# E. Sunnyside PRD

*City File # PA 22-033*

**Construction Drainage Report**

Prepared for

***Natural 9 Holdings, LLC***

*10515 20th Street SE, Suite 202*
*Lake Stevens, WA 98258*

Prepared by

LDC | Surveying Engineering Planning

*20210 142nd Ave NE*
*Woodinville, WA 98072*
*(425) 806-1869*


**February 2023** **Job No: 21-202**

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## APPENDICES

## SECTION 1: PROJECT OVERVIEW

The proposed E. Sunnyside PRD project is comprised of parcel numbers 00590700016201 and 00590700016202 which includes the existing single-family residence located at 4614 87th Ave NE, Marysville, WA. Total site parcel area equals approximately 4.29 acres. The project proposes the development of 28 single-family residences. The site is currently developed with four existing buildings on the two lots not being developed as well as a private driveway and associated improvements from 87th Ave NE. Development will also include frontage improvements to 87th Ave NE which will also provide access and utilities to the proposed residences. Due to the City of Marysville's future plans to convert E Sunnyside School Road to a future non-motorized trail corridor, no improvements are required to said roadway. The project area is located north of E Sunnyside School Road and west of 87th Ave NE in Marysville, WA. The site is located within the SW ¼ of the SW ¼ of Section 36, Township 30 N, Range 05 E, W.M. See Vicinity Map in the following pages for visual representation of the subject property.

### 1.1 EXISTING SITE

The project site consists of two parcels. Parcel 00590700016201 is occupied by a single-family home, garage, and outbuilding with a lumber stockpile area. Parcel 00590700016202 is connected to the west of parcel 00590700016201, and is occupied by a small shed at the northwest corner of the site. Pervious land cover for both parcels consist of pasture and landscaped areas. Access to both lots is via a gravel driveway on the eastern parcel from 87th Ave NE. All existing buildings will be demolished.

Site soils are classified as Tokul gravelly medial loam at 0 to 8 percent slope. According to Geotechnical Investigation by Cobalt Geosciences from December 20, 2021, the existing conditions of the site soils does not make widespread infiltration feasible. The report also confirms existing site slopes are generally sloping from north to south and southwest at 5% to 15%.

### 1.2 DOWNSTREAM ANALYSIS

Drainage from the existing site generally flows gently to the south/southwest towards E Sunnyside School Road. A high point located on parcel 00590700016201 extends from the mid-northeastern edge to the southwestern edge of said parcel and serves as a basin breakline for the area in which flows are directed east towards Steven's Creek and west towards King Creek. Refer to

Section 3.0 "Downstream Analysis Report" for a more in-depth description as well as Figure 4.0 in Appendix 3 for a visual depiction of the downstream flow paths.

## 1.3 PROPOSED DEVELOPMENT

Development activities are proposed for both parcels. 28 single-family units will be constructed with access from the west of 87th Ave NE and from a future subdivision north of the site. Development will disturb 4.417 acres; this consists of the developed lots and access roads from the northern property and from 87th Ave. Frontage improvements along 87th Ave include the creation of an access point to the proposed lots, sidewalk, ADA ramps and landscaping. This proposed development is designed under the City of Marysville Drainage and Erosion Control Standards and the 2019 Department of Ecology Stormwater Management Manual for Western Washington (2019 SWMMWW). The proposed project will exceed the 10,000-sf effective impervious and the 5,000-sf pollution generating hard surface (PGHS) thresholds, and will therefore be required to meet flow control and runoff treatment requirements.

## 1.4 PROPOSED DRAINAGE SYSTEM

The project is required to meet flow control and water quality treatment requirements. This project proposes 47,916 sf of pollution generating hard surface and a total of 117,917 sf of impervious surfaces. All flows from newly developed impervious surfaces are proposed be collected and conveyed to one of two detention vaults located along the southern boundary of the site. The two detention vaults are designed to provide flow control for each of the two basins in the proposed development. Water quality treatment will be provided by utilizing a media filter drain downstream of the east detention vault and upstream of the west detention vault. Refer to Section 5.0 Stormwater Management for WWHM sizing output and more detail on facility design.

## 1.5 EROSION/SEDIMENTATION CONTROL

Erosion control measures that will be utilized during construction will include a combination of silt fence, plastic covering, a sediment trap, and storm drain inlet protection. The Stormwater Pollution Prevention Plan will be included in the construction submittal which will be submitted at a later date.

## 1.6 MINIMUM REQUIREMENTS

Per the 2019 SWMMWW, this project is new development and Minimum Requirements 1-9 apply to the proposed development.

**Minimum Requirement #1: Preparation of Stormwater Site Plans:** This Report along with the Construction Plans satisfies this minimum requirement.

**Minimum Requirement #2: Construction Stormwater Pollution Prevention:** A construction SWPPP will be provided as a separate submittal.

**Minimum Requirement #3: Source Control of Pollution:** Permanent source control BMPs are not applicable for the subject site since the associated activities for the new residential development do not fall within the types of facilities listed within Volume IV of the Drainage Manual (Residential developments are not required to implement source control BMP's). BMPs for erosion and sedimentation control are specified in the Construction Plans and the SWPPP.

**Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls:**
Existing drainage flows primarily southwest off the site with a smaller portion of the site along and near the frontage basin on 87th Ave NE on the eastern boundary of the site, flowing to the south. Runoff that flows to the southwest is noted as coming from the "West Basin" while flows from the east flowing south along and near the 87th Ave NE frontage is noted as coming from the "East Basin". In the developed condition, stormwater runoff from the on-site basins will be collected and detained in one of two detention facilities located at the southern edges of the site before being released to the existing City of Marysville storm system. Collected surface runoff will generally convey in the same directions as the predeveloped conditions outfall directions. See Downstream Analysis in Section 3 of this report for further information regarding the location of existing natural outfalls.

**Minimum Requirement #5: On-site Stormwater Management:**
The geotechnical investigation of site soils and underlying geology performed by Cobalt Geosciences dated December 20th, 2021, revealed that the dense site soil conditions make widespread infiltration infeasible. The investigation recommended a detention system with

overflow to City or County infrastructure. See Section 4 of this report for further information on the detention facility.

**Minimum Requirement #6: Runoff Treatment:** The project is required to provide runoff treatment as the 47,916 sf of proposed PGHS exceeds the 5,000 sf PGHS threshold. Media filter drains will be installed downstream of the east detention facility and upstream of the west detention facility to provide runoff treatment for each respective basin.

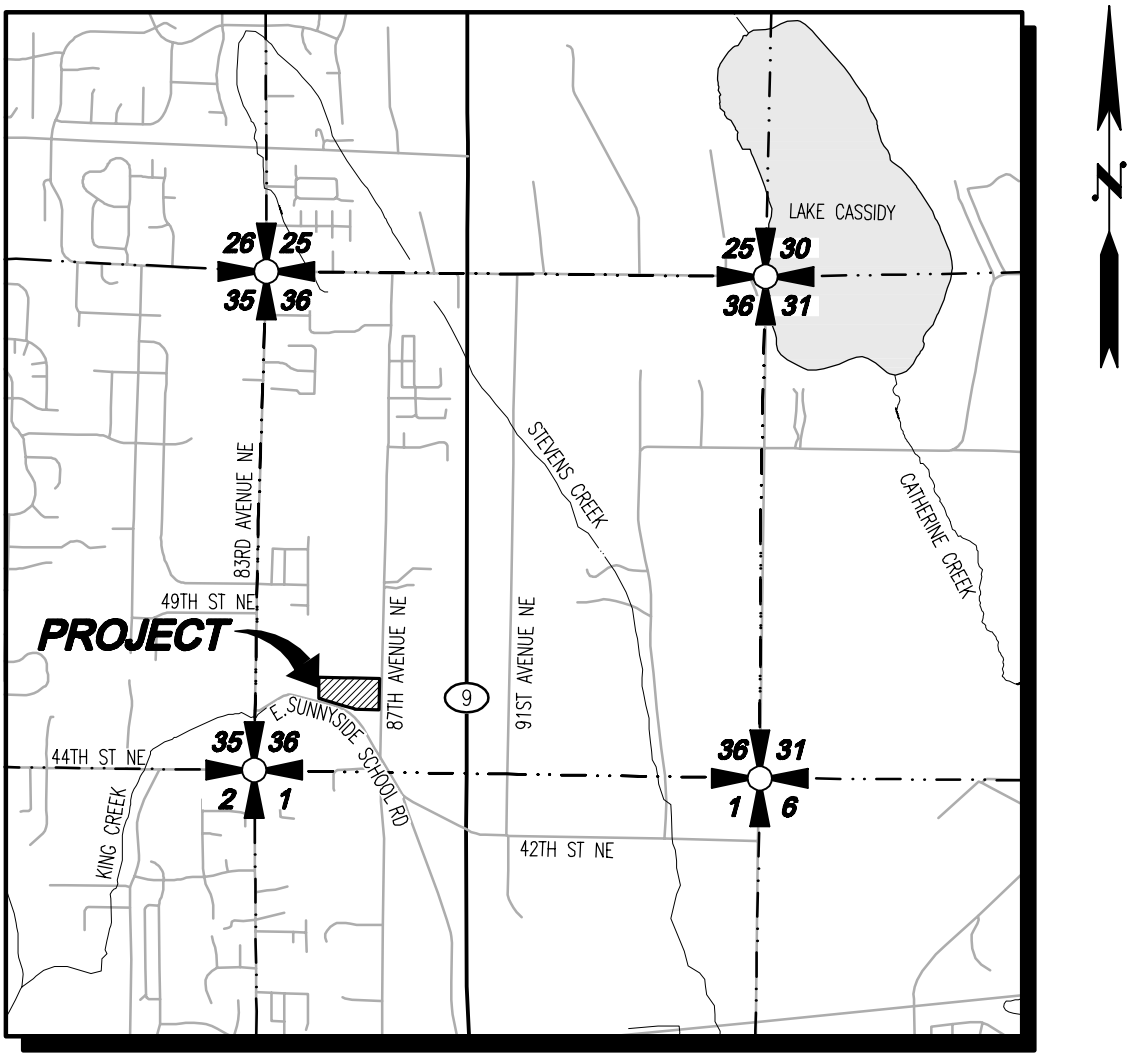
**Minimum Requirement #7: Flow Control:** The project is required to provide flow control as the proposed total effective impervious surfaces exceeds the 10,000-sf threshold. Flow control is proposed via two separate detention vaults for the East and West Basins and associated control structures to provide flow control for the developed condition flows. See Section 4 of this report for a summary of the facility sizing and design.

**Minimum Requirement #8: Wetlands Protection:** There are no wetlands onsite or immediately adjacent.

**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. Figure 3.0 – Proposed Development Map




## VICINITY MAP

SCALE: 1"=2000'

Drawing: \\ldc.local\ldcdata\Projects\Civil\2021\C21-202 Sunnyside Plat\Drawings\Exhibits\C21202E-EX-VM.dwg Plotted: Jun 22, 2022 - 2:03pm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**NATURAL 9 HOLDINGS,LLC**

# SUNNYSIDE PLAT

*VICINITY MAP*

Existing Conditions Map.mxd | MOD: 7/12/2022 | fcavada

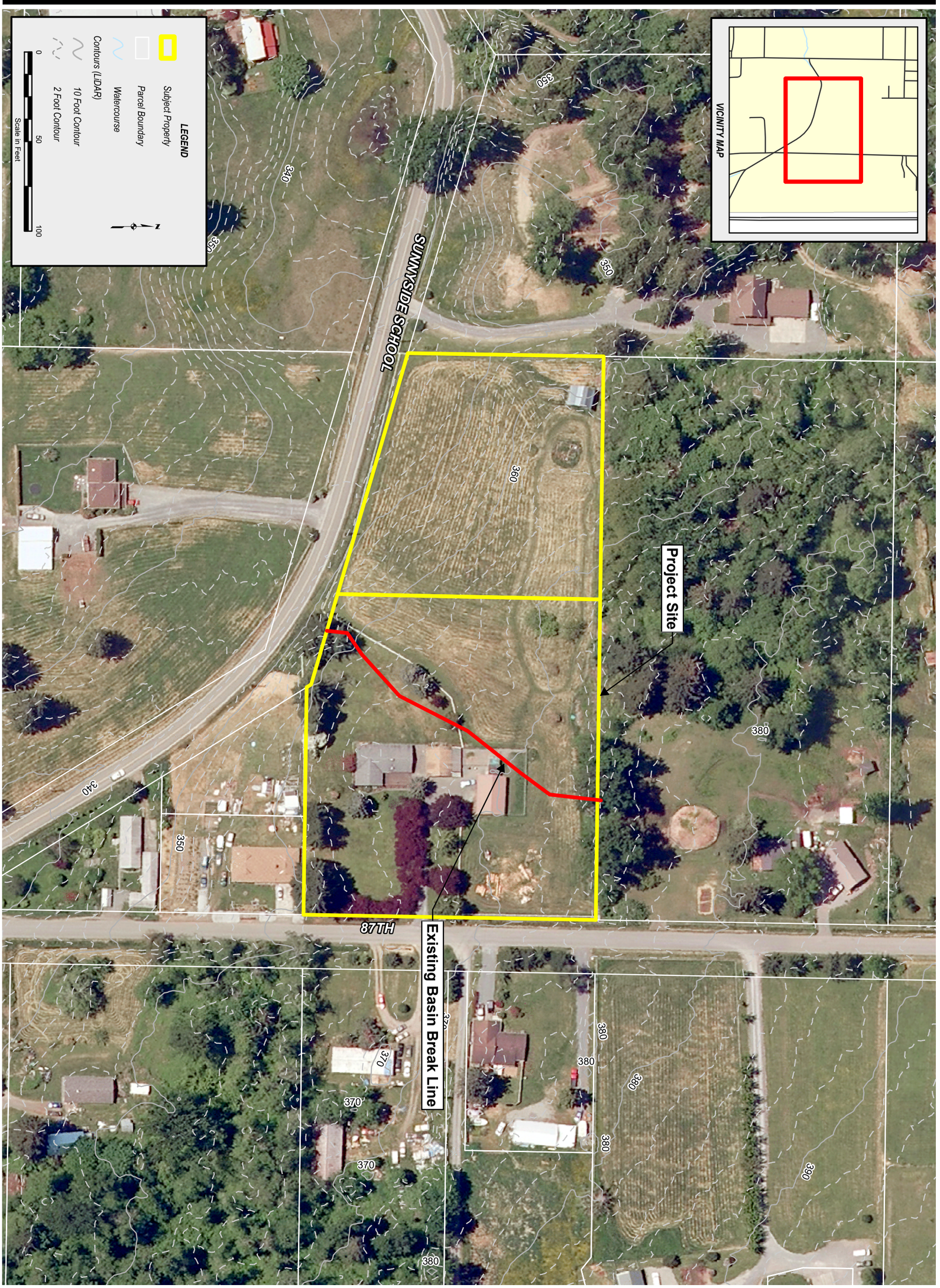


FIGURE: **2.0**

| | |
|---|---|
| REVISION | |
| JOB NUMBER: C21-282 | |
| DRAWING NAME: C21-282-2.0 | |
| DESIGNER: FCAVADA | |
| DRAWING BY: FCAVADA | |
| DATE: 7/12/2022 | |
| SCALE: AS SHOWN | |
| JURISDICTION: MARYSVILLE | |

