposed soils will be stabilized as specified in the Grading and Erosion Control Notes with temporary and permanent seeding, mulching, and plastic covering. See sheet ER-02 of the preliminary plans for notes.

Element #6 – Protect Slopes

Slopes are minor on the subject site. Slopes shall be protected as specified under Element #5.

Element #7 – Protect Drain Inlets

Storm drain inlet protection will be utilized to contain sediments within the project's clearing limits. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #8 – Stabilize Channels and Outlets

Temporary channels shall be stabilized with check dams. See sheets ER-01 and ER-02 of the preliminary plans for locations and details.

Element #9 – Control Pollutants

Pollutants shall be controlled as specified in Volume IV of the 2019 DOE Manual—Source Control BMPs to address potential sources of pollution which may exacerbate possible soil/groundwater contamination identified onsite.

Element #10 – Control De-Watering

There will be no de-watering as a part of this project. See sheet ER-02 of the preliminary plans for notes.

Element #11 – Maintain BMPs

Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the preliminary plans for the Construction Sequence and notes.

Element #12: Manage the Project

The Grading and Erosion Control Notes specify seasonal work limitations. Maintenance of the BMPs is specified within the Construction Sequence and Grading and Erosion Control Notes. See sheets ER-01 and ER-02 of the preliminary plans for the Construction Sequence and notes.

Element #13: Protect on-site stormwater management BMPs

On-site stormwater management BMPs used for runoff from roofs and other hard surfaces are not feasible due to soil conditions and proposed project density.

SECTION 3: DOWNSTREAM ANALYSIS

Task 1. Study Area Definition and Maps

Snohomish County Bare Earth LiDAR, survey, and 2021 aerial photography were the best topographical references available for the area containing the site. The limits of the downstream analysis extend roughly 0.25 miles beyond the subject property's natural discharge location.

Task 2. Resource Review

All of the resources below have been reviewed for existing and potential issues near the project site:

Adopted Basin Plans

No Adopted Basin Plans were located that include the project site.

Drainage Basin

This site is in the Burn Hill Road Drainages sub-basin, within the Stillaguamish watershed. Discharge from the proposed development will discharge into the onsite wetland, which is tributary to Prairie Creek and then Portage Creek. Portage Creek is approximately a quarter mile from the site and eventually discharges into the Stillaguamish River. Note that there are two TDA Basins that the project will be developed within as downstream flowpaths from the North and South TDA Basins do not converge within 0.25 mile from the project site. See Figure 3.0 for flowpaths and the delineation of each TDA Basin.

Floodplain / Floodway (FEMA) maps

Per FEMA Floodplain map #53061C0415F the subject property is not within a floodplain.

Critical Areas Map

A wetland exists onsite that extends from the north property line towards the southeast corner of the site and has been given a 110' buffer. Reference the critical areas report submitted with this report for additional information regarding the wetland areas onsite.

Drainage Complaints

No relevant issues were identified near the proposed site.

Road Drainage Problems

No issues were identified near the proposed site.

Soil Survey

Site soils are classified as Tokul gravelly medial loam (where about 82% of the project site area is at 0 to 8 percent slopes and about 18% is at 15 to 30 percent slopes) which is classified as a Hydrologic Soil Group B type soil.

Wetland Inventory Maps

Wetlands are identified to be on the project site. Reference the critical areas report submitted with this report for additional information regarding the wetland areas onsite.

Migrating River Studies

Migrating River Studies are not considered applicable to the proposed development.

Section 303d List of Polluted Waters

Washington State Department of Ecology's Water Quality Assessment for Washington contains one listing for the Prairie Creek downstream of the project within one quarter mile of the site. Please refer to Appendix 3 for copies of applicable 303(d) listings.

Water Quality Problems

The Prairie Creek has been listed as a category 4A water due to bacteria concerns. No water quality problems were identified which would be exacerbated by the proposed development.

Stormwater Compliance Plans

Not applicable to the proposed project.

Task 3. Field Inspection/Downstream Analysis

On August 16th, 2022, a Downstream Analysis was performed at the site. The weather consisted of 77°F and sunny skies. The following observations were verified during the visit.

The subject property consists primarily of lawn and forested area. There is a partially developed area in the existing condition with a gravel road leading to a single-family residence in the mid-northwestern portion of the site and multiple storage sheds with varying degrees of disrepair in the mid-northwest edge of the site and other storage sheds in poor condition in the mid-southeastern and mid-northern portion of the subject property.

Flowpath 1 has been identified flowing from the southeast to the north within its own threshold discharge area. Runoff that travels north and east to the onsite wetland will travel northwest where flow is conveyed into Prairie Creek, a tributary of Portage Creek. Flow continues north and west underneath 89th Ave NE. The flow then continues north and west towards the Stillaguamish River past the ¼-mile boundary of this analysis.

Flowpath 2 is generated by runoff from the southern half of the site along the north side of 172nd St NE (Sisco Heights Rd). Runoff leaves the southwest corner of the site and enters a vegetated drainage ditch before flowing west for approximately 200 ft to a catch basin on the side of the road near the intersection of 89th Ave NE and 172nd St NE. The flowpath then enters another open ditch and follows the east side of State Route 9 north and beyond the ¼-mile buffer of analysis. See Figure 3.0, "Downstream Analysis Map" in Appendix 3 for a visual representation of current discharge.

An amount of upstream flow occurs from the western edge, northeast corner, and southeast corner of the project site, as illustrated in Images 2, 3, & 4 in Appendix 3. This upstream flow will drain into the onsite wetland area and conveys north and west. None of this upstream area will be collected or captured by project improvements.

Task 4. Drainage System Description and Problem Descriptions

Based on the information available and all the resources available including visual inspection of the downstream flow path to the ¼-mile boundary, there is no evidence of existing or anticipated downstream drainage problems. All flows are adequately carried through natural channels.

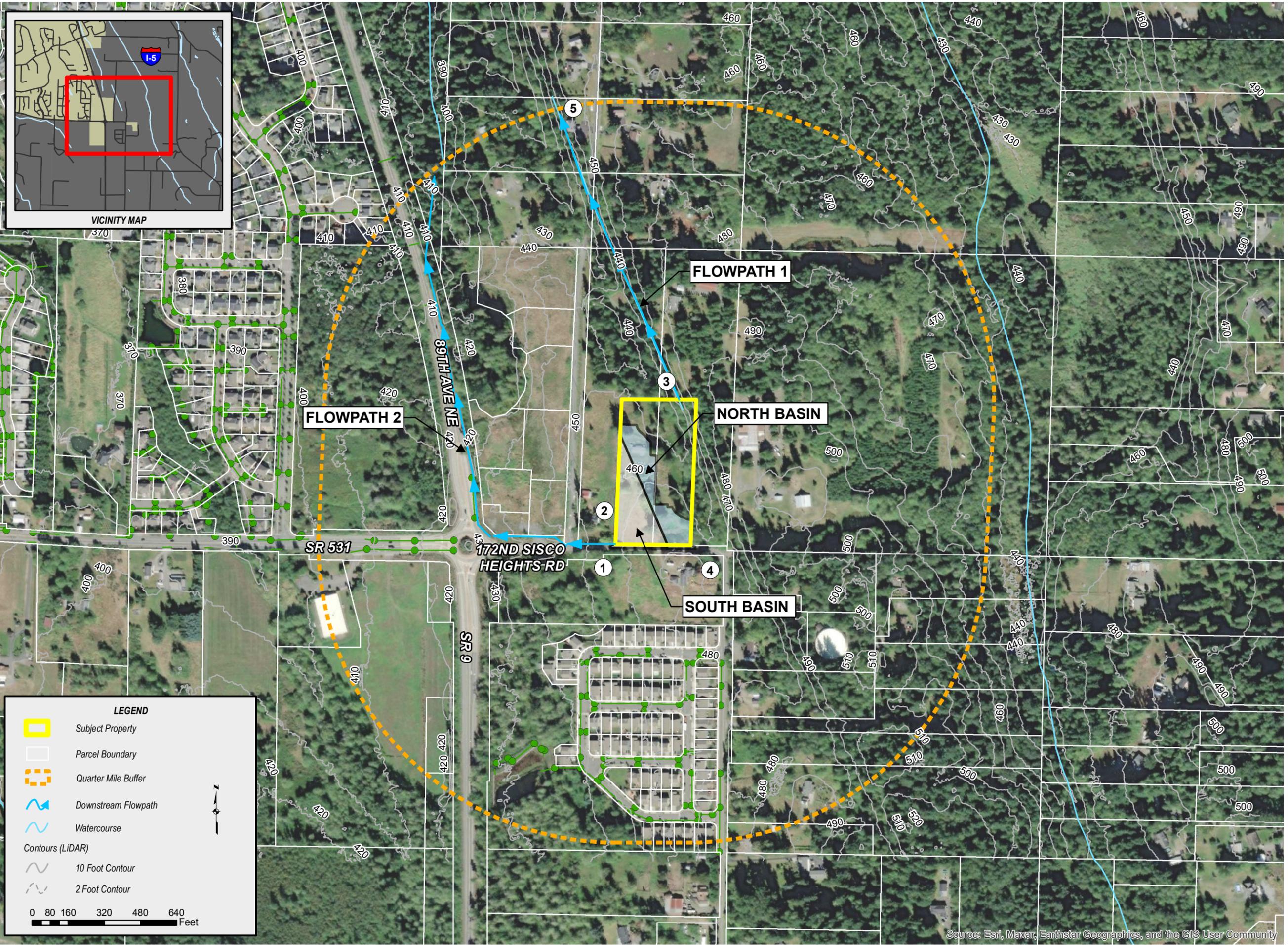
Task 5. Mitigation of Existing or Potential Drainage Problems

No evidence of existing or potential problems with downstream drainage conveyance infrastructure was found. Mitigation is not required.

Appendix 3: Resource Review

1. Figure 3.0 - Downstream Analysis Map
2. Downstream Analysis Photographs
3. USDA Soils Map & Description
4. FEMA Floodplain Map Firmette #53061C0415F
5. Section 303d Map

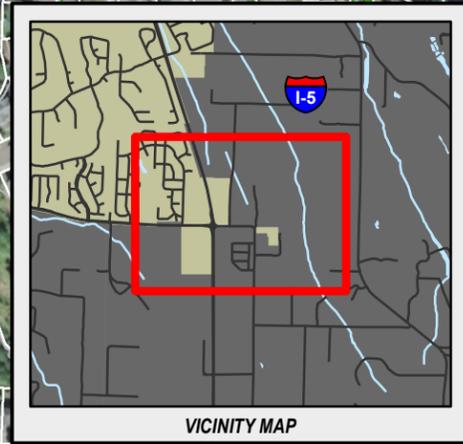
2.0 Downstream.mxd | MOD: 9/22/2022 | rferguson



LEGEND

- Subject Property
- Parcel Boundary
- Quarter Mile Buffer
- Downstream Flowpath
- Watercourse
- Contours (LiDAR)
 - 10 Foot Contour
 - 2 Foot Contour

0 80 160 320 480 640 Feet



SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (KING COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

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DOWNSTREAM MAP

NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET
REVISION:
JOB NUMBER: C21-213
DRAWING NAME: C21-213-3.0
DESIGNER: RFERGUSON
DRAWING BY: RFERGUSON
DATE: 9/22/2022
SCALE: AS SHOWN
JURISDICTION: ARLINGTON

FIGURE:

3.0

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Downstream Analysis Photographs



Image 1: Facing northeast from the southwestern corner of the project site near the intersection 89th Ave NE and 172nd St NE. Onsite runoff from the near side of the hill will flow offsite to the southwest into vegetated drainage ditches, and onsite runoff from the far side of the hill will flow to the low point of the onsite wetland to the northeast.



Image 2: Facing northeasterly near the western edge of the site (edge of site border is located along sheds as seen above). Upstream runoff offsite on the far side of the hill will flow east onsite, where it will continue northeast to the onsite wetland.