NAD 1983 HARN
STATEPLANE WASHINGTON

## NATURAL 9 HOLDINGS, LLC

# KALLICOTT PLAT
## EXISTING CONDITIONS MAP


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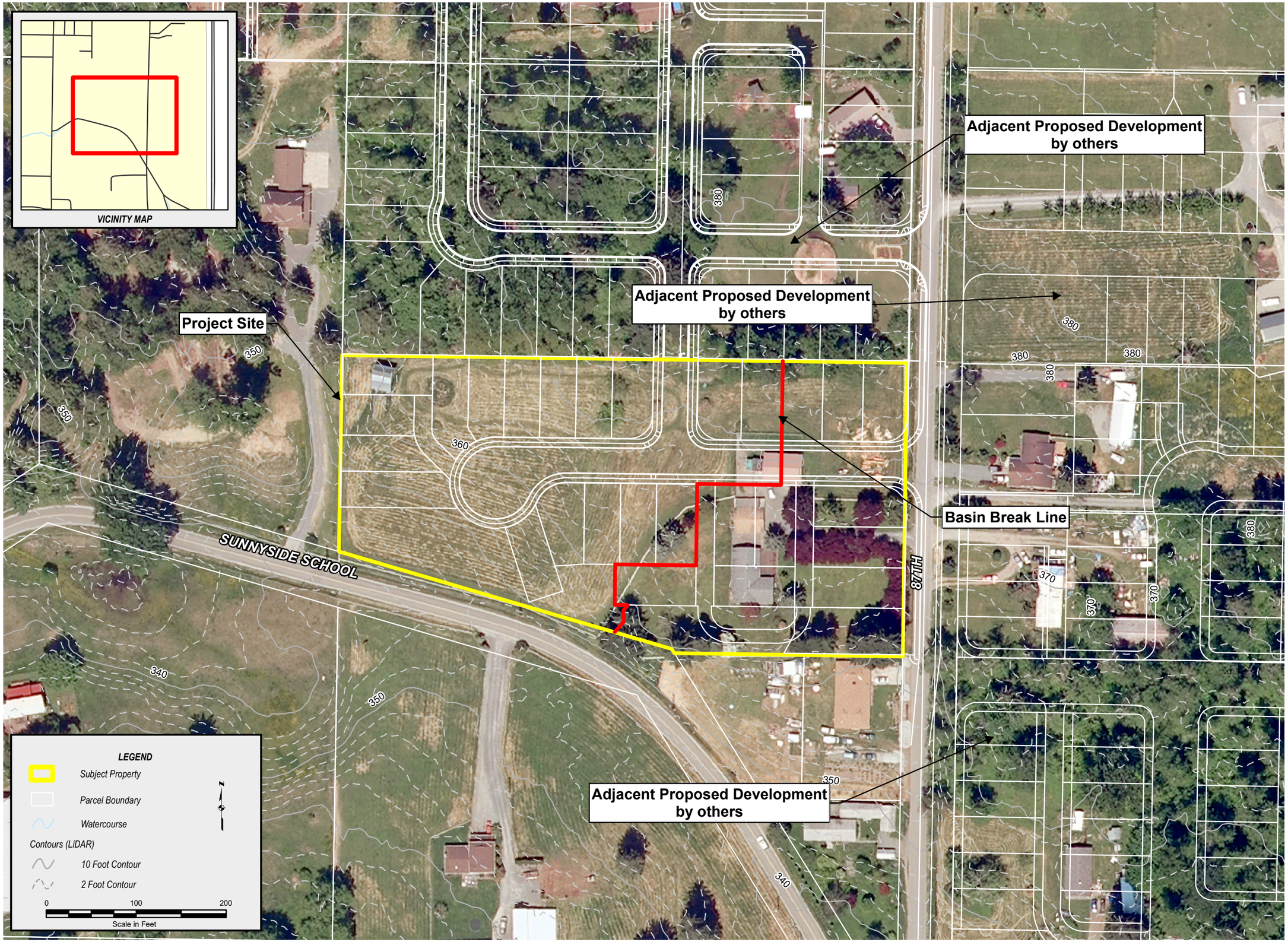
SOURCE INFORMATION

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




Developed Conditions Map.mxd | MOD: 6/30/2022 | fcavada

SOURCE INFORMATION

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

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# KALLICOTT PLAT
## PROPOSED DEVELOPMENT MAP

NAD 1983 HARN
STATEPLANE WASHINGTON

| |
|---|
| REVISION: |
| JOB NUMBER: C21-202 |
| DRAWING NAME: C21-202-3.0 |
| DESIGNER: FCAVADA |
| DRAWING BY: FCAVADA |
| DATE: 6/30/2022 |
| SCALE: AS SHOWN |
| JURISDICTION: MARYSVILLE |

FIGURE:
**3.0**

# SECTION 2: RISK ASSESSMENT ANALYSIS AND TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

## 2.1 TEMPORARY EROSION AND SEDIMENT CONTROL

A Stormwater Pollution Prevention Plan (SWPPP) will be provided as a separate document as a part of the construction submittal. The SWPPP report will be modeled under the guidelines of Volume II, Section 3 of the 2019 SWMMWW.

## SECTION 3: DOWNSTREAM ANALYSIS REPORT

### 3.1 TASK 1: STUDY AREA DEFINITION AND MAPS

Snohomish County Bare Earth LiDAR, survey, and 2020 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 (See Figure 4.0, Downstream Analysis Map).

### 3.2 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 located within the Snohomish drainage basin/watershed and the Sunnyside and Lake Stevens sub-basins.
- **Floodplain / Floodway (FEMA) maps**
  According to FEMA floodplain mapping, the subject property is not within a floodplain. Reference the FEMA FIS study map 53061C0736F.
- **Critical Areas Map**
  No wetlands or critical areas were found onsite.
- **Drainage Complaints**
  No drainage complaints have been reported for the site.
- **Road Drainage Problems**
  No drainage problems were recorded.
- **Soil Survey**
  According to USGS soil maps, site soils are classified as Tokul gravelly medial loam at 0 to 8 percent slope.
- **Wetland Inventory Maps**
  There are no wetlands located onsite.
- **Migrating River Studies**
  Migrating River Studies are not applicable to the proposed site development.

- **Section 303d List of Polluted Waters**

  Washington State Department of Ecology's Water Quality Assessment for Washington shows no impacted or polluted waters within 0.25 miles of the site.
- **Water Quality Problems**

  No known water quality problems are present within the site or anywhere within the 0.25-mile downstream flow path.
- **Stormwater Compliance Plans**

  Not applicable to the proposed project.

## 3.3 TASK 3: FIELD INSPECTION/DOWNSTREAM ANALYSIS

On November 24, 2021, a Downstream Analysis was performed at the site for runoff from the western basin of the site. The weather consisted of 41ºF and overcast skies. On June 22, 2022, a second Downstream Analysis was performed at the site for runoff from the eastern basin. The following observations were verified during the visits.

The subject property is currently developed with a gravel access from 87th Ave NE within the right of way.

The natural discharge locations exist on-site and currently leave the site in two flow paths. One flow path generally discharges overland southwestward and south across property lines and continues westward until entering King Creek, which flows into Ebey Slough, and eventually releases into the Possession Sound. The second flow path generally discharges overland southward and exits the project boundary where flows continue southeasterly to Steven's Creek, which eventually releases into Lake Stevens. There is also a Figure 4.0, "Downstream Analysis Map" for a map exhibit of the discharge from the project site. The onsite flow paths will convey all developed flows as described below.

**Developed Flow Paths**

Runoff leaves the site westward via overland flow along Sunnyside School Road for approximately 695 LF. Flows is collected by a culvert near the intersection of 83rd Ave NE and Sunnyside School Road and is conveyed across 83rd Ave NE. After crossing the road, flow is conveyed 82 LF through a culvert before being discharged into King Creek. The flow in King Creek continues past the quarter-

mile boundary for this analysis and converges with Ebey Slough, which eventually discharges into the Possession Sound.

A second flow path from the eastern basin flows to the south along 87th Ave towards the Sunnyside School Road intersection. Southbound upstream flow from 87th Ave converges at the center of the intersection, which is a low point where flow is then directed to the southeast along Sunnyside School Road. There is a swale on the northside of Sunnyside School Road that carries flow past the quarter-mile boundary and into an unnamed stream tributary to Stevens Creek. The unnamed stream continues approximately 4,100 ft southeast until converging with Stevens Creek, which eventually discharges into Lake Stevens.

## 3.4 TASK 4: DRAINAGE SYSTEM DESCRIPTION AND PROBLEM DESCRIPTIONS

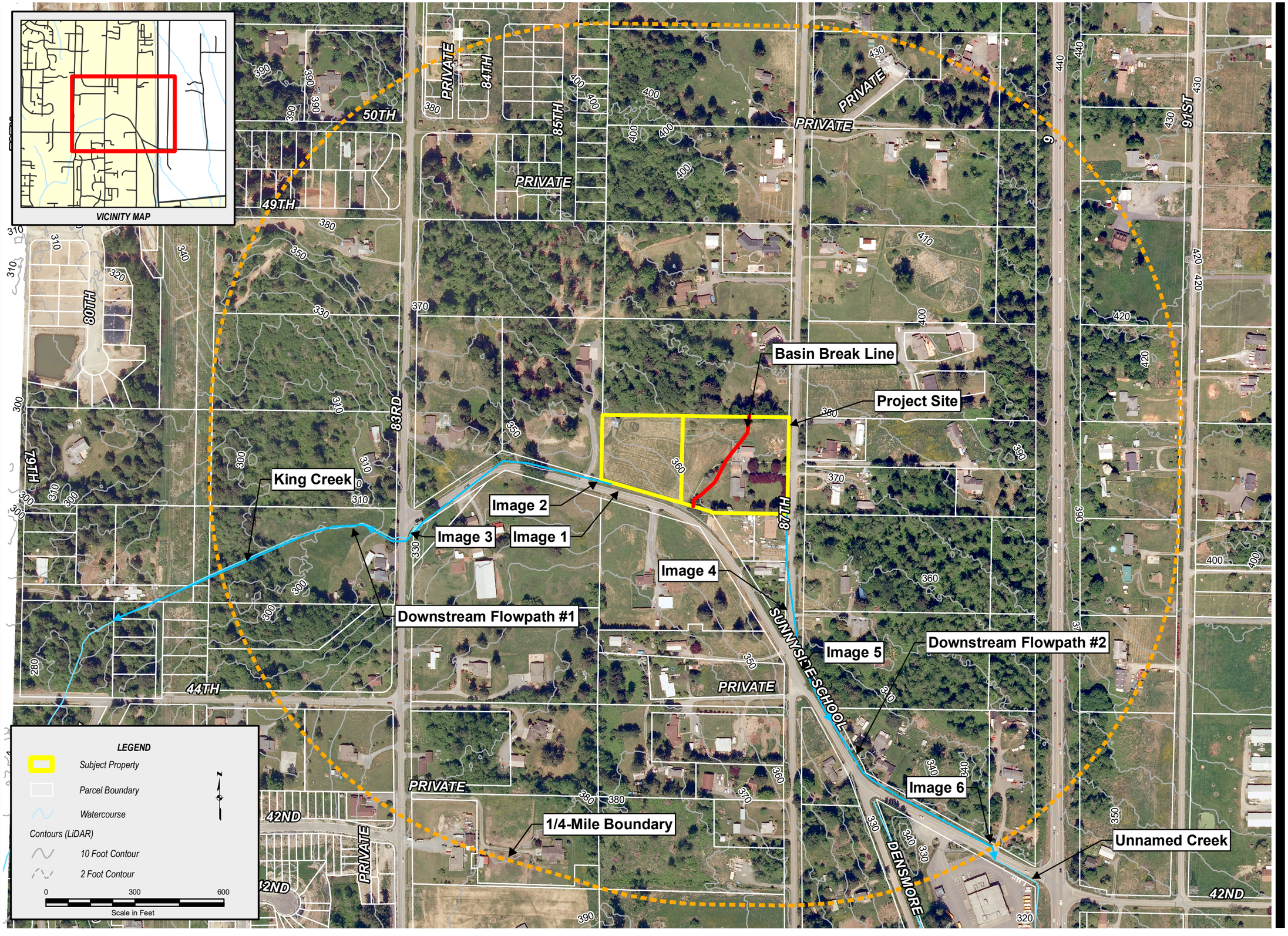
There are three drainage complaints filed to the City of Marysville for drainage problems regarding the open channels and culverts near the site, which appear to be resolved or not considered as relevant to the design of this project. All downstream appurtenances and open channels are adequately sized to sufficiently convey flows resulting from large storm events.

## 3.5 TASK 5: MITIGATION OF EXISTING OR POTENTIAL DRAINAGE PROBLEMS

No drainage issues were apparent during visual investigations of the site.

## Appendix 3: Resource Review

1. Figure 4.0 - Downstream Analysis Map
2. Downstream Analysis Photos
3. FEMA Floodplain Maps
4. USGS Soils Map
5. USGS Soils Description
6. City of Marysville Drainage Complaints




SOURCE INFORMATION

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


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# KALLICOTT PLAT
## DOWNSTREAM MAP

NAD 1983 HARN
STATEPLANE WASHINGTON
NORTH FIPS 4601 FEET

| | |
|---|---|
| REVISION: | |
| JOB NUMBER: | C21-202 |
| DRAWING NAME: | C21-202-4.0 |
| DESIGNER: | FCAVADA |
| DRAWING BY: | NMARTIN |
| DATE: | 2/21/2023 |
| SCALE: | AS SHOWN |
| JURISDICTION: | MARYSVILLE |

FIGURE:
**4.0**

Downstream Map.mxd | MOD: 2/21/2023 | nmartin

# Downstream Analysis Photographs

## Western Basin Flow Path

Image 1: Facing north along Sunnyside School Road towards the southwest side of the site where flow is discharged from the site into the ditch south of the fence.

Image 2: Facing east towards the site. Flow from the site is discharged into a ditch that flows to the west towards the 83rd Ave and Sunnyside School Road intersection.

Image 3: Facing north at the intersection of 83rd Ave and Sunnyside School Road near the quarter-mile buffer. Runoff from the project site's western basin flows to the west from Sunnyside School Road and continues west/southwest (left on picture) to King Creek. Flows continue along King Creek past the quarter-mile boundary of analysis and flows into Ebey Slough, which eventually discharges into the Possession Sound.

# Eastern Basin Flow Path

Image 4: Facing south near the intersection of 87th Ave and Sunnyside School Road. Flow from the eastern portion of the site will flow to the south towards the intersection and then continue southeast along Sunnyside School Road.

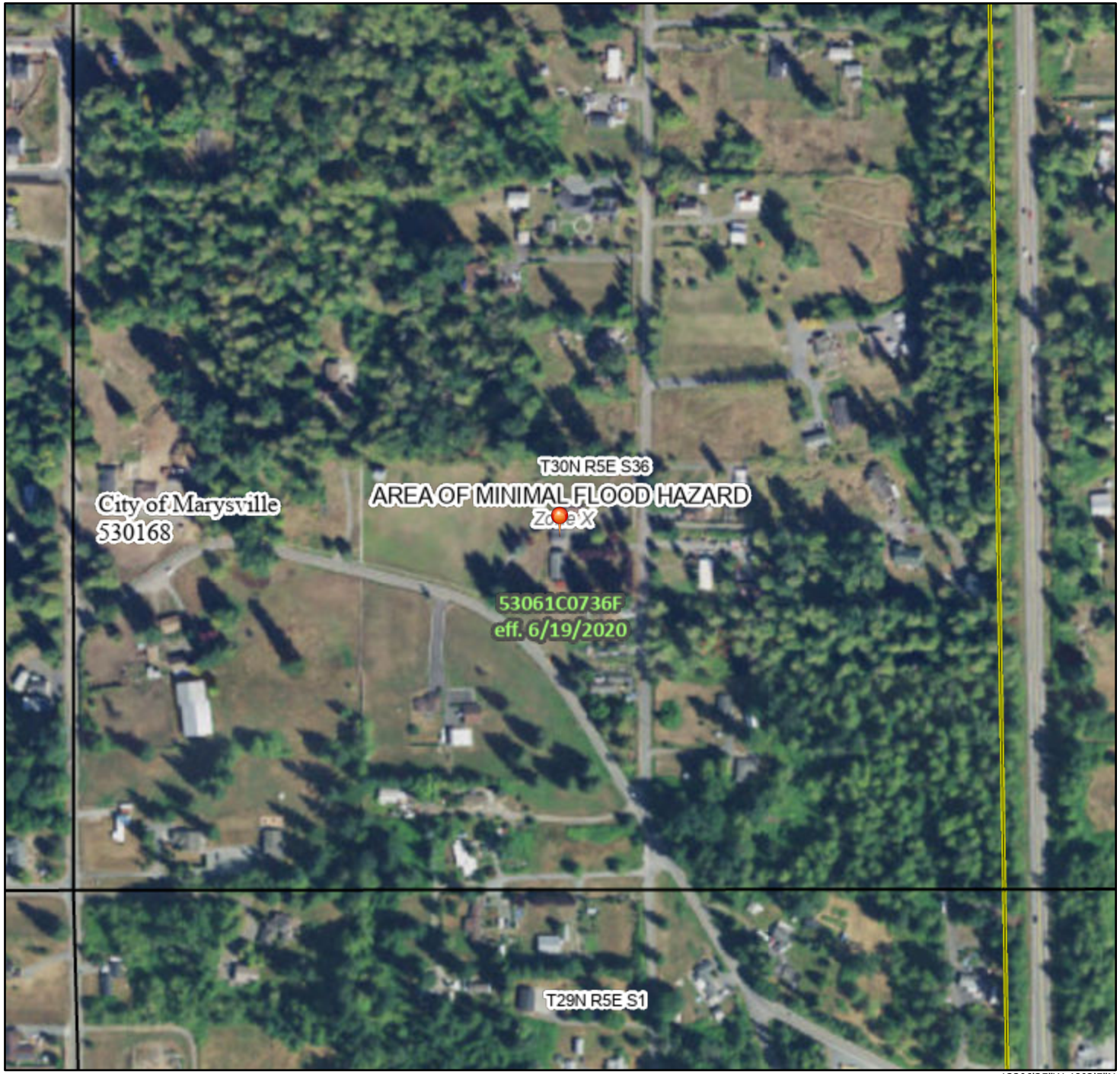
Image 5: Facing southeast from the northeast corner of the Sunnyside School Road and 87th Ave intersection. The project site's eastern basin runoff along and near the project frontage flows south along 87th Ave NE and discharges into the swale along the north side of Sunnyside School Road at the intersection of Sunnyside School Road and 87th Ave. Runoff continues southeast along the Sunnyside School Road past the quarter-mile boundary of analysis until discharging into the unnamed stream tributary to Steven's Creek.

Image 6: Facing southeast at the quarter-mile boundary of analysis along the northside of Sunnyside School Road. The swale continues past the quarter-mile boundary for the downstream analysis. Per Snohomish County GIS, the swale discharges into an unnamed creek tributary to Stevens Creek.

# National Flood Hazard Layer FIRMette

FEMA

122°7'13"W 48°2'29"N




122°6'35"W 48°2'5"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

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

## Legend

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

**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*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

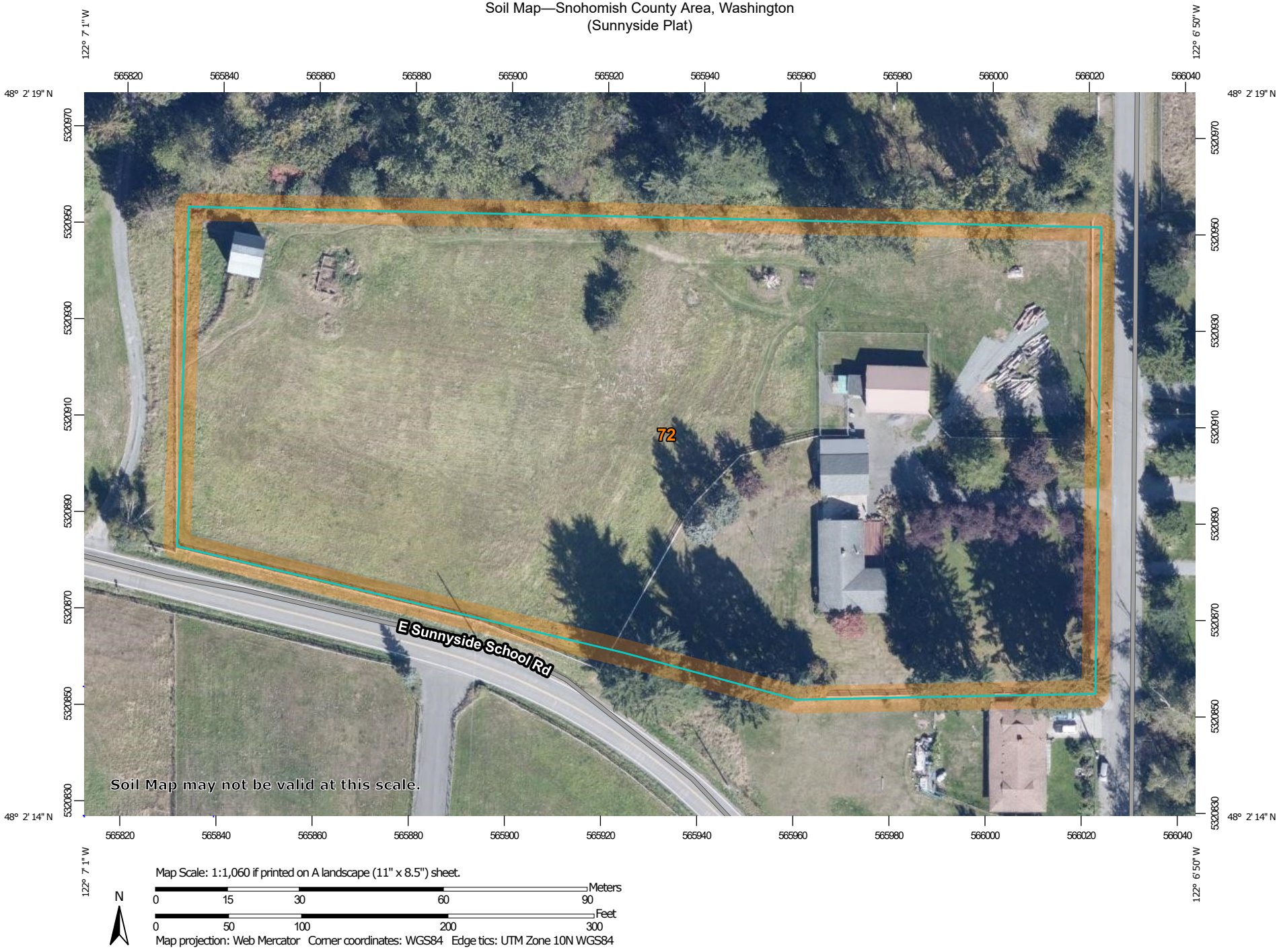
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 11/12/2021 at 1:01 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.

Soil Map—Snohomish County Area, Washington
(Sunnyside Plat)




Map Scale: 1:1,060 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

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: 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: Sep 26, 2018—Oct 16, 2018

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 | 4.2 | 100.0% |
| **Totals for Area of Interest** | | **4.2** | **100.0%** |

# Asset History Report

**Genarated On:06/16/2022**

**Genarated By:Brooke Ensor**

## Work Order#:5816

Location:48.03558549714815,-122.11289635026496 Status:Archive Priority:Normal Created By:Jake Wetzel On 10/22/2020 11:56:50 AM

Assigned To:Jake Wetzel

Account#:

Department: Streets

Type:CM

Project:

Related WR#:1251

Related INS#:0

Start Date:10/22/2020

Start Time:

Completed Date:

Completed Time:

Scheduled:No

Stand By:No

WO Billable:No

Instruction: Grind 2' of shoulder. Compact base and stabilize and repave

Assets:

Activity: STREETS - SHOULDER RESTORATION/GRADING

Service Address: 8805 E. Sunnyside School Road

Loc. Address:

Work Performed:

Description: Shoulder Failure into adjacent ditch

## Sub-Modules:

### Timesheet:

No Data

### FollowUp:

No Data

### Waste:

No Data

### Facility:

No Data

### Attachment:

No Data

### Equipment:

No Data

## Rental:

No Data

## Parts Used details:

No Data

## Related Child Inspection:

No Data

## Duplicate:

No Data

# Asset History Report

**Genarated On:06/16/2022**

**Genarated By:Brooke Ensor**

## Work Order#:6085

Location:48.03522,-122.11314 Status:Archive Priority:Normal Created By:Randy Schoolcraft On 12/22/2020 7:31:02 AM

Assigned To:Randy Schoolcraft

Account#:

Department: Storm/Sewer

Type:CM

Project:

Related WR#:0

Related INS#:0

Start Date:12/21/2020

Start Time:

Completed Date:02/12/2021

Completed Time:

Scheduled:No

Stand By:No

WO Billable:No

Instruction:

Assets:

Activity: STORM/SEWER - FLOODING RESPONSE

Service Address: 8805 east Sunnyside School Road.

Loc. Address:

Work Performed:

Description: flooding of ditch due to heavy rains

## Sub-Modules:

### Timesheet:

| Employee | Hour Type | Pay Type | Work Hours | Date | Mileage | Created By |
|---|---|---|---|---|---|---|
| Randy Schoolcraft | STORM DRAINAGE - 40145040 | COMPENSATION TIME EARNED - 1.5 | 0.50 | 12/21/2020 12:00:00 AM | 0.00 | Randy Schoolcraft on 12/22/2020 |

Notes :

### FollowUp:

No Data

### Waste:

No Data

### Facility:

No Data

### Attachment:

No Data

### Equipment:

No Data

## Rental:

No Data

## Parts Used details:

No Data

## Related Child Inspection:

No Data

## Duplicate:

No Data

# Asset History Report

**Genarated On:06/16/2022**

**Genarated By:Brooke Ensor**

## Work Order#:10082

Location:48.03323074053586,-122.11266928450794 Status:Completed Priority:Normal Created By:Jessie Balbiani On 05/31/2022 3:53:17 PM

Assigned To:Austin Akau

Account#:

Department: Storm/Sewer

Type:CM

Project:

Related WR#:2310

Related INS#:0

Start Date:05/31/2022

Start Time:

Completed Date:06/03/2022

Completed Time:

Scheduled:No

Stand By:No

WO Billable:No

Instruction:

Assets:

Activity: STORM/SEWER - CULVERT/DITCH MAINTENANCE

Service Address: 4116 DENSMORE RD

Loc. Address: 4116 Densmore Rd, Marysville, WA, 98270, USA

Work Performed: Cleared culvert of dirt and other debris

Description: Driveway culvert is blocked, standing water in ditch.

## Sub-Modules:

### Timesheet:

| Employee | Hour Type | Pay Type | Work Hours | Date | Mileage | Created By |
|---|---|---|---|---|---|---|
| Austin Akau | STORM DRAINAGE - 40145040 | REGULAR - 1 | 2.00 | 06/03/2022 12:00:00 AM | 0.00 | Austin Akau on 06/03/2022 |

Notes :

### FollowUp:

No Data

### Waste:

No Data

### Facility:

No Data

### Attachment:

No Data

### Equipment:

No Data

## Rental:

No Data

## Parts Used details:

No Data

## Related Child Inspection:

No Data

## Duplicate:

No Data

# SECTION 4: DETENTION AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

## 4.1 PREDEVELOPED AREAS

The project is divided into two drainage basins with different flow paths, labeled as the East and West Basins. The two basins have been modeled in WWHM as the following in the predeveloped condition:

Table 4.1.1 – Predeveloped East Basin Land Cover Areas

| **Predeveloped East Basin** | **Area** |
|---|---|
| *Forest, Flat* | *1.53 AC* |
| *Forest, Mod* | *0.23 AC* |
| **Total** | **1.76 AC** |

Table 4.1.2 – Predeveloped West Basin Land Cover Areas

| **Predeveloped West Basin** | **Area** |
|---|---|
| *Forest, Flat* | *1.06 AC* |
| *Forest, Mod* | *1.267 AC* |
| *Forest, Steep* | *0.33 AC* |
| **Total** | **2.657 AC** |

## 4.2 DEVELOPED AREAS

Project development consists of impervious surfaces associated with the 28 single-family residential lots, two access points into the site from the northern property and 87th Ave, tract areas, and associated utilities. Lots were assumed to have 2,*500* sf of impervious areas for modeling purposes. Frontage improvements will take place within the 87th Ave right-of-way (ROW) and developed runoff from the frontage improvements will be included as a portion of the tributary areas for the East Basin detention vault. The project will produce 2.707 acres of new and replaced impervious surfaces, 1.10 acres being PGHS.

*Pervious Land Cover*

Pervious land cover in each developed basin has been modeled as pasture. In Section 7.1 of the Low Impact Development Technical Guidance Manual for Puget Sound (LID Manual), referenced in Volume V, V-11, BMP T5.13 of the 2019 SWMMWW, it is prescribed that if landscaped areas are underlain with BMP T5.13 soils, the area may be modeled as pasture. These landscaped areas

will be underlain with BMP T5.13 soil mixtures in the developed condition and thus have been modeled as pasture land cover in WWHM.

In the developed condition, the East and West Basins have been modeled in WWHM as the following:

Table 4.2.1 – Developed East Basin Land Cover Areas

| **Developed East Basin** | **Area** |
|---|---|
| *Pasture, Flat* | *0.59 AC* |
| *Pasture, Mod* | *0.10 AC* |
| *Roads, Flat* | *0.44 AC* |
| *Rooftops, Flat* | *0.63 AC* |
| **Total** | **1.76 AC** |

Table 4.2.2 – Developed West Basin Land Cover Areas

| **Developed West Basin** | **Area** |
|---|---|
| *Pasture, Flat* | *1.02 AC* |
| *Roads, Flat* | *0.296 AC* |
| *Roads, Mod* | *0.35 AC* |
| *Rooftops, Flat* | *0.977 AC* |
| *Driveways, Flat* | *0.014 AC* |
| **Total** | **2.657 AC** |

## 4.3 DETENTION

The project proposes two detention vaults (denoted as the East and West Vaults) to detain and mitigate flow from the developed surface runoff produced by each respective basin. The proposed facilities were designed with the following flow control evaluation parameters from the 2019 SWMMWW:

> *"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 post development flow duration values exceed any of the predevelopment flow levels between 50% and 100% of the 2-year predevelopment peak flow values (100% Threshold) then the flow duration requirement has not been met.*
*2. If the post development 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."*

A summary of the modeled and provided dimensions, elevations, peak flows, and water surface elevations for the two detention vaults can be found below. See Appendix 4 for WWHM output and volume calculations.