Image 3: Facing southwest near the northeastern corner of the site. Upstream stormwater runoff from the east (left) will flow onto the project site to the low point of the onsite wetland. Runoff on the near side of the hill as seen on the right (west) will also flow to the low point of the onsite wetland. Runoff on the far side of the hill on the right will flow offsite. Runoff flows northwest along the wetland into Prairie Creek, a tributary of Portage Creek, and continues north and west past the ¼-mile boundary of this analysis.

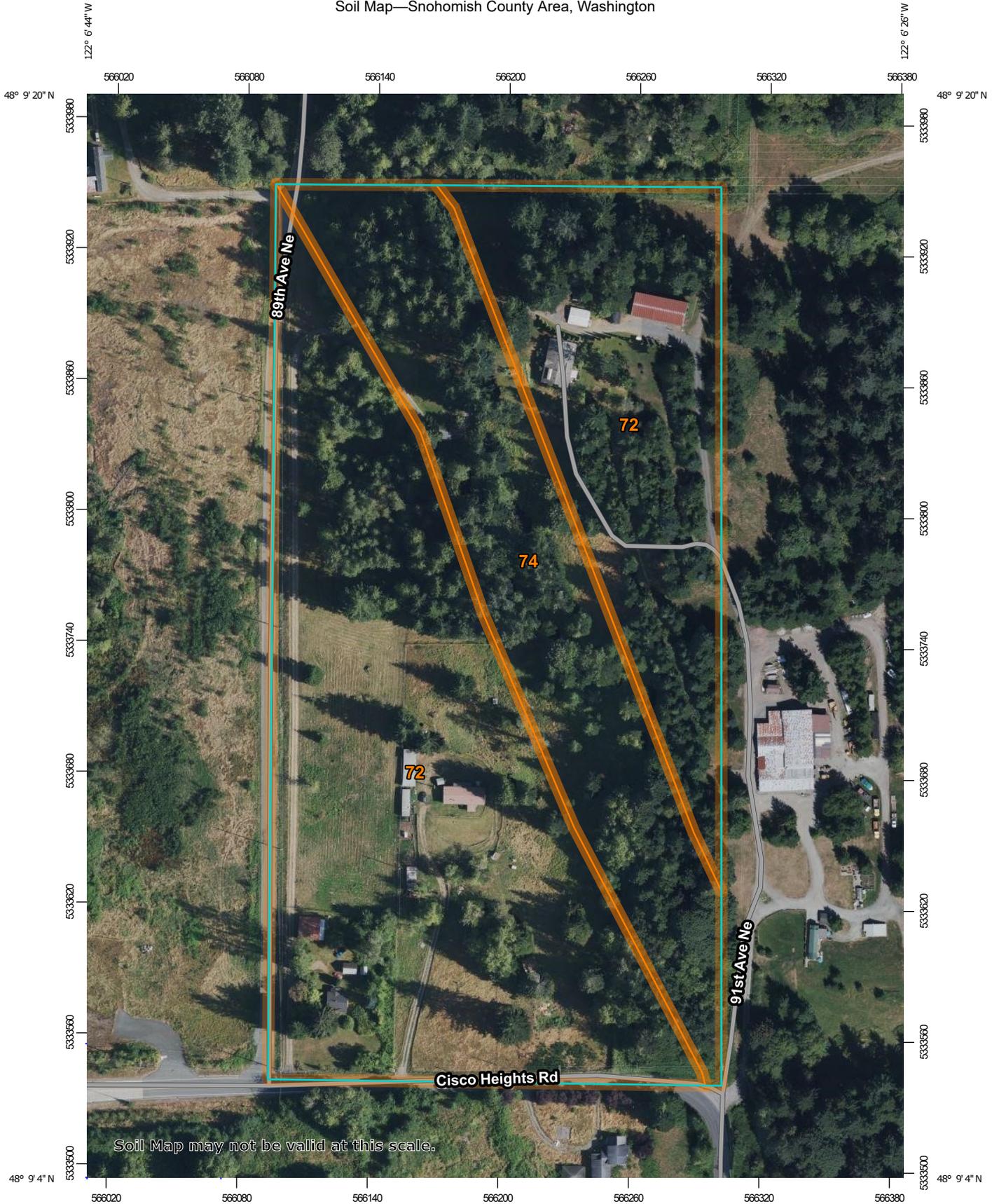


Image 4: Facing northwest near the southeastern corner of the site. Onsite runoff from the west (left) flows downhill to a low point and flows north and west into the onsite wetland. Offsite runoff from the east (right) flows downhill to the low point and flows north and west into the onsite wetland.



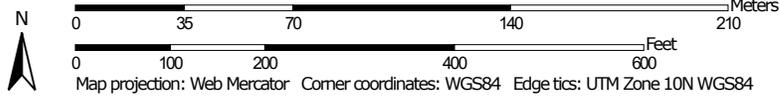
Image 5: Facing westerly near the quarter-mile boundary of analysis. Prairie Creek is located down the hill into the valley where flow travels north and west, where it discharges into Portage Creek, which feeds into the Stillaguamish River.

Soil Map—Snohomish County Area, Washington



Soil Map may not be valid at this scale.

Map Scale: 1:2,420 if printed on A portrait (8.5" x 11") sheet.



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: Snohomish County Area, Washington

Survey Area Data: Version 23, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 16, 2020—Aug 19, 2020

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
72	Tokul gravelly medial loam, 0 to 8 percent slopes	15.6	74.3%
74	Tokul gravelly medial loam, 15 to 30 percent slopes	5.4	25.7%
Totals for Area of Interest		21.1	100.0%

Snohomish County Area, Washington

72—Tokul gravelly medial loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t61k

Elevation: 160 to 1,150 feet

Mean annual precipitation: 45 to 70 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 140 to 200 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Tokul and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tokul

Setting

Landform: Hillslopes, till plains

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Side slope, tread

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Volcanic ash mixed with loess over glacial till

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material

O_a - 1 to 2 inches: highly decomposed plant material

A - 2 to 6 inches: gravelly medial loam

B_{s1} - 6 to 9 inches: gravelly medial loam

B_{s2} - 9 to 17 inches: gravelly medial loam

B_{s3} - 17 to 24 inches: gravelly medial loam

BC - 24 to 33 inches: gravelly medial fine sandy loam

2B_{sm} - 33 to 62 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent

Depth to restrictive feature: 20 to 39 inches to densic material; 20 to 39 inches to cemented horizon

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (K_{sat}): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Limited Depth Soils (G002XN302WA),
Limited Depth Soils (G002XF303WA)
Other vegetative classification: Limited Depth Soils
(G002XN302WA), Limited Depth Soils (G002XF303WA)
Hydric soil rating: No

Minor Components

Pastik

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Barneston

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Norma

Percent of map unit: 3 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

Mckenna

Percent of map unit: 2 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 23, Aug 31, 2021

Snohomish County Area, Washington

74—Tokul gravelly medial loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t61m

Elevation: 160 to 1,640 feet

Mean annual precipitation: 45 to 70 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 140 to 200 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Tokul and similar soils: 70 percent

Minor components: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tokul

Setting

Landform: Till plains, hillslopes

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Side slope, tread

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Volcanic ash mixed with loess over glacial till

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material

O_a - 1 to 2 inches: highly decomposed plant material

A - 2 to 6 inches: gravelly medial loam

B_{s1} - 6 to 9 inches: gravelly medial loam

B_{s2} - 9 to 17 inches: gravelly medial loam

B_{s3} - 17 to 24 inches: gravelly medial loam

BC - 24 to 33 inches: gravelly medial fine sandy loam

2B_{sm} - 33 to 62 inches: cemented material

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: 20 to 39 inches to densic material; 20 to 39 inches to cemented horizon

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (K_{sat}): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F002XA005WA - Puget Lowlands Moist Forest
Forage suitability group: Limited Depth Soils (G002XF303WA),
Unnamed (G002XN303WA)
Other vegetative classification: Limited Depth Soils
(G002XF303WA), Unnamed (G002XN303WA)
Hydric soil rating: No

Minor Components

Rinker

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Barneston

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Vanzandt

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Pastik

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Norma

Percent of map unit: 3 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave

Across-slope shape: Concave
Hydric soil rating: Yes

Mckenna

Percent of map unit: 2 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

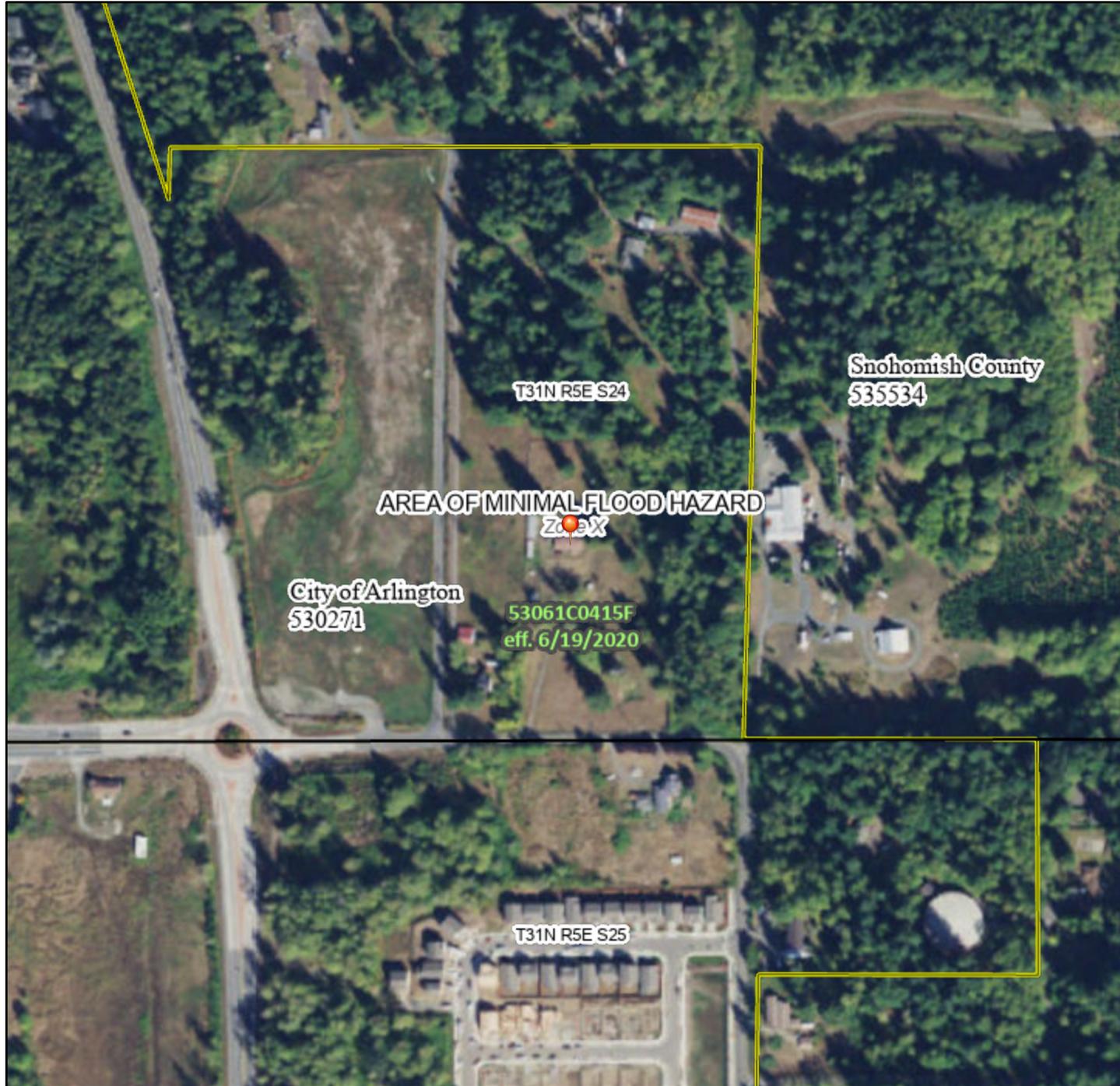
Data Source Information

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 23, Aug 31, 2021

National Flood Hazard Layer FIRMette



122°6'55"W 48°9'22"N



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

122°6'18"W 48°8'58"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		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 <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		Cross Sections with 1% Annual Chance Water Surface Elevation
MAP PANELS		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