Table 4.3.1 – East Detention Vault: Detention Details Summary

| **East Detention Vault** | |
|---|---|
| **Modeled/Provided Area:** | 3,600 SF |
| **Modeled Internal Dimensions:** | 36' x 100' |
| **Modeled/Provided Live Storage Volume:** | 25,200 CF |
| **Live Storage Elevation:** | 353.50 |
| **Riser Height:** | 7' |
| **Riser Diameter:** | 12" |
| **Riser Type:** | Flat |
| **Orifice 1 Diameter:** | 0.8125 in |
| **Orifice 1 Height:** | 0 ft |
| **Orifice 2 Diameter:** | 1.375 in |
| **Orifice 2 Height:** | 3.75 ft |
| **Orifice 3 Diameter:** | 0.78125 in |
| **Orifice 3 Height:** | 5.25 ft |
| **Top of Riser Elevation:** | 360.50 |

Table 4.3.2 – East Detention Vault: Flow Rates and Water Surface Elevation by Storm Event

| **Storm Event** | **Predeveloped Rate (cfs)** | **Unmitigated Rate (cfs)** | **Mitigated Rates (cfs)** | **Water Surface Elevation (ft)** |
|---|---|---|---|---|
| **2-Year** | 0.0599 | 0.5902 | 0.0357 | 357.24 |
| **10-Year** | 0.1176 | 0.9802 | 0.0694 | 357.66 |
| **50-Year** | 0.1839 | 1.4137 | 0.1135 | 358.91 |
| **100-Year** | 0.2170 | 1.6271 | 0.1375 | 359.59 |

Table 4.3.3 – West Detention Vault: Detention Details Summary

| West Detention Vault | |
|---|---|
| **Modeled/Provided Area:** | 5,208 SF |
| **Modeled Internal Dimensions:** | 14′ x 372′ |
| **Modeled/Provided Live Storage Volume:** | 36,456 CF |
| **Live Storage Elevation:** | 341.90 |
| **Riser Height:** | 7′ |
| **Riser Diameter:** | 18″ |
| **Riser Type:** | Flat |
| **Orifice 1 Diameter:** | 1.0625 in |
| **Orifice 1 Height:** | 0 ft |
| **Orifice 2 Diameter:** | 1.50 in |
| **Orifice 2 Height:** | 4.00 ft |
| **Orifice 3 Diameter:** | 1.25 in |
| **Orifice 3 Height:** | 4.80 ft |
| **Top of Riser Elevation:** | 348.90 |

Table 4.3.4 – West Detention Vault: Flow Rates and Water Surface Elevation by Storm Event

| Storm Event | Predeveloped Rate (cfs) | Unmitigated Rate (cfs) | Mitigated Rates (cfs) | Water Surface Elevation (ft) |
|---|---|---|---|---|
| **2-Year** | 0.1001 | 0.9368 | 0.0553 | 345.22 |
| **10-Year** | 0.2034 | 1.5353 | 0.0992 | 346.24 |
| **50-Year** | 0.3254 | 2.1722 | 0.1546 | 346.99 |
| **100-Year** | 0.3872 | 2.4780 | 0.1840 | 347.45 |

## 4.4 WATER QUALITY

This project proposes 47,916 sf of PGHS, which exceeds the 5,000-sf threshold for water quality set in the 2019 SWMMWW. Therefore, this project will provide water quality treatment to all runoff from PGHS surfaces by utilizing a media filter drain downstream of the east detention vault and upstream of the west detention vault. A summary of design criteria is provided below:

Table 4.3.5 – East Detention Vault: BayFilter Design Summary

| East Detention Vault BayFilter 522 | |
|---|---|
| Tributary Area | *1.76 AC* |
| Tributary PGIS Area | *0.44 AC* |
| Water Quality Flow Rate (2 yr mitigated peak) | 0.0357 cfs |
| Number of Cartridges | 1 |
| Cartridge Height | 22″ |
| Internal Drop | 1.67′ |
| Peak Flow Rate | 0.05 cfs |
| Peak Flow Storm Event | 100-year |

Table 4.3.6 – West Detention Vault: BayFilter Design Summary

| East Detention Vault BayFilter 545 | |
|---|---|
| Tributary Area | *2.657 AC* |
| Tributary PGIS Area | *0.66 AC* |
| Water Quality Flow Rate (2 yr mitigated peak) | 0.3089 cfs |
| Number of Cartridges | 4 |
| Cartridge Height | 36″ |
| Internal Drop | 2.83′ |
| Peak Flow Rate | 0.10 cfs |
| Peak Flow Storm Event | 100-year |

The east detention BayFilter 48" Manhole structure is located downstream of the associated vault and will therefore need to meet the mitigated 2-year release rate of 0.0357 cfs for water quality treatment. The west detention BayFilter 84" Manhole structure is located upstream of the associated vault, and will therefore need to meet the developed, predetention (or unmitigated) water quality flow rate of 0.3089 cfs adjusted for 15 minutes. Detailed WWHM output is provided in Appendix 4.

## 4.5 LOW IMPACT DEVELOPMENT

The low impact development (LID) standards for on-site stormwater management from Volume 1, section 3.4.5 in the 2019 SWMMWW, were considered for feasibility in the design of this project. The project is required to comply with Minimum Requirement #5 and will comply by applying achievable BMPs from List #2 as listed below:

Lawn and Landscaped Areas:

1. **BMP T5.13 Post-Construction Soil Quality and Depth**: This BMP will be applied to disturbed pervious surfaces and in accordance with BMP requirements.

Roofs:

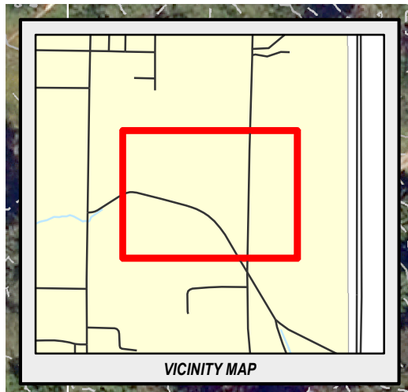
1. **BMP T5.30 Full Dispersion:** Due to spatial constraints for a natural vegetated flow path, full dispersion is not feasible for the project**.**
2. **BMP T5.10A Downspout Full Infiltration:** BMP is infeasible for the site as site soils do not allow for infiltration due to less 36" in depth to restrictive soil layer. Infiltration on the western basin is also infeasible due to the large amount of fill that would be required for soils suitable for infiltration and infiltrating under the resulting perimeter walls is not practical.
3. **BMP T5.10B Downspout Dispersion Systems:** Downspout dispersion is infeasible for the site due to spatial constraints for vegetated flow path.
4. **BMP T5.10C Perforated Stub-out Connections:** This BMP is feasible and will be applied to the project.
5. **BMP 7.30 Bioretention:** Sufficient area and soils for infiltration for bioretention are not available onsite. This BMP is infeasible.

Other Hard Surfaces:

1. **BMP T5.30 Full Dispersion:** Sufficient flow paths and native retention are not available due to site layout. This BMP is infeasible.
2. **BMP T5.15 Permeable Pavement**: BMP is infeasible for the site as site soils do not allow for infiltration.
3. **BMP T5.12 Sheet Flow Dispersion:** Sufficient flow paths and native retention are not available due to site layout. This BMP is infeasible.

## Appendix 4: Stormwater Management

1. Figure 5.0: Predeveloped Hydrology Map
2. Figure 6.0: Developed Hydrology Map
3. BayFilter Details
4. WWHM East Detention Vault Output
5. WWHM East Detention Vault Unmitigated Output
6. WWHM West Detention Vault Output
7. WWHM West Detention Vault Unmitigated Output




## Predeveloped West Basin

| | |
|---|---|
| *Pervious:* | |
| *Forest, Flat* | *1.06 AC* |
| *Forest, Mod* | *1.267 AC* |
| *Forest, Steep* | *0.33 AC* |
| *TOTAL* | *2.657 AC* |

## Predeveloped East Basin

| | |
|---|---|
| *Pervious:* | |
| *Forest, Flat* | *1.53 AC* |
| *Forest, Mod* | *0.23 AC* |
| *TOTAL* | *1.76 AC* |

SUNNYSIDE SCHOOL

HILL28

West Basin

East Basin

**LEGEND**

- *Subject Property*
- *Parcel Boundary*
- *Watercourse*

*Contours (LiDAR)*

- *10 Foot Contour*
- *2 Foot Contour*

0 100 200

Scale in Feet

N

Predeveloped Hydrology Map.mxd | MOD: 7/12/2022 | fcavada

SOURCE INFORMATION

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

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Kent
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Kent, WA 98030
T 425.482.2893

www.LDCcorp.com

*NATURAL 9 HOLDINGS, LLC*

# *KALLICOTT PLAT*

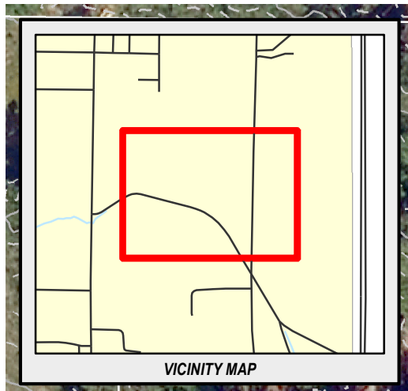
## *PREDEVELOPED HYDROLOGY MAP*

NAD 1983 HARN
STATEPLANE WASHINGTON

| | |
|---|---|
| REVISION: | |
| JOB NUMBER: | C21-202 |
| DRAWING NAME: | C21-202-5.0 |
| DESIGNER: | FCAVADA |
| DRAWING BY: | FCAVADA |
| DATE: | 7/12/2022 |
| SCALE: | AS SHOWN |
| JURISDICTION: | MARYSVILLE |

*FIGURE:*

**5.0**




## Developed West Basin

| | |
|---|---|
| *Pervious:* | |
| *Pasture, Flat* | *1.02 AC* |
| *Impervious:* | |
| *Roads, Flat* | *0.296 AC* |
| *Roads, Mod* | *0.35 AC* |
| *Rooftops, Flat:* | *0.977 AC* |
| *Driveways, Flat:* | *0.014 AC* |
| *TOTAL* | *2.657 AC* |

## Developed East Basin

| | |
|---|---|
| *Pervious:* | |
| *Pasture, Flat* | *0.59 AC* |
| *Pasture, Mod* | *0.10 AC* |
| *Impervious:* | |
| *Roads, Flat* | *0.44 AC* |
| *Rooftops, Flat:* | *0.63 AC* |
| *TOTAL* | *1.76 AC* |

SUNNYSIDE SCHOOL

87TH

West Basin

East Basin

350 340 360 370 380 390

**LEGEND**

- *Subject Property*
- *Parcel Boundary*
- *Watercourse*

*Contours (LiDAR)*

- *10 Foot Contour*
- *2 Foot Contour*

0 100 200

Scale in Feet

N

Developed Hydrology Map.mxd | MOD: 6/28/2022 | fcavada

SOURCE INFORMATION

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

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NATURAL 9 HOLDINGS, LLC

# KALLICOTT PLAT

## DEVELOPED HYDROLOGY MAP

NAD 1983 HARN
STATEPLANE WASHINGTON

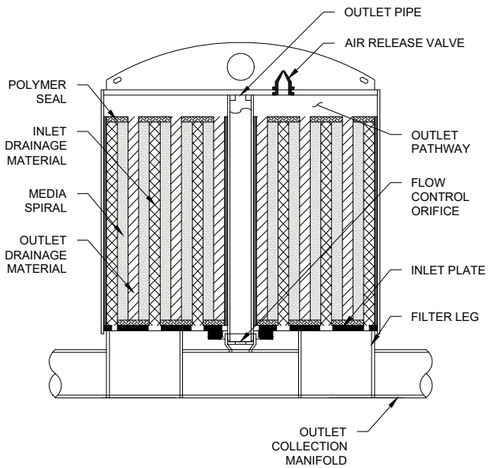
| |
|---|
| REVISION: |
| JOB NUMBER: C21-202 |
| DRAWING NAME: C21-202-6.0 |
| DESIGNER: FCAVADA |
| DRAWING BY: FCAVADA |
| DATE: 6/28/2022 |
| SCALE: AS SHOWN |
| JURISDICTION: MARYSVILLE |

*FIGURE:*

**6.0**

| BAYFILTER TREATMENT FLOW | |
|---|---|
| FILTER MODEL | GPM (L/MIN) |
| 522 | 22.5 (85.1) |
| 530 | 30.0 (113.6) |
| 545 | 45.0 (170.3) |

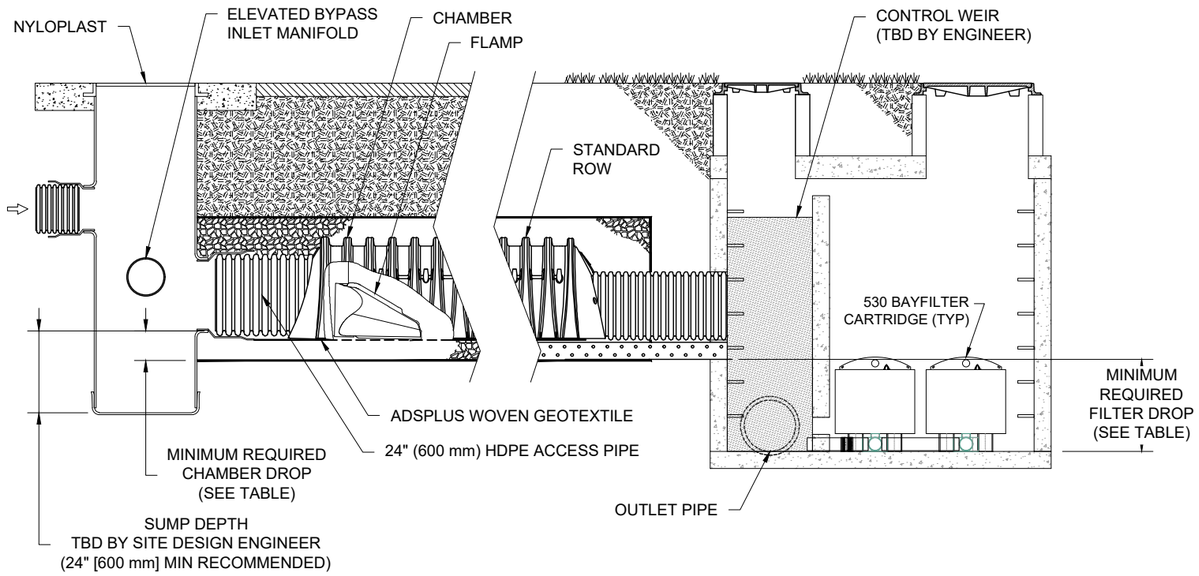
| BAYFILTER TREATMENT VOLUME | |
|---|---|
| FILTER MODEL | FT³ (m³) |
| 522 | 1,250 (35.4) |
| 530 | 2,500 (70.8) |
| 545 | 2,500 (70.8) |




**FILTER CARTRIDGE SECTION**

| ISOLATOR ROW PLUS FLOW RATES | | | |
|---|---|---|---|
| CHAMBER MODEL | SURFACE LOADING RATE GPM/FT² (L/S/m²) | EFFECTIVE FILTRATION TREATMENT AREA FT² (m²) | MTFR CFS (L/S)* |
| SC-160 | 4.13 (2.8) | 11.45 (1.064) | 0.11 (2.983) |
| SC-310 | 4.13 (2.8) | 17.7 (1.644) | 0.16 (4.612) |
| SC-740 | 4.13 (2.8) | 27.8 (2.583) | 0.26 (7.244) |
| DC-780 | 4.13 (2.8) | 27.8 (2.583) | 0.26 (7.244) |
| MC-3500 | 4.13 (2.8) | 42.9 (3.986) | 0.40 (11.178) |
| MC-4500 | 4.13 (2.8) | 30.1 (2.796) | 0.28 (7.843) |
| MC-7200 | 4.13 (2.8) | 50.0 (4.645) | 0.46 (13.028) |

* PER CHAMBER LOADING RATES BASED ON NJCAT VERIFICATION TESTING OF THE STORMTECH SC-740 ISOLATOR ROW PLUS IN ACCORDANCE WITH NJDEP LABORATORY PROTOCOL TO ACCESS TOTAL SUSPENDED SOLIDS REMOVAL BY FILTRATION MANUFACTURED TREATMENT DEVICES, 2013.