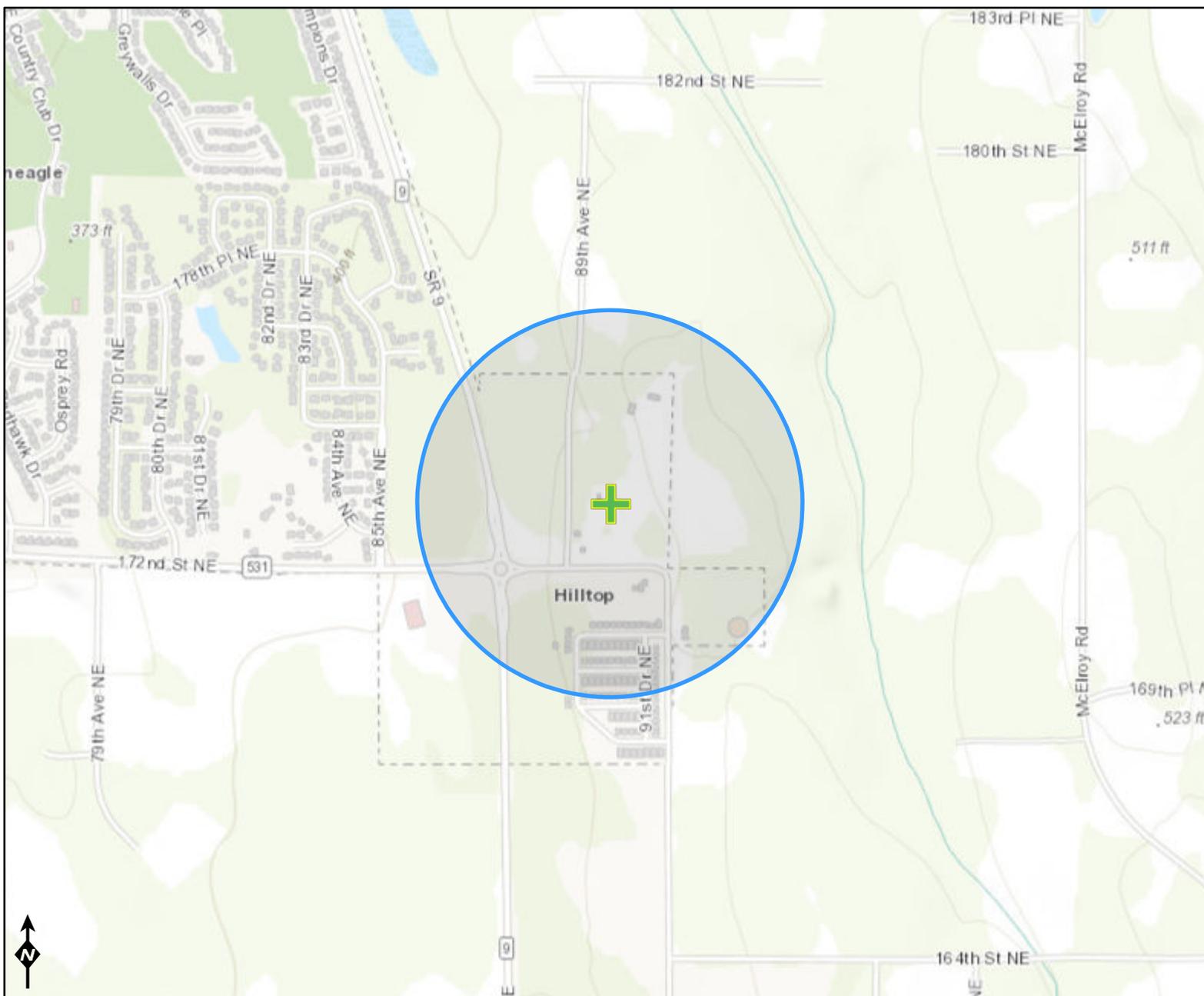


This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/1/2022 at 7:54 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Water Quality Atlas



Assessed Water/Sediment

Water

-  Category 5 - 303d
-  Category 4C
-  Category 4B
-  Category 4A
-  Category 2
-  Category 1

Sediment

-  Category 5 - 303d
-  Category 4C
-  Category 4B
-  Category 4A
-  Category 2
-  Category 1

SECTION 4: DETENTION AND WATER QUALITY TREATMENT DESIGN

4.1 Pre-Developed Hydrology/Land Cover

The pre-developed and developed conditions were modeled in WWHM for the purpose of peak flow determination for direct discharge. The onsite wetland area and buffer was not included in the modeling as it will not be disturbed during development. Based on the site location, the WWHM used the Everett Gage and a Precipitation Scale factor of 1.2.

North Basin (modeled within the North TDA Basin):

The predeveloped condition was applied to the North Basin. For visual representation of the listed basins, see Figure 4.0, "Predeveloped Hydrology Map". The values as modeled in WWHM are as follows:

Table 1: Predeveloped Conditions: North Basin

North Basin	
Ground Cover	Area (acre)
Forest, flat	1.00
Total	1.00

South Basin (modeled within the South TDA Basin):

The predeveloped condition was applied to the South Basin. For visual representation of the listed basins, see Figure 4.0, "Predeveloped Hydrology Map". The values as modeled in WWHM are as follows:

Table 2: Predeveloped Conditions: South Basin

South Basin	
Ground Cover	Area (acre)
Forest, flat	0.33
Forest, mod	0.98
Total	1.31

4.2 Developed Site Hydrology

In the developed condition, the project will develop 36 single-family lots and associated driveways and utilities. Frontage improvements, including pavement widening and construction of pedestrian facilities, will be constructed along 172nd St NE.

In compliance with the 2019 DOE Manual, all runoff from onsite developed/disturbed surfaces will be collected, treated, and discharged directly to existing/historic flow paths. The developed site is split into North and South detention systems to match the overall areas distribution of the Predeveloped North and South TDA Basins and downstream discharge locations.

North Basin (modeled within the North TDA Basin):

The developed North Basin is 1.00 acres comprised of 15 single family lots, open spaces, and ROW. Consistent with Section 20.48.064 of the Arlington Municipal Code, the assumed maximum impervious coverage of 40% per lot was used. In the developed condition, the North Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 3: Developed Conditions: North Basin

North Basin	
Ground Cover	Area (acre)
Roof Tops, flat	0.30
Roads, flat	0.18
Sidewalks, flat	0.10
Pasture, flat	0.42
Total	1.00

South Basin (modeled within the South TDA Basin):

The developed South Basin is 1.28 acres comprised of 21 single family lots, open spaces, and ROW. Consistent with Section 20.48.064 of the Arlington Municipal Code, the assumed maximum impervious coverage of 40% per lot was used. In the developed condition, the South Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 4: Developed Conditions: South Basin

South Basin	
Ground Cover	Area (acre)
Roof Tops, flat	0.27
Roads, flat	0.28
Roads, mod	0.12
Sidewalks, flat	0.21
Sidewalk, mod	0.01
Pasture, flat	0.39
Total	1.28

Frontage Bypass Basin (modeled within the South TDA Basin):

The developed Frontage Bypass Basin is 0.03 acres, comprised of roadway on the west side of the frontage area that cannot be collected due to vertical constraints. In the developed condition, the Frontage Bypass Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 5: Developed Conditions: Onsite Basin

Frontage Bypass Basin	
Ground Cover	Area (acre)
Road, mod	0.03
Total	0.03

4.3 Detention Facility Design

The proposed detention vault facilities used for mitigating developed condition flows were designed in compliance with 2019 DOE requirements to model hydrologic conditions and detention in a continuous runoff model (WWHM2012) where the following evaluation parameters are employed:

"Flow duration is computed by counting the number of flow values that exceed a specified flow level. The specified flow levels used by WWHM in the flow duration analysis are listed below.

1. 50% of the 2-year predevelopment peak flow.
2. 100% of the 2-year predevelopment peak flow.
3. 100% of the 50-year predevelopment peak flow.

There are three criteria by which flow duration values are compared:

1. *If the postdevelopment flow duration values exceed any of the predevelopment flow levels between 50% and 100% of the 2-year predevelopment peak flow values (100 Percent Threshold) then the flow duration requirement has not been met.*
2. *If the postdevelopment flow duration values exceed any of the predevelopment flow levels between 100% of the 2-year and 100% of the 50-year predevelopment peak flow values more than 10 percent of the time (110 Percent Threshold) then the flow duration requirement has not been met.*
3. *If more than 50 percent of the flow duration levels exceed the 100 percent threshold then the flow duration requirement has not been met."*

Detention Vault Facilities

The proposed detention facilities detain, and release collected storm water runoff from the onsite North and South Basins. The predeveloped site consists of two TDAs (North and South TDA Basins), so the proposed system will be comprised of two separate vaults that outfall at separate locations to match the predeveloped conditions. The facilities are located within the north and south edges of the site. Flows from the onsite basins are collected and conveyed to the detention vaults via a network of catch basins and storm water conveyance pipes. Detailed WWHM output is provided in Appendix 4. A summary of the detailed statistics and inputs used for modeling the system in WWHM2012 can be found below.

Table 6: North Detention Vault Design Summary

WWHM Modeled North Detention Vault	
Live Storage Bottom Area	2,500 SF
Vault Dimensions	48.75'x48.75'
Riser Height	6.00'
Volume (modeled)	14,260 CF
Detailed North Detention Vault	
Live Storage Bottom Area (provided)	2,400 SF
Number of Cells	2
Cell Dimensions	20.0' x 60.0'
Begin Live Storage Elevation	451.25
Riser Height	6.00'
Volume (provided)	14,400 CF
Top of Riser Elevation	457.25
Top Outside of Vault Elevation	460.75

Table 7: South Detention Vault Design Summary

WWHM Modeled South Detention Vault	
Live Storage Bottom Area	2,070 SF
Vault Dimensions	45.5'x45.5'
Riser Height	10.00'
Volume (modeled)	20,703 CF

Detailed South Detention Vault	
Live Storage Bottom Area (provided)	2,100 SF
Number of Cells	2
Cell Dimensions	30.0' x 35.0'
Begin Live Storage Elevation	447.90
Riser Height	10.00'
Volume (provided)	24,360 CF
Top of Riser Elevation	457.90
Top Outside of Vault Elevation	459.40

See tables below for the flow rates and water surface elevations by storm event for the detention vaults.

Table 8: North Vault Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation (ft)
2-Year	0.0336	0.0175	454.09
10-Year	0.0654	0.0315	455.35
50-Year	0.1017	0.0489	455.78
100-Year	0.1197	0.0582	456.00

Table 9: South Vault Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation (ft)
2-Year	0.0473	0.0356	456.87
10-Year	0.0966	0.0595	457.88
50-Year	0.1552	0.0870	459.03
100-Year	0.1849	0.1009	459.86

4.4 Water Quality Treatment

Perkfilter-1

Water Quality Treatment for PGIS within the North Basin is accomplished through a Perkfilter Manhole located downstream of the detention vault. A summary of design criteria is provided below:

Table 6: Perkfilter-1 Design Summary

Perkfilter 1 – 48" Ø Concrete Manhole	
Tributary Area	1.00 AC
Tributary PGIS Area	0.11 AC
Water Quality Flow Rate (2-yr peak flow)	0.0176 cfs
Number of Cartridges	1
Cartridge Height	18"
Internal Drop	1.33'
Peak Flow Rate	0.0582 cfs
Peak Flow Storm Event	100-Year

Perkfilter-2

Water Quality Treatment for PGIS within the South Basin is accomplished through a Perkfilter Manhole located downstream of the detention vault. A summary of design criteria is provided below:

Table 7: Perkfilter-2 Design Summary

Perkfilter 2 – 48" Ø Concrete Manhole	
Tributary Area	1.28 AC
Tributary PGIS Area	0.27 AC
Water Quality Flow Rate (2-yr peak flow)	0.0356 cfs
Number of Cartridges	1
Cartridge Height	18"
Internal Drop	1.33'
Peak Flow Rate	0.1009 cfs
Peak Flow Storm Event	100-year

Appendix 4: Detention and Water Quality Design Analysis

1. Figure 4.0: Predeveloped Hydrology Map
2. Figure 5.0: Developed Hydrology Map
3. Perkfilter Details
4. WWHM2012 Output – North Vault Detention Model
5. WWHM2012 Output – South Vault Detention Model
6. WWHM2012 Output – Perkfilter 1 – 48" Ø Concrete Manhole
7. WWHM2012 Output – Perkfilter 2 – 48" Ø Concrete Manhole

3.00 Predeveloped Hydrology.mxd | MOD: 8/16/2023 | ctiweyang

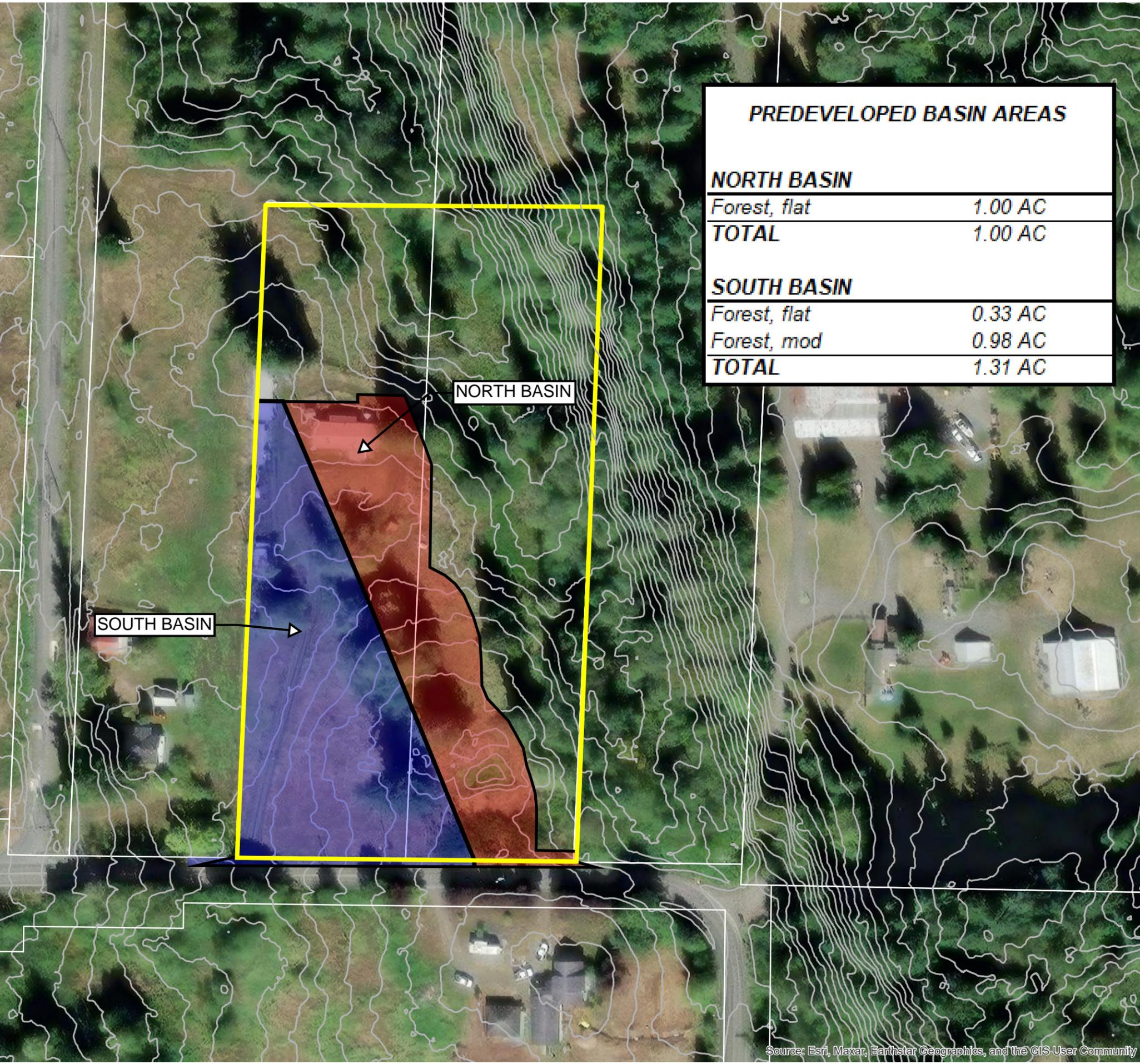


VICINITY MAP

LEGEND

- Subject Property
- Parcel Boundary
- Watercourse
- Contours (LiDAR)
 - 10 Foot Contour
 - 2 Foot Contour

0 100 200
Scale in Feet

PREDEVELOPED BASIN AREAS	
NORTH BASIN	
Forest, flat	1.00 AC
TOTAL	1.00 AC
SOUTH BASIN	
Forest, flat	0.33 AC
Forest, mod	0.98 AC
TOTAL	1.31 AC

JM1 HOLDINGS, LLC

ALLEN TOWNHOMES PREDEVELOPED HYDROLOGY MAP



Woodinville
20210 142nd Avenue NE
Woodinville, WA 98072
T: 425.386.1869 www.LDCcorp.com F: 425.482.2893

SOURCE INFORMATION

SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (KING COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

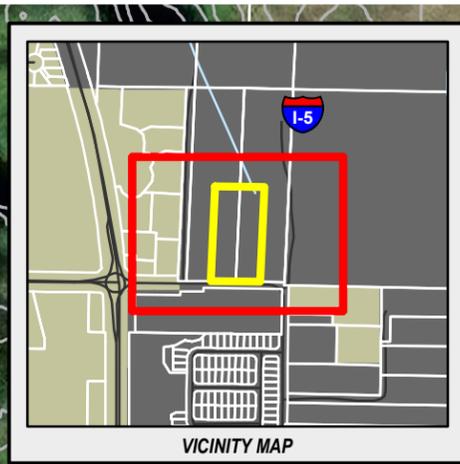
NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET	
REVISION:	
JOB NUMBER:	C21-213
DRAWING NAME:	C21-213-4.0
DESIGNER:	CTIWEYANG
DRAWING BY:	CTIWEYANG
DATE:	8/16/2023
SCALE:	AS SHOWN
JURISDICTION:	ARLINGTON

FIGURE:

4.0

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

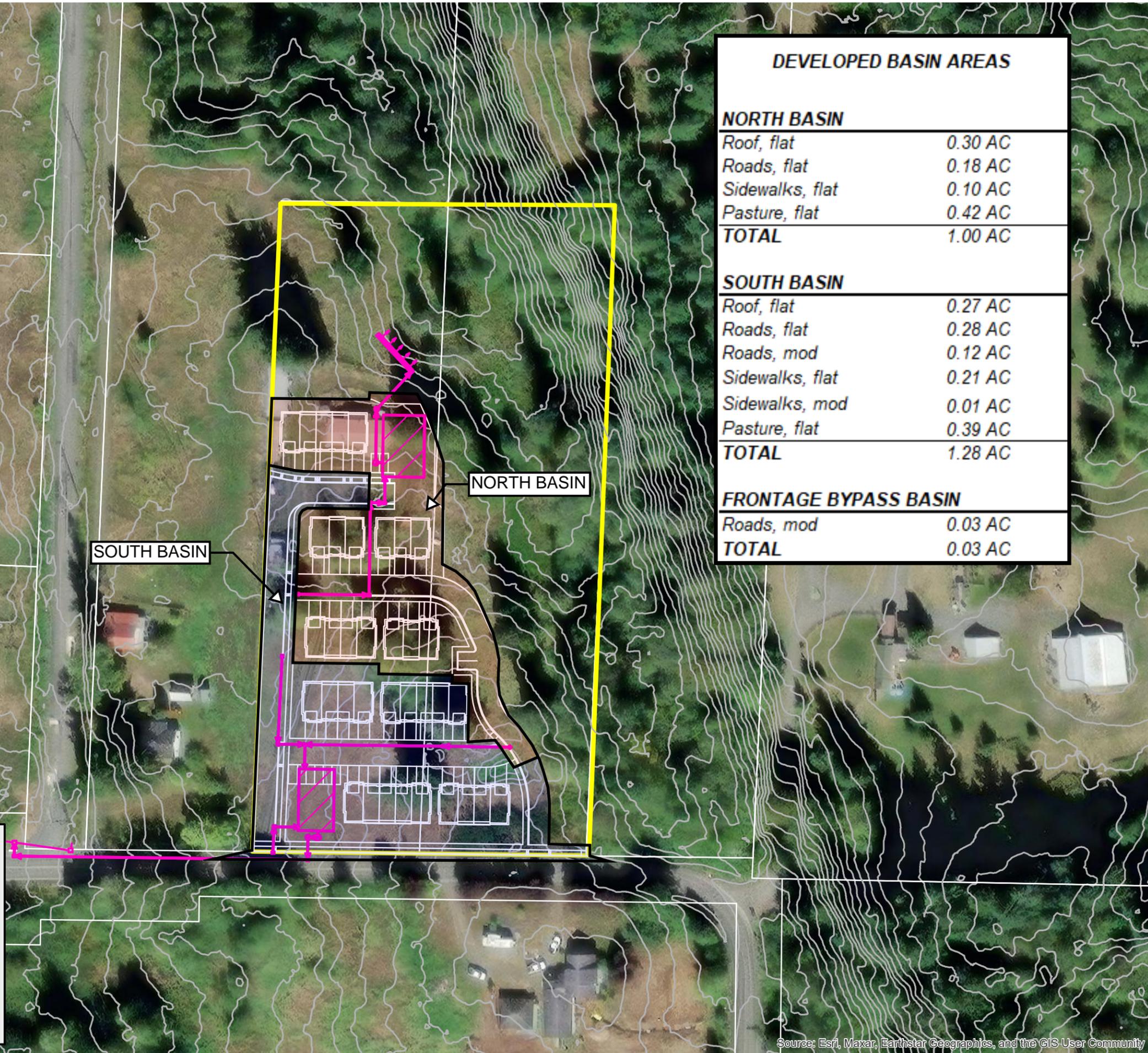
4.00 DevelopedHydrology.mxd | MOD: 8/16/2023 | ctiveyang



LEGEND

- Subject Property
- Parcel Boundary
- Watercourse
- Contours (LiDAR)
- 10 Foot Contour
- 2 Foot Contour

0 100 200
Scale in Feet



DEVELOPED BASIN AREAS	
NORTH BASIN	
Roof, flat	0.30 AC
Roads, flat	0.18 AC
Sidewalks, flat	0.10 AC
Pasture, flat	0.42 AC
TOTAL	1.00 AC
SOUTH BASIN	
Roof, flat	0.27 AC
Roads, flat	0.28 AC
Roads, mod	0.12 AC
Sidewalks, flat	0.21 AC
Sidewalks, mod	0.01 AC
Pasture, flat	0.39 AC
TOTAL	1.28 AC
FRONTAGE BYPASS BASIN	
Roads, mod	0.03 AC
TOTAL	0.03 AC

SOURCE INFORMATION	
SOURCE AGENCY	DESCRIPTION
SNOHOMISH COUNTY GIS	PARCEL BOUNDARY
SNOHOMISH COUNTY GIS	CONTOURS GENERATED FROM BARE EARTH LIDAR (KING COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.