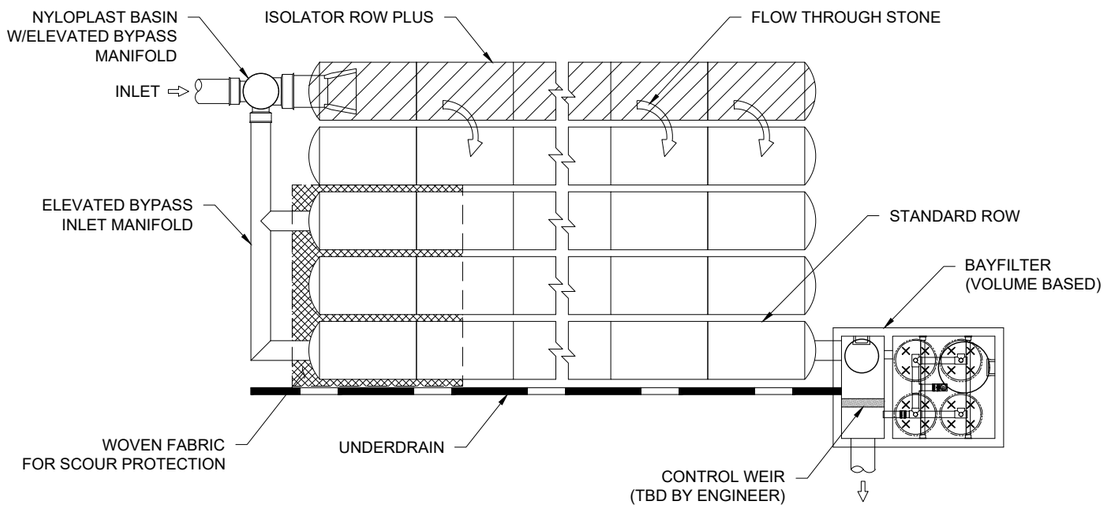



## ISOLATOR ROW PLUS & BAYFILTER CROSS SECTION/PROFILE

NTS

| CHAMBER MODEL | | 160 | 310 | 740 | 780 | 3500 | 4500 / 7200 |
|---|---|---|---|---|---|---|---|
| CHAMBER INLET TO OUTLET DROP [IN (mm)] | | 5 (126) | 6.9 (175) | 6.1 (155) | 9.1 (230) | 11.1 (281) | 11.3 (286) |
| FILTER MODEL | FILTER DROP [IN (mm)] | TOTAL DROP REQUIRED [IN (mm)] | | | | | |
| 522 | 20 (508) | 25 (635) | 26.9 (683) | 26.1 (663) | 29.1 (739) | 31.1 (790) | 31.3 (795) |
| 530 | 32 (813) | 37 (940) | 38.9 (988) | 38.1 (968) | 41.1 (1044) | 43.1 (1095) | 43.3 (1100) |
| 545 | 34 (864) | 39 (991) | 40.9 (1039) | 40.1 (1019) | 43.1 (1095) | 45.1 (1146) | 45.3 (1151) |

NOTE: IF THE DROP NOTED ABOVE CANNOT BE MET PLEASE CONTACT ADS ENGINEERING SERVICES AT 888-529-8188 FOR ASSISTANCE. THERE ARE ADVANCED DESIGN TECHNIQUES THAT ACCOMMODATE SMALLER DROPS.




## ISOLATOR ROW PLUS & BAYFILTER SCHEMATIC

NTS

## KEY BENEFITS OF BAYFILTER

- REMOVES GREATER THAN 80% TSS
- ENHANCED MEDIA IS CAPABLE OF REMOVING 65% OF TOTAL PHOSPHOROUS LOAD
- PREMIUM WATER QUALITY SYSTEM OFFERED BY ADS
- SYSTEMS ARE FULLY CUSTOMIZABLE
- CAN BE INSTALLED IN STANDARD MANHOLES OR PRECAST/CAST IN PLACE VAULTS FOR LARGER PROJECTS
- CAN BE DESIGNED FOR WATER QUALITY FLOW RATES OR WATER QUALITY VOLUMES
- LARGE FILTER SURFACE AREA DUE TO COILED FILTER MEDIA DESIGN
- CAPABLE OF HANDLING BETWEEN 150 TO 300 LBS OF SEDIMENT GREATLY REDUCING MAINTENANCE CYCLES

**BAYFILTER CONFIGURATOR**

https://bayfilterconfigurator.ads-pipe.com/

| BAYFILTER SEDIMENT CAPTURE CAPACITY* | |
|---|---|
| FILTER MODEL | LBS (kg) |
| 522 | 131 (59) |
| 530 | 262 (119) |
| 545 | 262 (119) |

* BASED ON NJCAT TESTING PROTOCOL.

## KEY BENEFITS OF A ISOLATOR PLUS & BAYFILTER DESIGN

- ENHANCED SEDIMENT REMOVAL BY COMBINING TWO INDUSTRY PROVEN DEVICES
- UPSTREAM ISOLATOR ROW PLUS SIGNIFICANTLY REDUCES BAYFILTER MAINTENANCE CYCLES
- EASY TO INSTALL AND CONFIGURE TO SPECIFIC SITE CONSTRAINTS
- ONLINE DESIGN TOOLS ALLOW DESIGNERS TO EASILY CREATE LAYOUTS AND DETAILS

## KEY BENEFITS OF STORMTECH CHAMBERS

- LARGE FAMILY OF CHAMBERS TO FIT YOUR SITE
- EASILY CONFIGURABLE FOR IRREGULAR SHAPED BEDS
- MEETS PRODUCT REQUIREMENTS OF ASTM F2418 AND ASTM F2922 AND DESIGN REQUIREMENTS OF ASTM F2787
- EXCEED AASHTO LRFD DESIGN SPECIFICATIONS FOR HS-20 LIVE LOADS & DEEP BURIAL EARTH LOADS
- PATENTED ISOLATOR ROW PLUS FOR LESS FREQUENT MAINTENANCE, WATER QUALITY AND LONG-TERM PERFORMANCE
- THIRD PARTY VERIFIED PERFORMANCE
- FIELD ENGINEERS AND INTERNAL ENGINEERING SERVICES DEPARTMENT TO ASSIST ENGINEERING WITH LAYOUTS

**STORMTECH DESIGN TOOL**

https://designtool.ads-pipe.com/



STORMTECH® + WQ STD DETAIL
ISOLATOR ROW PLUS® & BAYFILTER®

DATE: 2/10/22 | DRAWN: KLJ | CHECKED: KMS | PROJECT #: N/A

| DATE | DRWN | CHKD | DESCRIPTION |
|---|---|---|---|

ADS Advanced Drainage Systems, Inc.

4640 TRUEMAN BLVD
HILLIARD, OH 43026

**WWHM2012**
**PROJECT REPORT**

---

**Project Name:** East Basin detention sizing
**Site Name:** Kallicott
**Site Address:**
**City :**
**Report Date:** 6/28/2022
**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 :** Undeveloped East Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Forest, Flat | 1.53 |
| C, Forest, Mod | .23 |
| Pervious Total | 1.76 |

| Impervious Land Use | acre |
|---|---|
| Impervious Total | 0 |
| Basin Total | 1.76 |

---

**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|

---

**MITIGATED LAND USE**

**Name :** Dev East Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Pasture, Flat | .59 |
| C, Pasture, Mod | .1 |
| Pervious Total | 0.69 |

| Impervious Land Use | acre |
|---|---|
| ROADS FLAT | 0.44 |
| ROOF TOPS FLAT | 0.63 |
| Impervious Total | 1.07 |
| Basin Total | 1.76 |

---

**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|
| Vault 1 | Vault 1 | |

---

**Name** : Vault 1
**Width** : 36 ft.
**Length** : 100 ft.
**Depth**: 8 ft.
**Discharge Structure**
**Riser Height**: 7 ft.
**Riser Diameter**: 12 in.
**Orifice 1 Diameter**: 0.8125 in. **Elevation**: 0 ft.
**Orifice 2 Diameter**: 1.375 in. **Elevation**: 3.75 ft.
**Orifice 3 Diameter**: 0.78125 in. **Elevation**: 5.25 ft.

**Element Flows To:**

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

---

**Vault Hydraulic Table**

| Stage(feet) | Area(ac.) | Volume(ac-ft.) | Discharge(cfs) | Infilt(cfs) |
|---|---|---|---|---|
| 0.0000 | 0.082 | 0.000 | 0.000 | 0.000 |
| 0.0889 | 0.082 | 0.007 | 0.005 | 0.000 |
| 0.1778 | 0.082 | 0.014 | 0.007 | 0.000 |
| 0.2667 | 0.082 | 0.022 | 0.009 | 0.000 |
| 0.3556 | 0.082 | 0.029 | 0.010 | 0.000 |
| 0.4444 | 0.082 | 0.036 | 0.011 | 0.000 |
| 0.5333 | 0.082 | 0.044 | 0.013 | 0.000 |
| 0.6222 | 0.082 | 0.051 | 0.014 | 0.000 |
| 0.7111 | 0.082 | 0.058 | 0.015 | 0.000 |
| 0.8000 | 0.082 | 0.066 | 0.016 | 0.000 |
| 0.8889 | 0.082 | 0.073 | 0.016 | 0.000 |
| 0.9778 | 0.082 | 0.080 | 0.017 | 0.000 |
| 1.0667 | 0.082 | 0.088 | 0.018 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 1.1556 | 0.082 | 0.095 | 0.019 | 0.000 |
| 1.2444 | 0.082 | 0.102 | 0.020 | 0.000 |
| 1.3333 | 0.082 | 0.110 | 0.020 | 0.000 |
| 1.4222 | 0.082 | 0.117 | 0.021 | 0.000 |
| 1.5111 | 0.082 | 0.124 | 0.022 | 0.000 |
| 1.6000 | 0.082 | 0.132 | 0.022 | 0.000 |
| 1.6889 | 0.082 | 0.139 | 0.023 | 0.000 |
| 1.7778 | 0.082 | 0.146 | 0.023 | 0.000 |
| 1.8667 | 0.082 | 0.154 | 0.024 | 0.000 |
| 1.9556 | 0.082 | 0.161 | 0.025 | 0.000 |
| 2.0444 | 0.082 | 0.169 | 0.025 | 0.000 |
| 2.1333 | 0.082 | 0.176 | 0.026 | 0.000 |
| 2.2222 | 0.082 | 0.183 | 0.026 | 0.000 |
| 2.3111 | 0.082 | 0.191 | 0.027 | 0.000 |
| 2.4000 | 0.082 | 0.198 | 0.027 | 0.000 |
| 2.4889 | 0.082 | 0.205 | 0.028 | 0.000 |
| 2.5778 | 0.082 | 0.213 | 0.028 | 0.000 |
| 2.6667 | 0.082 | 0.220 | 0.029 | 0.000 |
| 2.7556 | 0.082 | 0.227 | 0.029 | 0.000 |
| 2.8444 | 0.082 | 0.235 | 0.030 | 0.000 |
| 2.9333 | 0.082 | 0.242 | 0.030 | 0.000 |
| 3.0222 | 0.082 | 0.249 | 0.031 | 0.000 |
| 3.1111 | 0.082 | 0.257 | 0.031 | 0.000 |
| 3.2000 | 0.082 | 0.264 | 0.032 | 0.000 |
| 3.2889 | 0.082 | 0.271 | 0.032 | 0.000 |
| 3.3778 | 0.082 | 0.279 | 0.032 | 0.000 |
| 3.4667 | 0.082 | 0.286 | 0.033 | 0.000 |
| 3.5556 | 0.082 | 0.293 | 0.033 | 0.000 |
| 3.6444 | 0.082 | 0.301 | 0.034 | 0.000 |
| 3.7333 | 0.082 | 0.308 | 0.034 | 0.000 |
| 3.8222 | 0.082 | 0.315 | 0.048 | 0.000 |
| 3.9111 | 0.082 | 0.323 | 0.056 | 0.000 |
| 4.0000 | 0.082 | 0.330 | 0.061 | 0.000 |
| 4.0889 | 0.082 | 0.337 | 0.066 | 0.000 |
| 4.1778 | 0.082 | 0.345 | 0.070 | 0.000 |
| 4.2667 | 0.082 | 0.352 | 0.073 | 0.000 |
| 4.3556 | 0.082 | 0.360 | 0.077 | 0.000 |
| 4.4444 | 0.082 | 0.367 | 0.080 | 0.000 |
| 4.5333 | 0.082 | 0.374 | 0.083 | 0.000 |
| 4.6222 | 0.082 | 0.382 | 0.086 | 0.000 |
| 4.7111 | 0.082 | 0.389 | 0.089 | 0.000 |
| 4.8000 | 0.082 | 0.396 | 0.091 | 0.000 |
| 4.8889 | 0.082 | 0.404 | 0.094 | 0.000 |
| 4.9778 | 0.082 | 0.411 | 0.096 | 0.000 |
| 5.0667 | 0.082 | 0.418 | 0.099 | 0.000 |
| 5.1556 | 0.082 | 0.426 | 0.101 | 0.000 |
| 5.2444 | 0.082 | 0.433 | 0.103 | 0.000 |
| 5.3333 | 0.082 | 0.440 | 0.110 | 0.000 |
| 5.4222 | 0.082 | 0.448 | 0.114 | 0.000 |
| 5.5111 | 0.082 | 0.455 | 0.118 | 0.000 |
| 5.6000 | 0.082 | 0.462 | 0.122 | 0.000 |
| 5.6889 | 0.082 | 0.470 | 0.125 | 0.000 |
| 5.7778 | 0.082 | 0.477 | 0.128 | 0.000 |
| 5.8667 | 0.082 | 0.484 | 0.131 | 0.000 |
| 5.9556 | 0.082 | 0.492 | 0.133 | 0.000 |
| 6.0444 | 0.082 | 0.499 | 0.136 | 0.000 |
| 6.1333 | 0.082 | 0.506 | 0.139 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 6.2222 | 0.082 | 0.514 | 0.141 | 0.000 |
| 6.3111 | 0.082 | 0.521 | 0.144 | 0.000 |
| 6.4000 | 0.082 | 0.528 | 0.146 | 0.000 |
| 6.4889 | 0.082 | 0.536 | 0.149 | 0.000 |
| 6.5778 | 0.082 | 0.543 | 0.151 | 0.000 |
| 6.6667 | 0.082 | 0.551 | 0.153 | 0.000 |
| 6.7556 | 0.082 | 0.558 | 0.155 | 0.000 |
| 6.8444 | 0.082 | 0.565 | 0.158 | 0.000 |
| 6.9333 | 0.082 | 0.573 | 0.160 | 0.000 |
| 7.0222 | 0.082 | 0.580 | 0.197 | 0.000 |
| 7.1111 | 0.082 | 0.587 | 0.554 | 0.000 |
| 7.2000 | 0.082 | 0.595 | 1.074 | 0.000 |
| 7.2889 | 0.082 | 0.602 | 1.616 | 0.000 |
| 7.3778 | 0.082 | 0.609 | 2.049 | 0.000 |
| 7.4667 | 0.082 | 0.617 | 2.310 | 0.000 |
| 7.5556 | 0.082 | 0.624 | 2.522 | 0.000 |
| 7.6444 | 0.082 | 0.631 | 2.704 | 0.000 |
| 7.7333 | 0.082 | 0.639 | 2.875 | 0.000 |
| 7.8222 | 0.082 | 0.646 | 3.036 | 0.000 |
| 7.9111 | 0.082 | 0.653 | 3.188 | 0.000 |
| 8.0000 | 0.082 | 0.661 | 3.333 | 0.000 |
| 8.0889 | 0.082 | 0.668 | 3.472 | 0.000 |
| 8.1778 | 0.000 | 0.000 | 3.605 | 0.000 |