LDC

Surveying
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JM1 HOLDINGS, LLC

ALLEN TOWNHOMES

DEVELOPED HYDROLOGY MAP

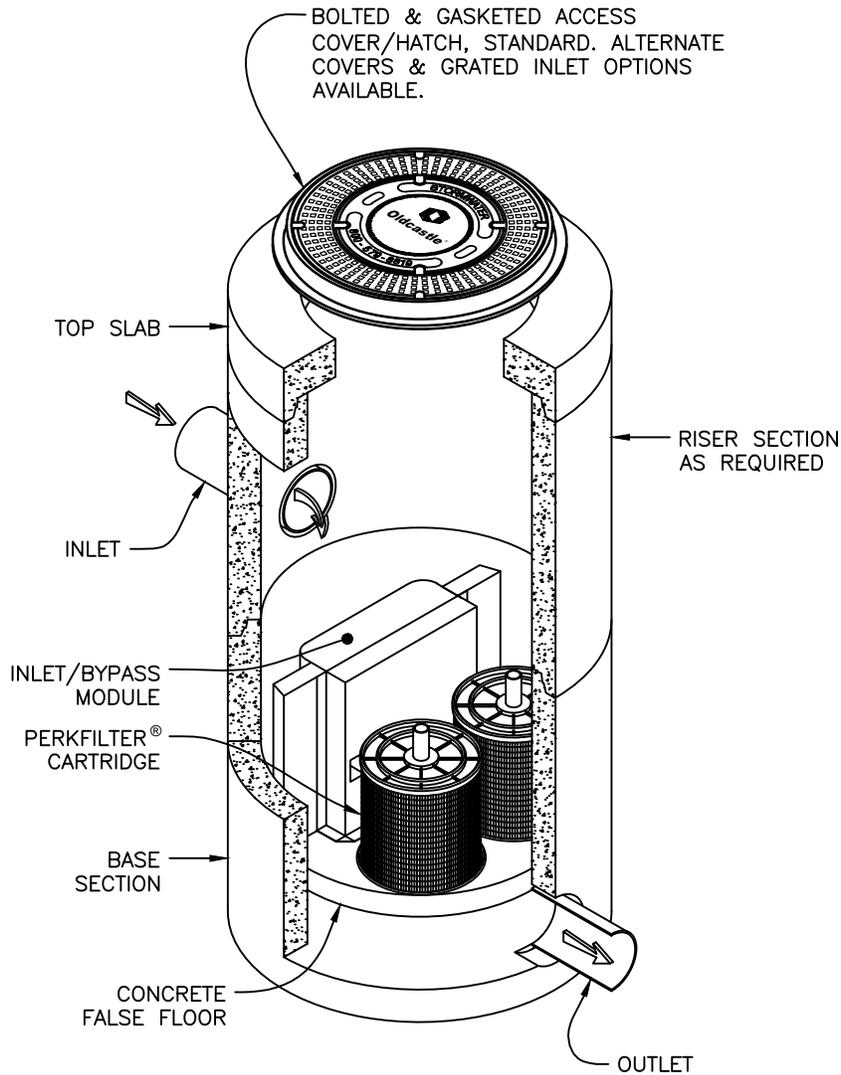
NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET
REVISION:
JOB NUMBER: C21-213
DRAWING NAME: C21-213-4.0
DESIGNER: CTIVEYANG
DRAWING BY: CTIVEYANG
DATE: 8/16/2023
SCALE: AS SHOWN
JURISDICTION: ARLINGTON

FIGURE:
5.0

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

PERKFILTER-1

PF-MH-48



Notes:

1. Precast concrete structure shall be manufactured in accordance with ASTM Designation C478.
2. Filter system shall be supplied with traffic rated (H20) bolted & gasketed Ø36" circular access covers with risers as required. Field poured concrete collar required, by others.
3. Inlet & outlet pipe(s) are to be Ø18" maximum. Inlet pipes must enter the structure in the inlet chamber.
4. Inlet chamber shall be supplied with drain-down device designed to remove standing water between storm events.
5. Minimum separation between invert in & invert out is outlet pipe diameter plus 4.00".
6. For depths less than specified minimums contact Oldcastle Infrastructure for engineering assistance.



PerkFilter®

Ø48" Manhole

One to Two Cartridges / Stacks



Oldcastle Infrastructure™

A CRH COMPANY

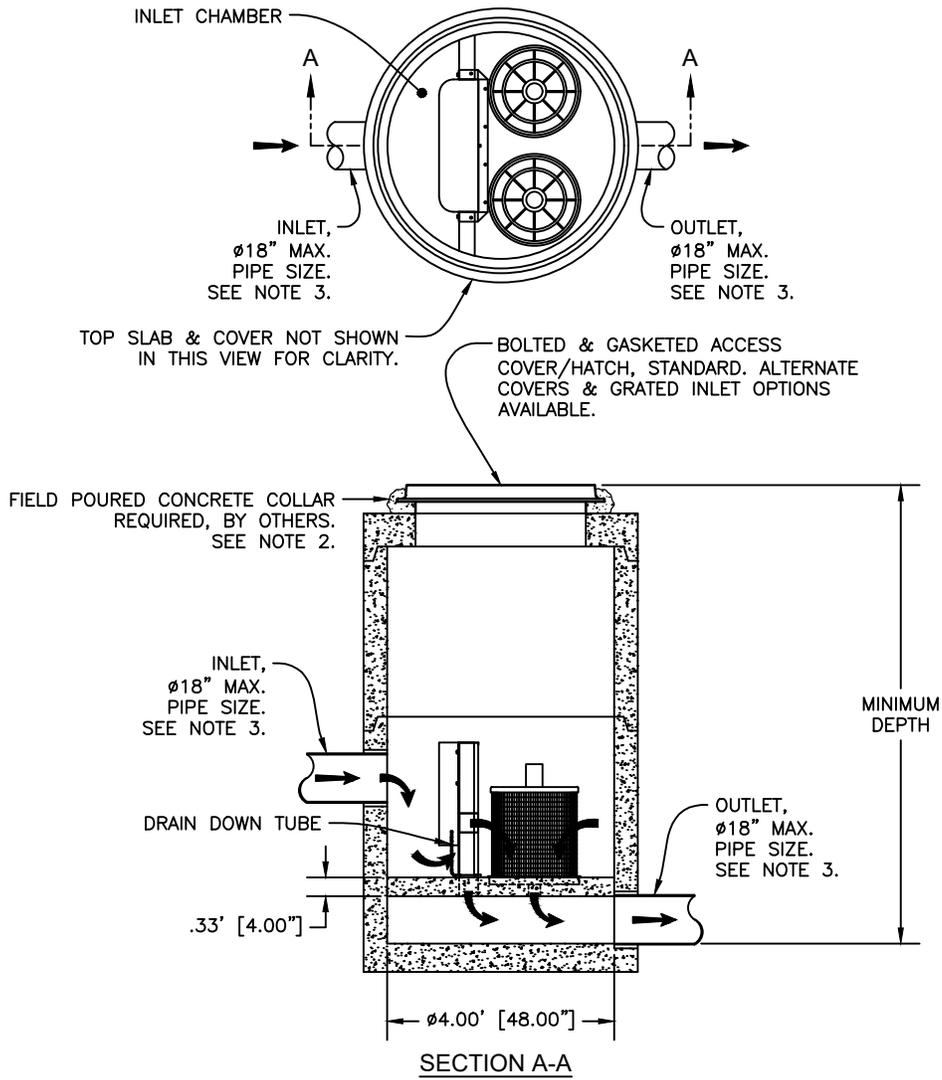
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DRAWING NO. PF-MH-48	REV A	ECO ECO-0168 ARG 1/22/2020	DATE PPS 1/23/20	SHEET 1 OF 2
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PERKFILTER-1

PF-MH-48



Minimum Depth						
PIPE SIZE	Ø6"	Ø8"	Ø10"	Ø12"	Ø15"	Ø18"
CARTRIDGE TYPE	MINIMUM DEPTH RIM TO OUTLET					
12"	3.67' [44.00"]	3.92' [47.00"]	4.17' [50.00"]	4.42' [53.00"]	4.67' [56.00"]	4.92' [59.00"]
18"	4.42' [53.00"]	4.67' [56.00"]	4.92' [59.00"]	5.17' [62.00"]	5.42' [65.00"]	5.67' [68.00"]
12" + 12"	5.17' [62.00"]	5.42' [65.00"]	5.67' [68.00"]	5.92' [71.00"]	6.17' [74.00"]	6.42' [77.00"]
12" + 18"	5.67' [68.00"]	5.92' [71.00"]	6.17' [74.00"]	6.42' [77.00"]	6.67' [80.00"]	6.92' [83.00"]

Ø48" PERKFILTER MANHOLE TREATMENT FLOW RATES, TOTAL FLOW CAPACITIES & MAXIMUM HEAD LOSS								
CARTRIDGE STACK QUANTITY	CARTRIDGE STACK CONFIGURATION							
	12"		18"		12" & 12"		12" & 18"	
	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)
1	12 / 0.03	2.47	18 / 0.04	3.05	24 / 0.05	3.45	30 / 0.07	3.62
2	24 / 0.05	2.47	36 / 0.08	3.05	48 / 0.11	3.45	60 / 0.13	3.62
MAXIMUM HEAD LOSS	1.7 FEET		2.3 FEET		2.9 FEET		3.5 FEET	



PerkFilter®

Ø48" Manhole

One to Two Cartridges / Stacks

Media Filtration



Oldcastle Infrastructure™

A CRH COMPANY

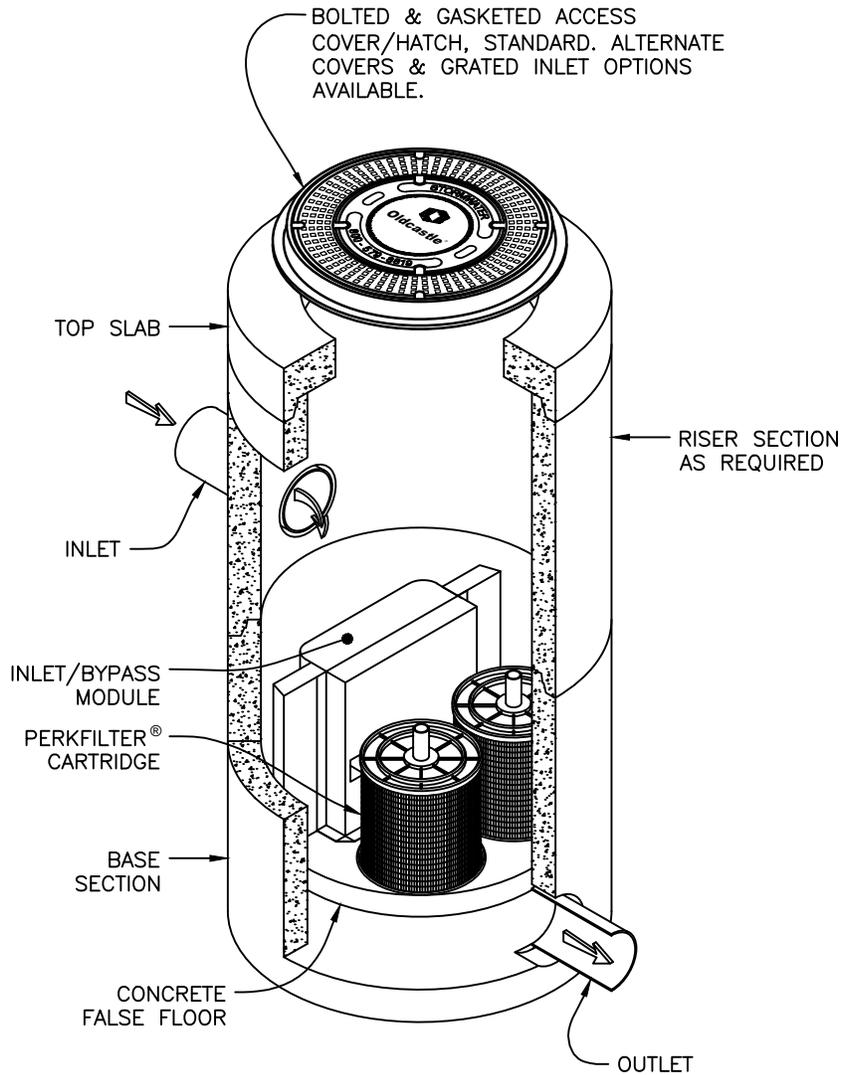
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DRAWING NO. PF-MH-48	REV A	ECO ECO-0168 ARG 1/22/2020	DATE PPS 1/23/20	SHEET 2 OF 2
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PERKFILTER-2

PF-MH-48



Notes:

1. Precast concrete structure shall be manufactured in accordance with ASTM Designation C478.
2. Filter system shall be supplied with traffic rated (H20) bolted & gasketed Ø36" circular access covers with risers as required. Field poured concrete collar required, by others.
3. Inlet & outlet pipe(s) are to be Ø18" maximum. Inlet pipes must enter the structure in the inlet chamber.
4. Inlet chamber shall be supplied with drain-down device designed to remove standing water between storm events.
5. Minimum separation between invert in & invert out is outlet pipe diameter plus 4.00".
6. For depths less than specified minimums contact Oldcastle Infrastructure for engineering assistance.



Media Filtration

PerkFilter®

Ø48" Manhole

One to Two Cartridges / Stacks



Oldcastle Infrastructure™

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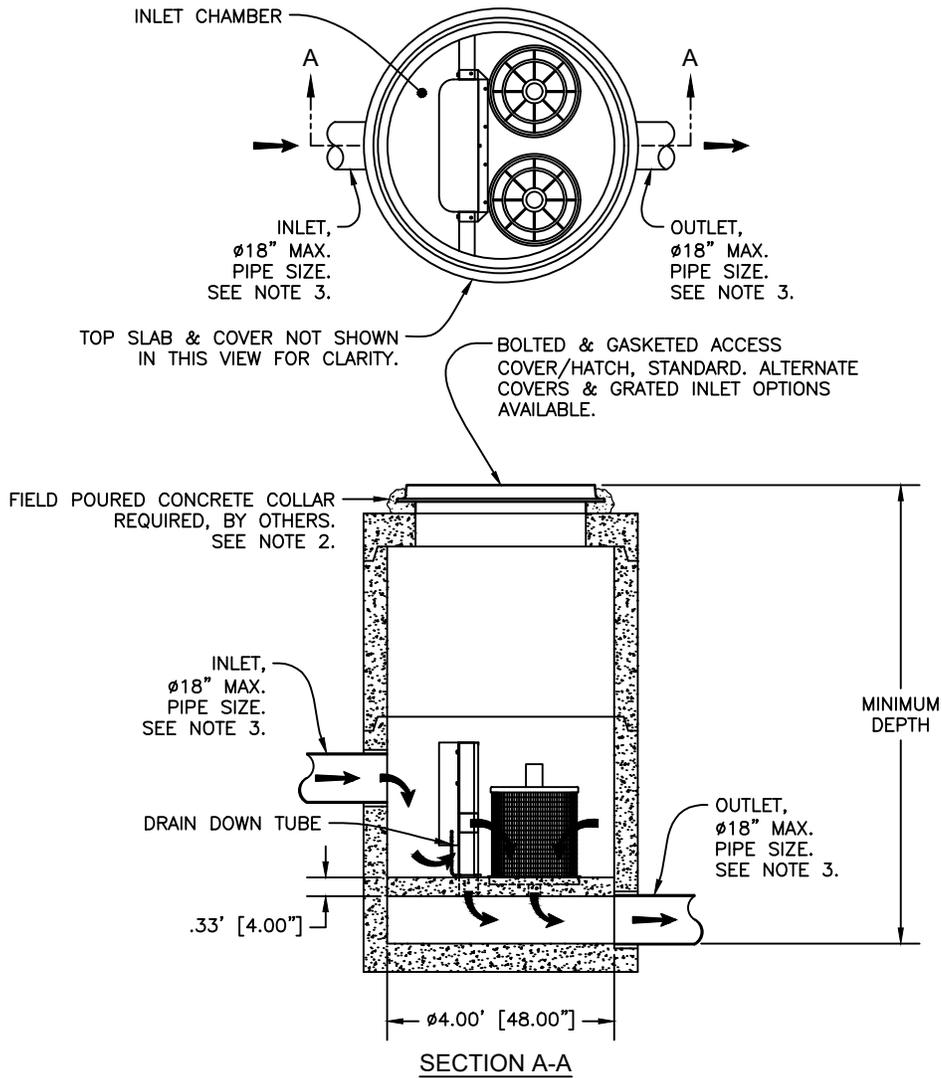
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DRAWING NO. PF-MH-48	REV A	ECO ECO-0168 ARG 1/22/2020	DATE PPS 1/23/20	SHEET 1 OF 2
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PERKFILTER-2

PF-MH-48



PIPE SIZE	Ø6"	Ø8"	Ø10"	Ø12"	Ø15"	Ø18"
CARTRIDGE TYPE	MINIMUM DEPTH RIM TO OUTLET					
12"	3.67' [44.00"]	3.92' [47.00"]	4.17' [50.00"]	4.42' [53.00"]	4.67' [56.00"]	4.92' [59.00"]
18"	4.42' [53.00"]	4.67' [56.00"]	4.92' [59.00"]	5.17' [62.00"]	5.42' [65.00"]	5.67' [68.00"]
12" + 12"	5.17' [62.00"]	5.42' [65.00"]	5.67' [68.00"]	5.92' [71.00"]	6.17' [74.00"]	6.42' [77.00"]
12" + 18"	5.67' [68.00"]	5.92' [71.00"]	6.17' [74.00"]	6.42' [77.00"]	6.67' [80.00"]	6.92' [83.00"]

CARTRIDGE STACK QUANTITY	CARTRIDGE STACK CONFIGURATION							
	12"		18"		12" & 12"		12" & 18"	
	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)	TREATMENT FLOW RATE (GPM / CFS)	TOTAL FLOW CAPACITY (CFS)
1	12 / 0.03	2.47	18 / 0.04	3.05	24 / 0.05	3.45	30 / 0.07	3.62
2	24 / 0.05	2.47	36 / 0.08	3.05	48 / 0.11	3.45	60 / 0.13	3.62
MAXIMUM HEAD LOSS	1.7 FEET		2.3 FEET		2.9 FEET		3.5 FEET	



PerkFilter®

Ø48" Manhole

One to Two Cartridges / Stacks



Oldcastle Infrastructure™

A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

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DRAWING NO. PF-MH-48	REV A	ECO ECO-0168 ARG 1/22/2020	DATE PPS 1/23/20	SHEET 2 OF 2
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**WVHM2012
PROJECT REPORT**

Project Name: North Vault
Site Name:
Site Address:
City :
Report Date: 8/15/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
 (adjusted) **Precip Scale:** 0.00
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Flat	1

Pervious Total	0
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<u>Impervious Land Use</u>	<u>acre</u>
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Impervious Total	0
------------------	---

Basin Total	0
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Element Flows To:		
Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.42
Pervious Total	0.42
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.18
ROOF TOPS FLAT	0.3
SIDEWALKS FLAT	0.1
Impervious Total	0.58
Basin Total	1

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : Vault 1
Width : 48.75 ft.
Length : 48.75 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.625 in. **Elevation**: 0 ft.
Orifice 2 Diameter: 1.125 in. **Elevation**: 4 ft.
Orifice 3 Diameter: 0.625 in. **Elevation**: 4.5 ft.

Element Flows To:

Outlet 1	Outlet 2
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Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.054	0.000	0.000	0.000
0.0778	0.054	0.004	0.003	0.000
0.1556	0.054	0.008	0.004	0.000
0.2333	0.054	0.012	0.005	0.000
0.3111	0.054	0.017	0.005	0.000
0.3889	0.054	0.021	0.006	0.000
0.4667	0.054	0.025	0.007	0.000
0.5444	0.054	0.029	0.007	0.000
0.6222	0.054	0.033	0.008	0.000
0.7000	0.054	0.038	0.008	0.000
0.7778	0.054	0.042	0.009	0.000

0.8556	0.054	0.046	0.009	0.000
0.9333	0.054	0.050	0.010	0.000
1.0111	0.054	0.055	0.010	0.000
1.0889	0.054	0.059	0.011	0.000
1.1667	0.054	0.063	0.011	0.000
1.2444	0.054	0.067	0.011	0.000
1.3222	0.054	0.072	0.012	0.000
1.4000	0.054	0.076	0.012	0.000
1.4778	0.054	0.080	0.012	0.000
1.5556	0.054	0.084	0.013	0.000
1.6333	0.054	0.089	0.013	0.000
1.7111	0.054	0.093	0.013	0.000
1.7889	0.054	0.097	0.014	0.000
1.8667	0.054	0.101	0.014	0.000
1.9444	0.054	0.106	0.014	0.000
2.0222	0.054	0.110	0.015	0.000
2.1000	0.054	0.114	0.015	0.000
2.1778	0.054	0.118	0.015	0.000
2.2556	0.054	0.123	0.015	0.000
2.3333	0.054	0.127	0.016	0.000
2.4111	0.054	0.131	0.016	0.000
2.4889	0.054	0.135	0.016	0.000
2.5667	0.054	0.140	0.017	0.000
2.6444	0.054	0.144	0.017	0.000
2.7222	0.054	0.148	0.017	0.000
2.8000	0.054	0.152	0.017	0.000
2.8778	0.054	0.157	0.018	0.000
2.9556	0.054	0.161	0.018	0.000
3.0333	0.054	0.165	0.018	0.000
3.1111	0.054	0.169	0.018	0.000
3.1889	0.054	0.174	0.018	0.000
3.2667	0.054	0.178	0.019	0.000
3.3444	0.054	0.182	0.019	0.000
3.4222	0.054	0.186	0.019	0.000
3.5000	0.054	0.191	0.019	0.000
3.5778	0.054	0.195	0.020	0.000
3.6556	0.054	0.199	0.020	0.000
3.7333	0.054	0.203	0.020	0.000
3.8111	0.054	0.207	0.020	0.000
3.8889	0.054	0.212	0.020	0.000
3.9667	0.054	0.216	0.021	0.000
4.0444	0.054	0.220	0.028	0.000
4.1222	0.054	0.224	0.033	0.000
4.2000	0.054	0.229	0.037	0.000
4.2778	0.054	0.233	0.040	0.000
4.3556	0.054	0.237	0.042	0.000
4.4333	0.054	0.241	0.044	0.000
4.5111	0.054	0.246	0.048	0.000
4.5889	0.054	0.250	0.052	0.000
4.6667	0.054	0.254	0.055	0.000
4.7444	0.054	0.258	0.058	0.000
4.8222	0.054	0.263	0.060	0.000
4.9000	0.054	0.267	0.062	0.000
4.9778	0.054	0.271	0.064	0.000
5.0556	0.054	0.275	0.067	0.000

5.1333	0.054	0.280	0.069	0.000
5.2111	0.054	0.284	0.070	0.000
5.2889	0.054	0.288	0.072	0.000
5.3667	0.054	0.292	0.074	0.000
5.4444	0.054	0.297	0.076	0.000
5.5222	0.054	0.301	0.078	0.000
5.6000	0.054	0.305	0.079	0.000
5.6778	0.054	0.309	0.081	0.000
5.7556	0.054	0.314	0.082	0.000
5.8333	0.054	0.318	0.084	0.000
5.9111	0.054	0.322	0.085	0.000
5.9889	0.054	0.326	0.087	0.000
6.0667	0.054	0.331	0.271	0.000
6.1444	0.054	0.335	0.662	0.000
6.2222	0.054	0.339	1.137	0.000
6.3000	0.054	0.343	1.602	0.000
6.3778	0.054	0.348	1.973	0.000
6.4556	0.054	0.352	2.209	0.000
6.5333	0.054	0.356	2.397	0.000
6.6111	0.054	0.360	2.560	0.000
6.6889	0.054	0.364	2.713	0.000
6.7667	0.054	0.369	2.858	0.000
6.8444	0.054	0.373	2.996	0.000
6.9222	0.054	0.377	3.127	0.000
7.0000	0.054	0.381	3.253	0.000
7.0778	0.054	0.386	3.375	0.000
7.1556	0.000	0.000	3.492	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:1
 Total Impervious Area:0