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**ANALYSIS RESULTS**

**Stream Protection Duration**

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**Predeveloped Landuse Totals for POC #1**
**Total Pervious Area:1.76**
**Total Impervious Area:0**

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**Mitigated Landuse Totals for POC #1**
**Total Pervious Area:0.69**
**Total Impervious Area:1.07**

---

**Flow Frequency Return Periods for Predeveloped. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.059877 |
| 5 year | 0.092391 |
| 10 year | 0.117577 |
| 25 year | 0.153735 |
| 50 year | 0.183938 |
| 100 year | 0.217046 |

**Flow Frequency Return Periods for Mitigated. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.035669 |
| 5 year | 0.054058 |
| 10 year | 0.069356 |

| | |
|---|---|
| **25 year** | 0.092768 |
| **50 year** | 0.113534 |
| **100 year** | 0.137477 |

---

**Stream Protection Duration**
**Annual Peaks for Predeveloped and Mitigated. POC #1**

| Year | Predeveloped | Mitigated |
|---|---|---|
| 1949 | 0.061 | 0.029 |
| 1950 | 0.062 | 0.032 |
| 1951 | 0.055 | 0.028 |
| 1952 | 0.044 | 0.026 |
| 1953 | 0.036 | 0.025 |
| 1954 | 0.202 | 0.031 |
| 1955 | 0.076 | 0.058 |
| 1956 | 0.067 | 0.062 |
| 1957 | 0.084 | 0.055 |
| 1958 | 0.063 | 0.029 |
| 1959 | 0.060 | 0.032 |
| 1960 | 0.056 | 0.033 |
| 1961 | 0.108 | 0.046 |
| 1962 | 0.053 | 0.028 |
| 1963 | 0.088 | 0.028 |
| 1964 | 0.064 | 0.024 |
| 1965 | 0.051 | 0.033 |
| 1966 | 0.030 | 0.027 |
| 1967 | 0.061 | 0.028 |
| 1968 | 0.074 | 0.034 |
| 1969 | 0.188 | 0.029 |
| 1970 | 0.043 | 0.028 |
| 1971 | 0.069 | 0.070 |
| 1972 | 0.050 | 0.030 |
| 1973 | 0.047 | 0.031 |
| 1974 | 0.105 | 0.031 |
| 1975 | 0.041 | 0.026 |
| 1976 | 0.044 | 0.030 |
| 1977 | 0.036 | 0.027 |
| 1978 | 0.043 | 0.026 |
| 1979 | 0.122 | 0.029 |
| 1980 | 0.057 | 0.025 |
| 1981 | 0.043 | 0.027 |
| 1982 | 0.056 | 0.050 |
| 1983 | 0.099 | 0.028 |
| 1984 | 0.058 | 0.078 |
| 1985 | 0.071 | 0.062 |
| 1986 | 0.166 | 0.125 |
| 1987 | 0.079 | 0.094 |
| 1988 | 0.041 | 0.034 |
| 1989 | 0.043 | 0.024 |
| 1990 | 0.055 | 0.045 |
| 1991 | 0.057 | 0.033 |
| 1992 | 0.043 | 0.034 |
| 1993 | 0.037 | 0.024 |
| 1994 | 0.039 | 0.032 |
| 1995 | 0.058 | 0.067 |
| 1996 | 0.100 | 0.062 |
| 1997 | 0.199 | 0.158 |

| | | |
|---|---|---|
| 1998 | 0.036 | 0.027 |
| 1999 | 0.047 | 0.033 |
| 2000 | 0.035 | 0.069 |
| 2001 | 0.014 | 0.021 |
| 2002 | 0.054 | 0.033 |
| 2003 | 0.042 | 0.031 |
| 2004 | 0.071 | 0.071 |
| 2005 | 0.049 | 0.032 |
| 2006 | 0.136 | 0.052 |
| 2007 | 0.107 | 0.033 |
| 2008 | 0.146 | 0.126 |
| 2009 | 0.044 | 0.031 |

---

**Stream Protection Duration**
**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| Rank | Predeveloped | Mitigated |
|---|---|---|
| 1 | 0.2016 | 0.1576 |
| 2 | 0.1985 | 0.1257 |
| 3 | 0.1882 | 0.1248 |
| 4 | 0.1663 | 0.0942 |
| 5 | 0.1456 | 0.0783 |
| 6 | 0.1362 | 0.0712 |
| 7 | 0.1221 | 0.0702 |
| 8 | 0.1082 | 0.0688 |
| 9 | 0.1066 | 0.0671 |
| 10 | 0.1053 | 0.0622 |
| 11 | 0.0999 | 0.0619 |
| 12 | 0.0991 | 0.0616 |
| 13 | 0.0880 | 0.0579 |
| 14 | 0.0842 | 0.0551 |
| 15 | 0.0788 | 0.0520 |
| 16 | 0.0764 | 0.0497 |
| 17 | 0.0741 | 0.0460 |
| 18 | 0.0712 | 0.0452 |
| 19 | 0.0707 | 0.0345 |
| 20 | 0.0688 | 0.0344 |
| 21 | 0.0673 | 0.0336 |
| 22 | 0.0643 | 0.0333 |
| 23 | 0.0630 | 0.0331 |
| 24 | 0.0621 | 0.0329 |
| 25 | 0.0610 | 0.0328 |
| 26 | 0.0607 | 0.0328 |
| 27 | 0.0602 | 0.0327 |
| 28 | 0.0580 | 0.0322 |
| 29 | 0.0577 | 0.0319 |
| 30 | 0.0572 | 0.0319 |
| 31 | 0.0568 | 0.0317 |
| 32 | 0.0563 | 0.0313 |
| 33 | 0.0558 | 0.0313 |
| 34 | 0.0551 | 0.0311 |
| 35 | 0.0551 | 0.0310 |
| 36 | 0.0537 | 0.0308 |
| 37 | 0.0532 | 0.0302 |
| 38 | 0.0513 | 0.0299 |
| 39 | 0.0495 | 0.0293 |
| 40 | 0.0492 | 0.0292 |

| | | |
|---|---|---|
| 41 | 0.0471 | 0.0291 |
| 42 | 0.0471 | 0.0286 |
| 43 | 0.0444 | 0.0278 |
| 44 | 0.0438 | 0.0278 |
| 45 | 0.0437 | 0.0277 |
| 46 | 0.0434 | 0.0277 |
| 47 | 0.0433 | 0.0276 |
| 48 | 0.0428 | 0.0275 |
| 49 | 0.0428 | 0.0267 |
| 50 | 0.0425 | 0.0267 |
| 51 | 0.0421 | 0.0267 |
| 52 | 0.0414 | 0.0265 |
| 53 | 0.0408 | 0.0260 |
| 54 | 0.0394 | 0.0257 |
| 55 | 0.0366 | 0.0255 |
| 56 | 0.0364 | 0.0253 |
| 57 | 0.0361 | 0.0252 |
| 58 | 0.0360 | 0.0245 |
| 59 | 0.0354 | 0.0244 |
| 60 | 0.0301 | 0.0236 |
| 61 | 0.0142 | 0.0215 |

---

**Stream Protection Duration**
**POC #1**
**The Facility PASSED**

**The Facility PASSED.**

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0299 | 18931 | 16288 | 86 | Pass |
| 0.0315 | 16307 | 10192 | 62 | Pass |
| 0.0330 | 14070 | 6038 | 42 | Pass |
| 0.0346 | 12089 | 2733 | 22 | Pass |
| 0.0362 | 10327 | 2562 | 24 | Pass |
| 0.0377 | 8906 | 2453 | 27 | Pass |
| 0.0393 | 7683 | 2359 | 30 | Pass |
| 0.0408 | 6631 | 2265 | 34 | Pass |
| 0.0424 | 5700 | 2188 | 38 | Pass |
| 0.0439 | 4958 | 2113 | 42 | Pass |
| 0.0455 | 4344 | 2040 | 46 | Pass |
| 0.0470 | 3760 | 1981 | 52 | Pass |
| 0.0486 | 3281 | 1905 | 58 | Pass |
| 0.0502 | 2879 | 1808 | 62 | Pass |
| 0.0517 | 2554 | 1693 | 66 | Pass |
| 0.0533 | 2239 | 1597 | 71 | Pass |
| 0.0548 | 1961 | 1513 | 77 | Pass |
| 0.0564 | 1709 | 1452 | 84 | Pass |
| 0.0579 | 1533 | 1359 | 88 | Pass |
| 0.0595 | 1392 | 1240 | 89 | Pass |
| 0.0610 | 1267 | 1113 | 87 | Pass |
| 0.0626 | 1166 | 1046 | 89 | Pass |
| 0.0642 | 1078 | 1000 | 92 | Pass |
| 0.0657 | 1013 | 951 | 93 | Pass |
| 0.0673 | 952 | 891 | 93 | Pass |
| 0.0688 | 886 | 838 | 94 | Pass |
| 0.0704 | 821 | 795 | 96 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.0719 | 773 | 762 | 98 | Pass |
| 0.0735 | 724 | 739 | 102 | Pass |
| 0.0750 | 685 | 709 | 103 | Pass |
| 0.0766 | 641 | 680 | 106 | Pass |
| 0.0782 | 620 | 649 | 104 | Pass |
| 0.0797 | 599 | 627 | 104 | Pass |
| 0.0813 | 575 | 607 | 105 | Pass |
| 0.0828 | 558 | 589 | 105 | Pass |
| 0.0844 | 528 | 569 | 107 | Pass |
| 0.0859 | 503 | 549 | 109 | Pass |
| 0.0875 | 484 | 529 | 109 | Pass |
| 0.0890 | 468 | 509 | 108 | Pass |
| 0.0906 | 447 | 477 | 106 | Pass |
| 0.0922 | 430 | 440 | 102 | Pass |
| 0.0937 | 420 | 408 | 97 | Pass |
| 0.0953 | 403 | 387 | 96 | Pass |
| 0.0968 | 387 | 367 | 94 | Pass |
| 0.0984 | 376 | 351 | 93 | Pass |
| 0.0999 | 355 | 334 | 94 | Pass |
| 0.1015 | 344 | 320 | 93 | Pass |
| 0.1030 | 337 | 303 | 89 | Pass |
| 0.1046 | 326 | 292 | 89 | Pass |
| 0.1062 | 316 | 286 | 90 | Pass |
| 0.1077 | 308 | 279 | 90 | Pass |
| 0.1093 | 293 | 273 | 93 | Pass |
| 0.1108 | 284 | 268 | 94 | Pass |
| 0.1124 | 277 | 260 | 93 | Pass |
| 0.1139 | 267 | 252 | 94 | Pass |
| 0.1155 | 259 | 244 | 94 | Pass |
| 0.1170 | 243 | 232 | 95 | Pass |
| 0.1186 | 235 | 212 | 90 | Pass |
| 0.1202 | 225 | 196 | 87 | Pass |
| 0.1217 | 213 | 174 | 81 | Pass |
| 0.1233 | 203 | 159 | 78 | Pass |
| 0.1248 | 194 | 138 | 71 | Pass |
| 0.1264 | 186 | 125 | 67 | Pass |
| 0.1279 | 175 | 121 | 69 | Pass |
| 0.1295 | 166 | 118 | 71 | Pass |
| 0.1310 | 160 | 115 | 71 | Pass |
| 0.1326 | 151 | 112 | 74 | Pass |
| 0.1342 | 145 | 97 | 66 | Pass |
| 0.1357 | 134 | 83 | 61 | Pass |
| 0.1373 | 125 | 78 | 62 | Pass |
| 0.1388 | 117 | 74 | 63 | Pass |
| 0.1404 | 106 | 70 | 66 | Pass |
| 0.1419 | 94 | 66 | 70 | Pass |
| 0.1435 | 79 | 61 | 77 | Pass |
| 0.1450 | 69 | 57 | 82 | Pass |
| 0.1466 | 60 | 53 | 88 | Pass |
| 0.1482 | 57 | 48 | 84 | Pass |
| 0.1497 | 54 | 42 | 77 | Pass |
| 0.1513 | 43 | 38 | 88 | Pass |
| 0.1528 | 40 | 27 | 67 | Pass |
| 0.1544 | 38 | 23 | 60 | Pass |
| 0.1559 | 36 | 18 | 50 | Pass |
| 0.1575 | 33 | 4 | 12 | Pass |
| 0.1590 | 28 | 0 | 0 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.1606 | 26 | 0 | 0 | Pass |
| 0.1622 | 21 | 0 | 0 | Pass |
| 0.1637 | 16 | 0 | 0 | Pass |
| 0.1653 | 15 | 0 | 0 | Pass |
| 0.1668 | 8 | 0 | 0 | Pass |
| 0.1684 | 6 | 0 | 0 | Pass |
| 0.1699 | 5 | 0 | 0 | Pass |
| 0.1715 | 4 | 0 | 0 | Pass |
| 0.1730 | 4 | 0 | 0 | Pass |
| 0.1746 | 4 | 0 | 0 | Pass |
| 0.1762 | 3 | 0 | 0 | Pass |
| 0.1777 | 3 | 0 | 0 | Pass |
| 0.1793 | 3 | 0 | 0 | Pass |
| 0.1808 | 3 | 0 | 0 | Pass |
| 0.1824 | 3 | 0 | 0 | Pass |
| 0.1839 | 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 Treatment? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft.) | Cumulative Volume Infiltration Credit | Percent Water Quality | Comment |
|---|---|---|---|---|---|---|---|
| Vault 1 POC | N | 235.99 | | | N | 0.00 | |
| Total Volume Infiltrated | | 235.99 | 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.

**WWHM2012**
**PROJECT REPORT**

---

**Project Name:** East Basin prior to detention
**Site Name:** Kallicott
**Site Address:**
**City :**
**Report Date:** 2/20/2023
**Gage :** Everett
**Data Start :** 1948/10/01
**Data End :** 2009/09/30
**Precip Scale:** 1.20
**Version Date:** 2017/07/05
**Version :** 4.2.13

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

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**High Flow Threshold for POC 1:** 50 year

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**PREDEVELOPED LAND USE**

**Name :** Undeveloped East Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Forest, Flat | 1.53 |
| C, Forest, Mod | .23 |
| Pervious Total | 1.76 |

| Impervious Land Use | acre |
|---|---|
| Impervious Total | 0 |
| Basin Total | 1.76 |

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**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|

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**MITIGATED LAND USE**

**Name :** Unmitigated Dev East Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Pasture, Flat | .59 |
| C, Pasture, Mod | .1 |
| Pervious Total | 0.69 |

| Impervious Land Use | acre |
|---|---|
| ROADS FLAT | 0.44 |
| ROOF TOPS FLAT | 0.63 |
| Impervious Total | 1.07 |
| Basin Total | 1.76 |

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Element Flows To:
Surface Interflow Groundwater

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ANALYSIS RESULTS

Stream Protection Duration

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Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.76
Total Impervious Area:0

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Mitigated Landuse Totals for POC #1
Total Pervious Area:0.69
Total Impervious Area:1.07

---

Flow Frequency Return Periods for Predeveloped. POC #1

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.059877 |
| 5 year | 0.092391 |
| 10 year | 0.117577 |
| 25 year | 0.153735 |
| 50 year | 0.183938 |
| 100 year | 0.217046 |

Flow Frequency Return Periods for Mitigated. POC #1

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.590214 |
| 5 year | 0.812266 |
| 10 year | 0.980193 |
| 25 year | 1.217566 |

| | |
|---|---|
| **50 year** | 1.413655 |
| **100 year** | 1.62709 |

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**Stream Protection Duration**
**Annual Peaks for Predeveloped and Mitigated. POC #1**

| Year | Predeveloped | Mitigated |
|---|---|---|
| 1949 | 0.061 | 0.665 |
| 1950 | 0.062 | 0.704 |
| 1951 | 0.055 | 0.706 |
| 1952 | 0.044 | 0.547 |
| 1953 | 0.036 | 0.718 |
| 1954 | 0.202 | 1.008 |
| 1955 | 0.076 | 0.700 |
| 1956 | 0.067 | 0.311 |
| 1957 | 0.084 | 0.550 |
| 1958 | 0.063 | 1.395 |
| 1959 | 0.060 | 0.522 |
| 1960 | 0.056 | 0.559 |
| 1961 | 0.108 | 1.941 |
| 1962 | 0.053 | 0.652 |
| 1963 | 0.088 | 0.787 |
| 1964 | 0.064 | 0.410 |
| 1965 | 0.051 | 0.497 |
| 1966 | 0.030 | 0.500 |
| 1967 | 0.061 | 1.109 |
| 1968 | 0.074 | 0.601 |
| 1969 | 0.188 | 1.333 |
| 1970 | 0.043 | 0.464 |
| 1971 | 0.069 | 0.650 |
| 1972 | 0.050 | 0.843 |
| 1973 | 0.047 | 0.682 |
| 1974 | 0.105 | 0.808 |
| 1975 | 0.041 | 0.665 |
| 1976 | 0.044 | 0.458 |
| 1977 | 0.036 | 0.452 |
| 1978 | 0.043 | 0.345 |
| 1979 | 0.122 | 0.784 |
| 1980 | 0.057 | 0.495 |
| 1981 | 0.043 | 0.461 |
| 1982 | 0.056 | 0.460 |
| 1983 | 0.099 | 0.637 |
| 1984 | 0.058 | 0.569 |
| 1985 | 0.071 | 0.782 |
| 1986 | 0.166 | 0.825 |
| 1987 | 0.079 | 0.682 |
| 1988 | 0.041 | 0.556 |
| 1989 | 0.043 | 0.571 |
| 1990 | 0.055 | 0.447 |
| 1991 | 0.057 | 0.548 |
| 1992 | 0.043 | 0.555 |
| 1993 | 0.037 | 0.429 |
| 1994 | 0.039 | 0.481 |
| 1995 | 0.058 | 0.406 |
| 1996 | 0.100 | 0.653 |
| 1997 | 0.199 | 0.736 |
| 1998 | 0.036 | 0.751 |

| | | |
|---|---|---|
| 1999 | 0.047 | 0.342 |
| 2000 | 0.035 | 1.185 |
| 2001 | 0.014 | 0.398 |
| 2002 | 0.054 | 0.386 |
| 2003 | 0.042 | 0.530 |
| 2004 | 0.071 | 1.010 |
| 2005 | 0.049 | 0.472 |
| 2006 | 0.136 | 0.645 |
| 2007 | 0.107 | 0.626 |
| 2008 | 0.146 | 0.465 |
| 2009 | 0.044 | 0.479 |

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**Stream Protection Duration**
**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| Rank | Predeveloped | Mitigated |
|---|---|---|
| 1 | 0.2016 | 1.9407 |
| 2 | 0.1985 | 1.3946 |
| 3 | 0.1882 | 1.3326 |
| 4 | 0.1663 | 1.1847 |
| 5 | 0.1456 | 1.1087 |
| 6 | 0.1362 | 1.0103 |
| 7 | 0.1221 | 1.0079 |
| 8 | 0.1082 | 0.8427 |
| 9 | 0.1066 | 0.8246 |
| 10 | 0.1053 | 0.8080 |
| 11 | 0.0999 | 0.7869 |
| 12 | 0.0991 | 0.7843 |
| 13 | 0.0880 | 0.7819 |
| 14 | 0.0842 | 0.7509 |
| 15 | 0.0788 | 0.7361 |
| 16 | 0.0764 | 0.7178 |
| 17 | 0.0741 | 0.7061 |
| 18 | 0.0712 | 0.7037 |
| 19 | 0.0707 | 0.6995 |
| 20 | 0.0688 | 0.6821 |
| 21 | 0.0673 | 0.6820 |
| 22 | 0.0643 | 0.6654 |
| 23 | 0.0630 | 0.6650 |
| 24 | 0.0621 | 0.6533 |
| 25 | 0.0610 | 0.6525 |
| 26 | 0.0607 | 0.6504 |
| 27 | 0.0602 | 0.6451 |
| 28 | 0.0580 | 0.6367 |
| 29 | 0.0577 | 0.6257 |
| 30 | 0.0572 | 0.6009 |
| 31 | 0.0568 | 0.5708 |
| 32 | 0.0563 | 0.5695 |
| 33 | 0.0558 | 0.5591 |
| 34 | 0.0551 | 0.5558 |
| 35 | 0.0551 | 0.5554 |
| 36 | 0.0537 | 0.5505 |
| 37 | 0.0532 | 0.5478 |
| 38 | 0.0513 | 0.5469 |
| 39 | 0.0495 | 0.5297 |
| 40 | 0.0492 | 0.5219 |
| 41 | 0.0471 | 0.5002 |

| | | |
|---|---|---|
| 42 | 0.0471 | 0.4974 |
| 43 | 0.0444 | 0.4954 |
| 44 | 0.0438 | 0.4811 |
| 45 | 0.0437 | 0.4785 |
| 46 | 0.0434 | 0.4716 |
| 47 | 0.0433 | 0.4648 |
| 48 | 0.0428 | 0.4637 |
| 49 | 0.0428 | 0.4610 |
| 50 | 0.0425 | 0.4601 |
| 51 | 0.0421 | 0.4585 |
| 52 | 0.0414 | 0.4520 |
| 53 | 0.0408 | 0.4467 |
| 54 | 0.0394 | 0.4289 |
| 55 | 0.0366 | 0.4101 |
| 56 | 0.0364 | 0.4062 |
| 57 | 0.0361 | 0.3979 |
| 58 | 0.0360 | 0.3865 |
| 59 | 0.0354 | 0.3449 |
| 60 | 0.0301 | 0.3420 |
| 61 | 0.0142 | 0.3111 |

---

**Stream Protection Duration**
**POC #1**
**The Facility PASSED**

**The Facility PASSED.**

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0299 | 18931 | 16288 | 86 | Pass |
| 0.0315 | 16307 | 10192 | 62 | Pass |
| 0.0330 | 14070 | 6038 | 42 | Pass |
| 0.0346 | 12089 | 2733 | 22 | Pass |
| 0.0362 | 10327 | 2562 | 24 | Pass |
| 0.0377 | 8906 | 2453 | 27 | Pass |
| 0.0393 | 7683 | 2359 | 30 | Pass |
| 0.0408 | 6631 | 2265 | 34 | Pass |
| 0.0424 | 5700 | 2188 | 38 | Pass |
| 0.0439 | 4958 | 2113 | 42 | Pass |
| 0.0455 | 4344 | 2040 | 46 | Pass |
| 0.0470 | 3760 | 1981 | 52 | Pass |
| 0.0486 | 3281 | 1905 | 58 | Pass |
| 0.0502 | 2879 | 1808 | 62 | Pass |
| 0.0517 | 2554 | 1693 | 66 | Pass |
| 0.0533 | 2239 | 1597 | 71 | Pass |
| 0.0548 | 1961 | 1513 | 77 | Pass |
| 0.0564 | 1709 | 1452 | 84 | Pass |
| 0.0579 | 1533 | 1359 | 88 | Pass |
| 0.0595 | 1392 | 1240 | 89 | Pass |
| 0.0610 | 1267 | 1113 | 87 | Pass |
| 0.0626 | 1166 | 1046 | 89 | Pass |
| 0.0642 | 1078 | 1000 | 92 | Pass |
| 0.0657 | 1013 | 951 | 93 | Pass |
| 0.0673 | 952 | 891 | 93 | Pass |
| 0.0688 | 886 | 838 | 94 | Pass |
| 0.0704 | 821 | 795 | 96 | Pass |
| 0.0719 | 773 | 762 | 98 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.0735 | 724 | 739 | 102 | Pass |
| 0.0750 | 685 | 709 | 103 | Pass |
| 0.0766 | 641 | 680 | 106 | Pass |
| 0.0782 | 620 | 649 | 104 | Pass |
| 0.0797 | 599 | 627 | 104 | Pass |
| 0.0813 | 575 | 607 | 105 | Pass |
| 0.0828 | 558 | 589 | 105 | Pass |
| 0.0844 | 528 | 569 | 107 | Pass |
| 0.0859 | 503 | 549 | 109 | Pass |
| 0.0875 | 484 | 529 | 109 | Pass |
| 0.0890 | 468 | 509 | 108 | Pass |
| 0.0906 | 447 | 477 | 106 | Pass |
| 0.0922 | 430 | 440 | 102 | Pass |
| 0.0937 | 420 | 408 | 97 | Pass |
| 0.0953 | 403 | 387 | 96 | Pass |
| 0.0968 | 387 | 367 | 94 | Pass |
| 0.0984 | 376 | 351 | 93 | Pass |
| 0.0999 | 355 | 334 | 94 | Pass |
| 0.1015 | 344 | 320 | 93 | Pass |
| 0.1030 | 337 | 303 | 89 | Pass |
| 0.1046 | 326 | 292 | 89 | Pass |
| 0.1062 | 316 | 286 | 90 | Pass |
| 0.1077 | 308 | 279 | 90 | Pass |
| 0.1093 | 293 | 273 | 93 | Pass |
| 0.1108 | 284 | 268 | 94 | Pass |
| 0.1124 | 277 | 260 | 93 | Pass |
| 0.1139 | 267 | 252 | 94 | Pass |
| 0.1155 | 259 | 244 | 94 | Pass |
| 0.1170 | 243 | 232 | 95 | Pass |
| 0.1186 | 235 | 212 | 90 | Pass |
| 0.1202 | 225 | 196 | 87 | Pass |
| 0.1217 | 213 | 174 | 81 | Pass |
| 0.1233 | 203 | 159 | 78 | Pass |
| 0.1248 | 194 | 138 | 71 | Pass |
| 0.1264 | 186 | 125 | 67 | Pass |
| 0.1279 | 175 | 121 | 69 | Pass |
| 0.1295 | 166 | 118 | 71 | Pass |
| 0.1310 | 160 | 115 | 71 | Pass |
| 0.1326 | 151 | 112 | 74 | Pass |
| 0.1342 | 145 | 97 | 66 | Pass |
| 0.1357 | 134 | 83 | 61 | Pass |
| 0.1373 | 125 | 78 | 62 | Pass |
| 0.1388 | 117 | 74 | 63 | Pass |
| 0.1404 | 106 | 70 | 66 | Pass |
| 0.1419 | 94 | 66 | 70 | Pass |
| 0.1435 | 79 | 61 | 77 | Pass |
| 0.1450 | 69 | 57 | 82 | Pass |
| 0.1466 | 60 | 53 | 88 | Pass |
| 0.1482 | 57 | 48 | 84 | Pass |
| 0.1497 | 54 | 42 | 77 | Pass |
| 0.1513 | 43 | 38 | 88 | Pass |
| 0.1528 | 40 | 27 | 67 | Pass |
| 0.1544 | 38 | 23 | 60 | Pass |
| 0.1559 | 36 | 18 | 50 | Pass |
| 0.1575 | 33 | 4 | 12 | Pass |
| 0.1590 | 28 | 0 | 0 | Pass |
| 0.1606 | 26 | 0 | 0 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.1622 | 21 | 0 | 0 | Pass |
| 0.1637 | 16 | 0 | 0 | Pass |
| 0.1653 | 15 | 0 | 0 | Pass |
| 0.1668 | 8 | 0 | 0 | Pass |
| 0.1684 | 6 | 0 | 0 | Pass |
| 0.1699 | 5 | 0 | 0 | Pass |
| 0.1715 | 4 | 0 | 0 | Pass |
| 0.1730 | 4 | 0 | 0 | Pass |
| 0.1746 | 4 | 0 | 0 | Pass |
| 0.1762 | 3 | 0 | 0 | Pass |
| 0.1777 | 3 | 0 | 0 | Pass |
| 0.1793 | 3 | 0 | 0 | Pass |
| 0.1808 | 3 | 0 | 0 | Pass |
| 0.1824 | 3 | 0 | 0 | Pass |
| 0.1839 | 3 | 0 | 0 | Pass |

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**Water Quality BMP Flow and Volume for POC #1**
**On-line facility volume:** 0.0685 **acre-feet**
**On-line facility target flow:** 0.0376 **cfs.**
**Adjusted for 15 min:** 0.0376 **cfs.**
**Off-line facility target flow:** 0.0217 **cfs.**
**Adjusted for 15 min:** 0.0217 **cfs.**

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**LID Report**

| LID Technique | Used for Treatment? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft.) | Cumulative Volume Infiltration Credit | Percent Water Quality Volume | Percent Water Quality Treated | Comment |
|---|---|---|---|---|---|---|---|---|
| Total Volume Infiltrated | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0% | No Treat. Credit |

Compliance with LID Standard 8
Duration Analysis Result = Passed

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## Perlnd and Implnd Changes

No changes have been made.

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**WWHM2012**
**PROJECT REPORT**

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**Project Name:** West Basin detention sizing
**Site Name:** Kallicott
**Site Address:**
**City** : Marysville
**Report Date:** 12/29/2022
**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

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

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**High Flow Threshold for POC 1:** 50 year

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**PREDEVELOPED LAND USE**

**Name** : Undeveloped West Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Forest, Flat | 1.06 |
| C, Forest, Mod | 1.267 |
| C, Forest, Steep | .33 |
| Pervious Total | 2.657 |

| Impervious Land Use | acre |
|---|---|
| Impervious Total | 0 |
| Basin Total | 2.657 |

---

**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|

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**MITIGATED LAND USE**

**Name** : Developed West Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Pasture, Flat | 1.02 |
| Pervious Total | 1.02 |

| Impervious Land Use | acre |
|---|---|
| ROADS FLAT | 0.296 |
| ROADS MOD | 0.35 |
| ROOF TOPS FLAT | 0.977 |
| DRIVEWAYS FLAT | 0.014 |
| Impervious Total | 1.637 |
| Basin Total | 2.657 |

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**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|
| Vault 1 | Vault 1 | |

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**Name** : Vault 1
**Width :** 14 ft.
**Length :** 372 ft.
**Depth:** 8 ft.

**Discharge Structure**

**Riser Height:** 7 ft.
**Riser Diameter:** 18 in.
**Orifice 1 Diameter:** 1.0625 in. **Elevation:** 0 ft.
**Orifice 2 Diameter:** 1.5 in. **Elevation:** 4 ft.
**Orifice 3 Diameter:** 1.25 in. **Elevation:** 4.8 ft.