Mitigated Landuse Totals for POC #1

Total Pervious Area:0.42
 Total Impervious Area:0.58

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.0336
5 year	0.051544
10 year	0.065383
25 year	0.085182
50 year	0.101671
100 year	0.119705

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.017588
5 year	0.025233
10 year	0.031451
25 year	0.040787
50 year	0.04893
100 year	0.058193

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.034	0.016
1950	0.034	0.018
1951	0.031	0.015
1952	0.024	0.014
1953	0.020	0.014
1954	0.110	0.017
1955	0.043	0.020
1956	0.038	0.021
1957	0.047	0.020
1958	0.034	0.016
1959	0.034	0.017
1960	0.032	0.018
1961	0.060	0.019
1962	0.029	0.015
1963	0.049	0.015
1964	0.035	0.013
1965	0.029	0.018
1966	0.017	0.015
1967	0.035	0.015
1968	0.042	0.019
1969	0.102	0.016
1970	0.024	0.015
1971	0.038	0.021
1972	0.028	0.016
1973	0.027	0.017
1974	0.058	0.017
1975	0.023	0.014
1976	0.024	0.016
1977	0.020	0.014
1978	0.024	0.014
1979	0.067	0.016
1980	0.031	0.014
1981	0.025	0.015
1982	0.032	0.019
1983	0.055	0.015
1984	0.033	0.031
1985	0.040	0.020
1986	0.094	0.066
1987	0.045	0.045
1988	0.023	0.019
1989	0.024	0.013

1990	0.031	0.019
1991	0.032	0.018
1992	0.025	0.018
1993	0.020	0.013
1994	0.022	0.017
1995	0.033	0.021
1996	0.056	0.020
1997	0.111	0.118
1998	0.020	0.015
1999	0.027	0.018
2000	0.020	0.020
2001	0.008	0.012
2002	0.030	0.018
2003	0.024	0.017
2004	0.040	0.020
2005	0.028	0.017
2006	0.075	0.020
2007	0.059	0.018
2008	0.083	0.065
2009	0.025	0.017

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1113	0.1176
2	0.1098	0.0656
3	0.1024	0.0646
4	0.0938	0.0454
5	0.0827	0.0313
6	0.0745	0.0211
7	0.0672	0.0210
8	0.0597	0.0205
9	0.0589	0.0204
10	0.0576	0.0204
11	0.0560	0.0203
12	0.0546	0.0201
13	0.0485	0.0201
14	0.0473	0.0197
15	0.0448	0.0196
16	0.0432	0.0193
17	0.0421	0.0191
18	0.0402	0.0191
19	0.0399	0.0188
20	0.0382	0.0187
21	0.0381	0.0184
22	0.0349	0.0183
23	0.0346	0.0182
24	0.0343	0.0179
25	0.0342	0.0179
26	0.0339	0.0179
27	0.0336	0.0179
28	0.0330	0.0177
29	0.0328	0.0175
30	0.0323	0.0174

31	0.0320	0.0173
32	0.0316	0.0172
33	0.0315	0.0171
34	0.0313	0.0170
35	0.0307	0.0170
36	0.0305	0.0167
37	0.0295	0.0165
38	0.0292	0.0163
39	0.0281	0.0161
40	0.0280	0.0160
41	0.0267	0.0158
42	0.0266	0.0155
43	0.0252	0.0152
44	0.0247	0.0152
45	0.0246	0.0151
46	0.0242	0.0151
47	0.0242	0.0151
48	0.0242	0.0150
49	0.0241	0.0147
50	0.0239	0.0145
51	0.0236	0.0145
52	0.0235	0.0143
53	0.0232	0.0143
54	0.0224	0.0141
55	0.0205	0.0140
56	0.0204	0.0139
57	0.0203	0.0137
58	0.0203	0.0132
59	0.0201	0.0131
60	0.0171	0.0129
61	0.0081	0.0116

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0168	19590	15421	78	Pass
0.0177	17002	10008	58	Pass
0.0185	14675	6740	45	Pass
0.0194	12726	3754	29	Pass
0.0202	10934	1961	17	Pass
0.0211	9443	862	9	Pass
0.0219	8168	829	10	Pass
0.0228	7075	812	11	Pass
0.0237	6136	799	13	Pass
0.0245	5313	783	14	Pass
0.0254	4654	773	16	Pass
0.0262	4066	762	18	Pass
0.0271	3553	751	21	Pass
0.0279	3136	740	23	Pass
0.0288	2759	725	26	Pass

0.0297	2449	701	28	Pass
0.0305	2145	687	32	Pass
0.0314	1894	668	35	Pass
0.0322	1656	658	39	Pass
0.0331	1508	649	43	Pass
0.0339	1370	636	46	Pass
0.0348	1250	625	50	Pass
0.0357	1154	610	52	Pass
0.0365	1069	599	56	Pass
0.0374	1009	587	58	Pass
0.0382	949	571	60	Pass
0.0391	888	559	62	Pass
0.0399	825	545	66	Pass
0.0408	777	528	67	Pass
0.0417	733	514	70	Pass
0.0425	687	497	72	Pass
0.0434	648	480	74	Pass
0.0442	622	461	74	Pass
0.0451	602	426	70	Pass
0.0459	583	408	69	Pass
0.0468	561	392	69	Pass
0.0477	538	377	70	Pass
0.0485	507	368	72	Pass
0.0494	487	361	74	Pass
0.0502	473	352	74	Pass
0.0511	457	345	75	Pass
0.0519	440	338	76	Pass
0.0528	424	330	77	Pass
0.0537	409	323	78	Pass
0.0545	394	315	79	Pass
0.0554	380	309	81	Pass
0.0562	368	299	81	Pass
0.0571	353	290	82	Pass
0.0579	341	279	81	Pass
0.0588	333	269	80	Pass
0.0597	322	259	80	Pass
0.0605	313	249	79	Pass
0.0614	302	238	78	Pass
0.0622	293	225	76	Pass
0.0631	284	213	75	Pass
0.0640	276	194	70	Pass
0.0648	265	160	60	Pass
0.0657	257	143	55	Pass
0.0665	241	132	54	Pass
0.0674	234	130	55	Pass
0.0682	226	127	56	Pass
0.0691	212	124	58	Pass
0.0700	205	122	59	Pass
0.0708	195	118	60	Pass
0.0717	187	115	61	Pass
0.0725	177	99	55	Pass
0.0734	166	91	54	Pass
0.0742	160	85	53	Pass
0.0751	150	81	54	Pass
0.0760	146	76	52	Pass

0.0768	135	72	53	Pass
0.0777	128	68	53	Pass
0.0785	120	64	53	Pass
0.0794	111	60	54	Pass
0.0802	99	55	55	Pass
0.0811	85	52	61	Pass
0.0820	75	47	62	Pass
0.0828	63	43	68	Pass
0.0837	59	38	64	Pass
0.0845	56	32	57	Pass
0.0854	49	24	48	Pass
0.0862	42	20	47	Pass
0.0871	39	10	25	Pass
0.0880	37	6	16	Pass
0.0888	36	6	16	Pass
0.0897	30	5	16	Pass
0.0905	28	5	17	Pass
0.0914	26	4	15	Pass
0.0922	19	4	21	Pass
0.0931	16	4	25	Pass
0.0940	13	4	30	Pass
0.0948	8	4	50	Pass
0.0957	6	4	66	Pass
0.0965	5	4	80	Pass
0.0974	4	4	100	Pass
0.0982	4	4	100	Pass
0.0991	3	3	100	Pass
0.1000	3	3	100	Pass
0.1008	3	3	100	Pass
0.1017	3	3	100	Pass

Water Quality BMP Flow and Volume for POC #1
 On-line facility volume: 0 acre-feet
 On-line facility target flow: 0 cfs.
 Adjusted for 15 min: 0 cfs.
 Off-line facility target flow: 0 cfs.
 Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Through	Volume	Volume
Volume	Water Quality	Treatment	Facility	(ac-ft.)	Infiltration
Infiltrated	Treated	(ac-ft)	(ac-ft)		Credit
Vault 1 POC	N	131.08			N
0.00					
Total Volume Infiltrated		131.08	0.00	0.00	
0.00	0.00	0%	No Treat.	Credit	
Compliance with LID Standard 8					
Duration Analysis Result = Failed					

PerlnD and ImplnD Changes

No changes have been made.

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**WVHM2012
PROJECT REPORT**

Project Name: South Vault
Site Name:
Site Address:
City :
Report Date: 8/15/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin A
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Flat	.33
C, Forest, Mod	.98
Pervious Total	1.31
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	1.31

Element Flows To:			
Surface	Interflow	Groundwater	

MITIGATED LAND USE

Name : Basin A
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.39
Pervious Total	0.39
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.28
ROADS MOD	0.12
ROOF TOPS FLAT	0.27
SIDEWALKS FLAT	0.21
SIDEWALKS MOD	0.01
Impervious Total	0.89
Basin Total	1.28

Element Flows To:

Surface	Interflow	Groundwater
Vault A	Vault A	

Name : Vault A

Width : 45.5 ft.

Length : 45.5 ft.

Depth: 11 ft.

Discharge Structure

Riser Height: 10 ft.

Riser Diameter: 12 in.

Orifice 1 Diameter: 0.625 in. **Elevation**: 0 ft.

Orifice 2 Diameter: 1.0625 in. **Elevation**: 5.5 ft.

Orifice 3 Diameter: 0.6875 in. **Elevation**: 7 ft.

Element Flows To:

Outlet 1	Outlet 2	
----------	----------	--

Vault Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.047	0.000	0.000	0.000
0.1222	0.047	0.005	0.003	0.000
0.2444	0.047	0.011	0.005	0.000
0.3667	0.047	0.017	0.006	0.000
0.4889	0.047	0.023	0.007	0.000
0.6111	0.047	0.029	0.008	0.000
0.7333	0.047	0.034	0.009	0.000
0.8556	0.047	0.040	0.009	0.000

0.9778	0.047	0.046	0.010	0.000
1.1000	0.047	0.052	0.011	0.000
1.2222	0.047	0.058	0.011	0.000
1.3444	0.047	0.063	0.012	0.000
1.4667	0.047	0.069	0.012	0.000
1.5889	0.047	0.075	0.013	0.000
1.7111	0.047	0.081	0.013	0.000
1.8333	0.047	0.087	0.014	0.000
1.9556	0.047	0.092	0.014	0.000
2.0778	0.047	0.098	0.015	0.000
2.2000	0.047	0.104	0.015	0.000
2.3222	0.047	0.110	0.016	0.000
2.4444	0.047	0.116	0.016	0.000
2.5667	0.047	0.122	0.017	0.000
2.6889	0.047	0.127	0.017	0.000
2.8111	0.047	0.133	0.017	0.000
2.9333	0.047	0.139	0.018	0.000
3.0556	0.047	0.145	0.018	0.000
3.1778	0.047	0.151	0.018	0.000
3.3000	0.047	0.156	0.019	0.000
3.4222	0.047	0.162	0.019	0.000
3.5444	0.047	0.168	0.020	0.000
3.6667	0.047	0.174	0.020	0.000
3.7889	0.047	0.180	0.020	0.000
3.9111	0.047	0.185	0.021	0.000
4.0333	0.047	0.191	0.021	0.000
4.1556	0.047	0.197	0.021	0.000
4.2778	0.047	0.203	0.021	0.000
4.4000	0.047	0.209	0.022	0.000
4.5222	0.047	0.214	0.022	0.000
4.6444	0.047	0.220	0.022	0.000
4.7667	0.047	0.226	0.023	0.000
4.8889	0.047	0.232	0.023	0.000
5.0111	0.047	0.238	0.023	0.000
5.1333	0.047	0.244	0.024	0.000
5.2556	0.047	0.249	0.024	0.000
5.3778	0.047	0.255	0.024	0.000
5.5000	0.047	0.261	0.024	0.000
5.6222	0.047	0.267	0.035	0.000
5.7444	0.047	0.273	0.040	0.000
5.8667	0.047	0.278	0.044	0.000
5.9889	0.047	0.284	0.047	0.000
6.1111	0.047	0.290	0.050	0.000
6.2333	0.047	0.296	0.052	0.000
6.3556	0.047	0.302	0.055	0.000
6.4778	0.047	0.307	0.057	0.000
6.6000	0.047	0.313	0.059	0.000
6.7222	0.047	0.319	0.061	0.000
6.8444	0.047	0.325	0.063	0.000
6.9667	0.047	0.331	0.065	0.000
7.0889	0.047	0.336	0.070	0.000
7.2111	0.047	0.342	0.074	0.000
7.3333	0.047	0.348	0.077	0.000
7.4556	0.047	0.354	0.080	0.000
7.5778	0.047	0.360	0.083	0.000

7.7000	0.047	0.366	0.085	0.000
7.8222	0.047	0.371	0.088	0.000
7.9444	0.047	0.377	0.090	0.000
8.0667	0.047	0.383	0.092	0.000
8.1889	0.047	0.389	0.094	0.000
8.3111	0.047	0.395	0.096	0.000
8.4333	0.047	0.400	0.098	0.000
8.5556	0.047	0.406	0.100	0.000
8.6778	0.047	0.412	0.102	0.000
8.8000	0.047	0.418	0.104	0.000
8.9222	0.047	0.424	0.106	0.000
9.0444	0.047	0.429	0.107	0.000
9.1667	0.047	0.435	0.109	0.000
9.2889	0.047	0.441	0.111	0.000
9.4111	0.047	0.447	0.113	0.000
9.5333	0.047	0.453	0.114	0.000
9.6556	0.047	0.458	0.116	0.000
9.7778	0.047	0.464	0.117	0.000
9.9000	0.047	0.470	0.119	0.000
10.022	0.047	0.476	0.156	0.000
10.144	0.047	0.482	0.695	0.000
10.267	0.047	0.487	1.442	0.000
10.389	0.047	0.493	2.046	0.000
10.511	0.047	0.499	2.378	0.000
10.633	0.047	0.505	2.635	0.000
10.756	0.047	0.511	2.867	0.000
10.878	0.047	0.517	3.082	0.000
11.000	0.047	0.522	3.282	0.000
11.122	0.047	0.528	3.470	0.000
11.244	0.000	0.000	3.649	0.000

Name : Bypass Frontage Basin
Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
Pervious Total	0
<u>Impervious Land Use</u>	<u>acre</u>
ROADS MOD	0.03
Impervious Total	0.03
Basin Total	0.03

Element Flows To:

Surface	Interflow	Groundwater
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ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
 Total Pervious Area:1.31
 Total Impervious Area:0

Mitigated Landuse Totals for POC #1
 Total Pervious Area:0.39
 Total Impervious Area:0.92

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.047289
5 year	0.074853
10 year	0.096618
25 year	0.12834
50 year	0.155183
100 year	0.184906

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.03557
5 year	0.049046
10 year	0.05946
25 year	0.074444
50 year	0.08702
100 year	0.100887

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.051	0.030
1950	0.052	0.033
1951	0.045	0.031
1952	0.036	0.031
1953	0.030	0.029
1954	0.180	0.039
1955	0.058	0.045
1956	0.051	0.049
1957	0.068	0.036
1958	0.057	0.052
1959	0.047	0.029
1960	0.043	0.032
1961	0.092	0.063

1962	0.044	0.030
1963	0.075	0.033
1964	0.058	0.026
1965	0.038	0.027
1966	0.022	0.025
1967	0.045	0.046
1968	0.055	0.033
1969	0.168	0.051
1970	0.032	0.028
1971	0.057	0.054
1972	0.037	0.041
1973	0.036	0.030
1974	0.092	0.037
1975	0.035	0.030
1976	0.037	0.031
1977	0.028	0.029
1978	0.033	0.028
1979	0.104	0.039
1980	0.049	0.032
1981	0.032	0.024
1982	0.042	0.037
1983	0.085	0.032
1984	0.043	0.061
1985	0.056	0.046
1986	0.128	0.102
1987	0.059	0.075
1988	0.030	0.033
1989	0.037	0.030
1990	0.041	0.031
1991	0.042	0.028
1992	0.032	0.030
1993	0.030	0.027
1994	0.029	0.032
1995	0.043	0.049
1996	0.079	0.041
1997	0.157	0.123
1998	0.027	0.034
1999	0.035	0.026
2000	0.029	0.052
2001	0.011	0.024
2002	0.040	0.028
2003	0.031	0.027
2004	0.053	0.050
2005	0.037	0.028
2006	0.119	0.045
2007	0.089	0.039
2008	0.108	0.097
2009	0.033	0.032

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1795	0.1230
2	0.1679	0.1024

3	0.1569	0.0975
4	0.1279	0.0749
5	0.1191	0.0635
6	0.1084	0.0608
7	0.1043	0.0544
8	0.0923	0.0517
9	0.0916	0.0516
10	0.0893	0.0509
11	0.0846	0.0504
12	0.0791	0.0495
13	0.0747	0.0490
14	0.0680	0.0457
15	0.0586	0.0456
16	0.0578	0.0452
17	0.0577	0.0446
18	0.0572	0.0415
19	0.0570	0.0406
20	0.0563	0.0394
21	0.0553	0.0391
22	0.0526	0.0388
23	0.0523	0.0367
24	0.0509	0.0366
25	0.0505	0.0364
26	0.0488	0.0335
27	0.0469	0.0330
28	0.0454	0.0327
29	0.0448	0.0325
30	0.0445	0.0325
31	0.0434	0.0324
32	0.0432	0.0322
33	0.0430	0.0320
34	0.0422	0.0318
35	0.0419	0.0318
36	0.0410	0.0314
37	0.0399	0.0313
38	0.0382	0.0312
39	0.0374	0.0306
40	0.0368	0.0304
41	0.0366	0.0304
42	0.0366	0.0301
43	0.0362	0.0301
44	0.0358	0.0300
45	0.0353	0.0295
46	0.0350	0.0295
47	0.0330	0.0294
48	0.0327	0.0285
49	0.0323	0.0284
50	0.0322	0.0284
51	0.0316	0.0279
52	0.0313	0.0279
53	0.0304	0.0279
54	0.0298	0.0272
55	0.0296	0.0268
56	0.0293	0.0266
57	0.0290	0.0265

58	0.0279	0.0265
59	0.0268	0.0246
60	0.0224	0.0244
61	0.0106	0.0240

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0236	15907	9661	60	Pass
0.0250	13454	4864	36	Pass
0.0263	11236	3527	31	Pass
0.0276	9458	2909	30	Pass
0.0290	7957	2528	31	Pass
0.0303	6725	2295	34	Pass
0.0316	5653	2127	37	Pass
0.0329	4830	2000	41	Pass
0.0343	4128	1929	46	Pass
0.0356	3516	1859	52	Pass
0.0369	3041	1774	58	Pass
0.0383	2624	1654	63	Pass
0.0396	2269	1550	68	Pass
0.0409	1943	1443	74	Pass
0.0422	1673	1317	78	Pass
0.0436	1501	1220	81	Pass
0.0449	1344	1116	83	Pass
0.0462	1208	1050	86	Pass
0.0476	1113	981	88	Pass
0.0489	1029	909	88	Pass
0.0502	954	844	88	Pass
0.0515	875	793	90	Pass
0.0529	806	750	93	Pass
0.0542	759	711	93	Pass
0.0555	700	678	96	Pass
0.0569	657	642	97	Pass
0.0582	626	605	96	Pass
0.0595	602	571	94	Pass
0.0608	574	545	94	Pass
0.0622	550	521	94	Pass
0.0635	516	483	93	Pass
0.0648	498	449	90	Pass
0.0662	479	424	88	Pass
0.0675	456	409	89	Pass
0.0688	436	395	90	Pass
0.0701	421	381	90	Pass
0.0715	399	367	91	Pass
0.0728	383	353	92	Pass
0.0741	364	341	93	Pass
0.0755	351	329	93	Pass
0.0768	340	320	94	Pass
0.0781	328	313	95	Pass

0.0794	319	305	95	Pass
0.0808	308	294	95	Pass
0.0821	292	280	95	Pass
0.0834	283	269	95	Pass
0.0848	272	260	95	Pass
0.0861	263	250	95	Pass
0.0874	243	232	95	Pass
0.0887	234	219	93	Pass
0.0901	221	199	90	Pass
0.0914	209	177	84	Pass
0.0927	196	159	81	Pass
0.0941	187	139	74	Pass
0.0954	175	129	73	Pass
0.0967	165	122	73	Pass
0.0981	157	117	74	Pass
0.0994	150	112	74	Pass
0.1007	140	101	72	Pass
0.1020	130	92	70	Pass
0.1034	121	80	66	Pass
0.1047	107	73	68	Pass
0.1060	88	68	77	Pass
0.1074	76	62	81	Pass
0.1087	64	59	92	Pass
0.1100	59	55	93	Pass
0.1113	55	52	94	Pass
0.1127	46	44	95	Pass
0.1140	41	36	87	Pass
0.1153	40	27	67	Pass
0.1167	38	22	57	Pass
0.1180	32	15	46	Pass
0.1193	27	10	37	Pass
0.1206	21	5	23	Pass
0.1220	16	1	6	Pass
0.1233	15	0	0	Pass
0.1246	9	0	0	Pass
0.1260	6	0	0	Pass
0.1273	6	0	0	Pass
0.1286	4	0	0	Pass
0.1299	4	0	0	Pass
0.1313	4	0	0	Pass
0.1326	4	0	0	Pass
0.1339	4	0	0	Pass
0.1353	4	0	0	Pass
0.1366	4	0	0	Pass
0.1379	3	0	0	Pass
0.1392	3	0	0	Pass
0.1406	3	0	0	Pass
0.1419	3	0	0	Pass
0.1432	3	0	0	Pass
0.1446	3	0	0	Pass
0.1459	3	0	0	Pass
0.1472	3	0	0	Pass
0.1485	3	0	0	Pass
0.1499	3	0	0	Pass
0.1512	3	0	0	Pass

0.1525	3	0	0	Pass
0.1539	3	0	0	Pass
0.1552	3	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
 On-line facility volume: 0 acre-feet
 On-line facility target flow: 0 cfs.
 Adjusted for 15 min: 0 cfs.
 Off-line facility target flow: 0 cfs.
 Adjusted for 15 min: 0 cfs.

LID Report

LID Technique	Used for	Total Volume	Volume	Infiltration	Cumulative
Percent	Water Quality	Percent	Through	Volume	Volume
Volume	Treatment?	Needs	Facility	(ac-ft.)	Infiltration
Infiltrated	Water Quality	Treatment	(ac-ft)	(ac-ft)	Credit
Infiltrated	Treated	(ac-ft)	(ac-ft)	(ac-ft)	Credit
Vault A POC	N	184.05			N
0.00					
Total Volume Infiltrated		184.05	0.00	0.00	
0.00	0.00	0%	No Treat. Credit		
Compliance with LID Standard 8					
Duration Analysis Result = Failed					

PerlnD and Implnd Changes

No changes have been made.

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SECTION 5: CONVEYANCE DESIGN

Conveyance analysis and design will be included in the construction drainage report to be submitted at a later date.

SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, detention vaults, a two Perfilter manholes. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages.

NO. 5 – CATCH BASINS AND MANHOLES				
Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed	
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.	
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.	
		Trash or debris in the catch basin that exceeds 1/3 the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.	
		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 catch basin.	
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.	
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.	
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.	
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.	
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.	
		Cracks wider than ½ 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.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe.	
	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.	
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.	
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.	
	Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
		Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
Damaged		Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.	

NO. 5 – CATCH BASINS AND MANHOLES			
Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $\frac{7}{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. Any open structure requires urgent maintenance.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. Any open structure requires urgent maintenance.	Cover/lid protects opening to structure.
	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.

NO. 6 – CONVEYANCE PIPES AND DITCHES			
Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

SECTION 7: SPECIAL REPORTS AND STUDIES

The following studies were conducted in preparation of this Report:

- Geotechnical Investigation, Cobalt Geosciences, November 16, 2021