**Element Flows To:**

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

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**Vault Hydraulic Table**

| Stage(feet) | Area(ac.) | Volume(ac-ft.) | Discharge(cfs) | Infilt(cfs) |
|---|---|---|---|---|
| 0.0000 | 0.119 | 0.000 | 0.000 | 0.000 |
| 0.0889 | 0.119 | 0.010 | 0.009 | 0.000 |
| 0.1778 | 0.119 | 0.021 | 0.012 | 0.000 |
| 0.2667 | 0.119 | 0.031 | 0.015 | 0.000 |
| 0.3556 | 0.119 | 0.042 | 0.018 | 0.000 |
| 0.4444 | 0.119 | 0.053 | 0.020 | 0.000 |
| 0.5333 | 0.119 | 0.063 | 0.022 | 0.000 |
| 0.6222 | 0.119 | 0.074 | 0.024 | 0.000 |
| 0.7111 | 0.119 | 0.085 | 0.025 | 0.000 |
| 0.8000 | 0.119 | 0.095 | 0.027 | 0.000 |
| 0.8889 | 0.119 | 0.106 | 0.028 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 0.9778 | 0.119 | 0.116 | 0.030 | 0.000 |
| 1.0667 | 0.119 | 0.127 | 0.031 | 0.000 |
| 1.1556 | 0.119 | 0.138 | 0.032 | 0.000 |
| 1.2444 | 0.119 | 0.148 | 0.034 | 0.000 |
| 1.3333 | 0.119 | 0.159 | 0.035 | 0.000 |
| 1.4222 | 0.119 | 0.170 | 0.036 | 0.000 |
| 1.5111 | 0.119 | 0.180 | 0.037 | 0.000 |
| 1.6000 | 0.119 | 0.191 | 0.038 | 0.000 |
| 1.6889 | 0.119 | 0.201 | 0.039 | 0.000 |
| 1.7778 | 0.119 | 0.212 | 0.040 | 0.000 |
| 1.8667 | 0.119 | 0.223 | 0.041 | 0.000 |
| 1.9556 | 0.119 | 0.233 | 0.042 | 0.000 |
| 2.0444 | 0.119 | 0.244 | 0.043 | 0.000 |
| 2.1333 | 0.119 | 0.255 | 0.044 | 0.000 |
| 2.2222 | 0.119 | 0.265 | 0.045 | 0.000 |
| 2.3111 | 0.119 | 0.276 | 0.046 | 0.000 |
| 2.4000 | 0.119 | 0.286 | 0.047 | 0.000 |
| 2.4889 | 0.119 | 0.297 | 0.048 | 0.000 |
| 2.5778 | 0.119 | 0.308 | 0.049 | 0.000 |
| 2.6667 | 0.119 | 0.318 | 0.050 | 0.000 |
| 2.7556 | 0.119 | 0.329 | 0.050 | 0.000 |
| 2.8444 | 0.119 | 0.340 | 0.051 | 0.000 |
| 2.9333 | 0.119 | 0.350 | 0.052 | 0.000 |
| 3.0222 | 0.119 | 0.361 | 0.053 | 0.000 |
| 3.1111 | 0.119 | 0.372 | 0.054 | 0.000 |
| 3.2000 | 0.119 | 0.382 | 0.054 | 0.000 |
| 3.2889 | 0.119 | 0.393 | 0.055 | 0.000 |
| 3.3778 | 0.119 | 0.403 | 0.056 | 0.000 |
| 3.4667 | 0.119 | 0.414 | 0.057 | 0.000 |
| 3.5556 | 0.119 | 0.425 | 0.057 | 0.000 |
| 3.6444 | 0.119 | 0.435 | 0.058 | 0.000 |
| 3.7333 | 0.119 | 0.446 | 0.059 | 0.000 |
| 3.8222 | 0.119 | 0.457 | 0.059 | 0.000 |
| 3.9111 | 0.119 | 0.467 | 0.060 | 0.000 |
| 4.0000 | 0.119 | 0.478 | 0.061 | 0.000 |
| 4.0889 | 0.119 | 0.488 | 0.080 | 0.000 |
| 4.1778 | 0.119 | 0.499 | 0.088 | 0.000 |
| 4.2667 | 0.119 | 0.510 | 0.094 | 0.000 |
| 4.3556 | 0.119 | 0.520 | 0.100 | 0.000 |
| 4.4444 | 0.119 | 0.531 | 0.105 | 0.000 |
| 4.5333 | 0.119 | 0.542 | 0.109 | 0.000 |
| 4.6222 | 0.119 | 0.552 | 0.114 | 0.000 |
| 4.7111 | 0.119 | 0.563 | 0.118 | 0.000 |
| 4.8000 | 0.119 | 0.573 | 0.121 | 0.000 |
| 4.8889 | 0.119 | 0.584 | 0.137 | 0.000 |
| 4.9778 | 0.119 | 0.595 | 0.146 | 0.000 |
| 5.0667 | 0.119 | 0.605 | 0.153 | 0.000 |
| 5.1556 | 0.119 | 0.616 | 0.160 | 0.000 |
| 5.2444 | 0.119 | 0.627 | 0.166 | 0.000 |
| 5.3333 | 0.119 | 0.637 | 0.172 | 0.000 |
| 5.4222 | 0.119 | 0.648 | 0.177 | 0.000 |
| 5.5111 | 0.119 | 0.658 | 0.182 | 0.000 |
| 5.6000 | 0.119 | 0.669 | 0.187 | 0.000 |
| 5.6889 | 0.119 | 0.680 | 0.192 | 0.000 |
| 5.7778 | 0.119 | 0.690 | 0.197 | 0.000 |
| 5.8667 | 0.119 | 0.701 | 0.201 | 0.000 |
| 5.9556 | 0.119 | 0.712 | 0.205 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 6.0444 | 0.119 | 0.722 | 0.209 | 0.000 |
| 6.1333 | 0.119 | 0.733 | 0.214 | 0.000 |
| 6.2222 | 0.119 | 0.743 | 0.218 | 0.000 |
| 6.3111 | 0.119 | 0.754 | 0.221 | 0.000 |
| 6.4000 | 0.119 | 0.765 | 0.225 | 0.000 |
| 6.4889 | 0.119 | 0.775 | 0.229 | 0.000 |
| 6.5778 | 0.119 | 0.786 | 0.233 | 0.000 |
| 6.6667 | 0.119 | 0.797 | 0.236 | 0.000 |
| 6.7556 | 0.119 | 0.807 | 0.240 | 0.000 |
| 6.8444 | 0.119 | 0.818 | 0.243 | 0.000 |
| 6.9333 | 0.119 | 0.828 | 0.247 | 0.000 |
| 7.0222 | 0.119 | 0.839 | 0.303 | 0.000 |
| 7.1111 | 0.119 | 0.850 | 0.841 | 0.000 |
| 7.2000 | 0.119 | 0.860 | 1.661 | 0.000 |
| 7.2889 | 0.119 | 0.871 | 2.635 | 0.000 |
| 7.3778 | 0.119 | 0.882 | 3.649 | 0.000 |
| 7.4667 | 0.119 | 0.892 | 4.592 | 0.000 |
| 7.5556 | 0.119 | 0.903 | 5.367 | 0.000 |
| 7.6444 | 0.119 | 0.914 | 5.922 | 0.000 |
| 7.7333 | 0.119 | 0.924 | 6.289 | 0.000 |
| 7.8222 | 0.119 | 0.935 | 6.704 | 0.000 |
| 7.9111 | 0.119 | 0.945 | 7.046 | 0.000 |
| 8.0000 | 0.119 | 0.956 | 7.371 | 0.000 |
| 8.0889 | 0.119 | 0.967 | 7.682 | 0.000 |
| 8.1778 | 0.000 | 0.000 | 7.981 | 0.000 |

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**ANALYSIS RESULTS**

**Stream Protection Duration**

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**Predeveloped Landuse Totals for POC #1**
**Total Pervious Area:2.657**
**Total Impervious Area:0**

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**Mitigated Landuse Totals for POC #1**
**Total Pervious Area:1.02**
**Total Impervious Area:1.637**

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**Flow Frequency Return Periods for Predeveloped. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.100088 |
| 5 year | 0.157857 |
| 10 year | 0.203351 |
| 25 year | 0.269513 |
| 50 year | 0.325399 |
| 100 year | 0.387193 |

**Flow Frequency Return Periods for Mitigated. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.055347 |

| | |
|---|---|
| **5 year** | 0.07952 |
| **10 year** | 0.099204 |
| **25 year** | 0.128786 |
| **50 year** | 0.154611 |
| **100 year** | 0.184009 |

---

**Stream Protection Duration**
**Annual Peaks for Predeveloped and Mitigated. POC #1**

| Year | Predeveloped | Mitigated |
|---|---|---|
| 1949 | 0.106 | 0.048 |
| 1950 | 0.111 | 0.053 |
| 1951 | 0.092 | 0.046 |
| 1952 | 0.076 | 0.043 |
| 1953 | 0.063 | 0.042 |
| 1954 | 0.366 | 0.053 |
| 1955 | 0.124 | 0.060 |
| 1956 | 0.107 | 0.088 |
| 1957 | 0.141 | 0.061 |
| 1958 | 0.159 | 0.049 |
| 1959 | 0.097 | 0.054 |
| 1960 | 0.091 | 0.055 |
| 1961 | 0.226 | 0.057 |
| 1962 | 0.094 | 0.048 |
| 1963 | 0.156 | 0.045 |
| 1964 | 0.117 | 0.042 |
| 1965 | 0.080 | 0.054 |
| 1966 | 0.049 | 0.045 |
| 1967 | 0.098 | 0.047 |
| 1968 | 0.120 | 0.059 |
| 1969 | 0.337 | 0.048 |
| 1970 | 0.067 | 0.046 |
| 1971 | 0.118 | 0.080 |
| 1972 | 0.079 | 0.051 |
| 1973 | 0.075 | 0.051 |
| 1974 | 0.190 | 0.051 |
| 1975 | 0.075 | 0.044 |
| 1976 | 0.076 | 0.051 |
| 1977 | 0.058 | 0.045 |
| 1978 | 0.070 | 0.043 |
| 1979 | 0.211 | 0.051 |
| 1980 | 0.099 | 0.042 |
| 1981 | 0.069 | 0.046 |
| 1982 | 0.091 | 0.060 |
| 1983 | 0.173 | 0.046 |
| 1984 | 0.091 | 0.100 |
| 1985 | 0.118 | 0.060 |
| 1986 | 0.269 | 0.199 |
| 1987 | 0.123 | 0.142 |
| 1988 | 0.065 | 0.058 |
| 1989 | 0.076 | 0.039 |
| 1990 | 0.086 | 0.059 |
| 1991 | 0.089 | 0.055 |
| 1992 | 0.067 | 0.056 |
| 1993 | 0.063 | 0.042 |
| 1994 | 0.062 | 0.053 |
| 1995 | 0.091 | 0.089 |

| | | |
|---|---|---|
| 1996 | 0.169 | 0.071 |
| 1997 | 0.328 | 0.274 |
| 1998 | 0.058 | 0.044 |
| 1999 | 0.074 | 0.055 |
| 2000 | 0.060 | 0.090 |
| 2001 | 0.023 | 0.037 |
| 2002 | 0.084 | 0.056 |
| 2003 | 0.066 | 0.052 |
| 2004 | 0.111 | 0.098 |
| 2005 | 0.078 | 0.053 |
| 2006 | 0.239 | 0.061 |
| 2007 | 0.183 | 0.054 |
| 2008 | 0.232 | 0.203 |
| 2009 | 0.069 | 0.051 |

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**Stream Protection Duration**
**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| Rank | Predeveloped | Mitigated |
|---|---|---|
| 1 | 0.3659 | 0.2741 |
| 2 | 0.3373 | 0.2031 |
| 3 | 0.3275 | 0.1988 |
| 4 | 0.2691 | 0.1423 |
| 5 | 0.2386 | 0.1004 |
| 6 | 0.2321 | 0.0976 |
| 7 | 0.2260 | 0.0905 |
| 8 | 0.2114 | 0.0888 |
| 9 | 0.1896 | 0.0878 |
| 10 | 0.1830 | 0.0796 |
| 11 | 0.1729 | 0.0708 |
| 12 | 0.1686 | 0.0609 |
| 13 | 0.1591 | 0.0607 |
| 14 | 0.1562 | 0.0603 |
| 15 | 0.1414 | 0.0602 |
| 16 | 0.1236 | 0.0598 |
| 17 | 0.1235 | 0.0589 |
| 18 | 0.1201 | 0.0588 |
| 19 | 0.1181 | 0.0578 |
| 20 | 0.1180 | 0.0572 |
| 21 | 0.1168 | 0.0558 |
| 22 | 0.1109 | 0.0555 |
| 23 | 0.1107 | 0.0552 |
| 24 | 0.1073 | 0.0550 |
| 25 | 0.1058 | 0.0549 |
| 26 | 0.0991 | 0.0542 |
| 27 | 0.0985 | 0.0542 |
| 28 | 0.0971 | 0.0541 |
| 29 | 0.0938 | 0.0534 |
| 30 | 0.0923 | 0.0532 |
| 31 | 0.0909 | 0.0528 |
| 32 | 0.0908 | 0.0526 |
| 33 | 0.0908 | 0.0519 |
| 34 | 0.0906 | 0.0510 |
| 35 | 0.0893 | 0.0510 |
| 36 | 0.0860 | 0.0509 |
| 37 | 0.0845 | 0.0508 |
| 38 | 0.0803 | 0.0507 |

| | | |
|---|---|---|
| 39 | 0.0795 | 0.0506 |
| 40 | 0.0779 | 0.0488 |
| 41 | 0.0765 | 0.0483 |
| 42 | 0.0763 | 0.0480 |
| 43 | 0.0757 | 0.0480 |
| 44 | 0.0752 | 0.0467 |
| 45 | 0.0748 | 0.0461 |
| 46 | 0.0740 | 0.0461 |
| 47 | 0.0696 | 0.0459 |
| 48 | 0.0693 | 0.0455 |
| 49 | 0.0693 | 0.0452 |
| 50 | 0.0675 | 0.0451 |
| 51 | 0.0674 | 0.0447 |
| 52 | 0.0663 | 0.0436 |
| 53 | 0.0650 | 0.0436 |
| 54 | 0.0635 | 0.0430 |
| 55 | 0.0632 | 0.0426 |
| 56 | 0.0623 | 0.0425 |
| 57 | 0.0596 | 0.0422 |
| 58 | 0.0582 | 0.0422 |
| 59 | 0.0579 | 0.0415 |
| 60 | 0.0488 | 0.0387 |
| 61 | 0.0229 | 0.0367 |

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**Stream Protection Duration**
**POC #1**
**The Facility PASSED**

**The Facility PASSED.**

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0500 | 15297 | 14281 | 93 | Pass |
| 0.0528 | 12957 | 9383 | 72 | Pass |
| 0.0556 | 10919 | 5833 | 53 | Pass |
| 0.0584 | 9176 | 3390 | 36 | Pass |
| 0.0612 | 7738 | 1431 | 18 | Pass |
| 0.0640 | 6521 | 1325 | 20 | Pass |
| 0.0667 | 5491 | 1279 | 23 | Pass |
| 0.0695 | 4712 | 1220 | 25 | Pass |
| 0.0723 | 4060 | 1184 | 29 | Pass |
| 0.0751 | 3422 | 1152 | 33 | Pass |
| 0.0779 | 2928 | 1110 | 37 | Pass |
| 0.0806 | 2541 | 1070 | 42 | Pass |
| 0.0834 | 2235 | 1015 | 45 | Pass |
| 0.0862 | 1934 | 939 | 48 | Pass |
| 0.0890 | 1677 | 866 | 51 | Pass |
| 0.0918 | 1490 | 821 | 55 | Pass |
| 0.0945 | 1336 | 788 | 58 | Pass |
| 0.0973 | 1197 | 741 | 61 | Pass |
| 0.1001 | 1064 | 698 | 65 | Pass |
| 0.1029 | 985 | 671 | 68 | Pass |
| 0.1057 | 918 | 646 | 70 | Pass |
| 0.1085 | 853 | 622 | 72 | Pass |
| 0.1112 | 786 | 596 | 75 | Pass |
| 0.1140 | 744 | 568 | 76 | Pass |
| 0.1168 | 689 | 542 | 78 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.1196 | 642 | 504 | 78 | Pass |
| 0.1224 | 610 | 465 | 76 | Pass |
| 0.1251 | 586 | 453 | 77 | Pass |
| 0.1279 | 565 | 445 | 78 | Pass |
| 0.1307 | 545 | 438 | 80 | Pass |
| 0.1335 | 522 | 432 | 82 | Pass |
| 0.1363 | 490 | 420 | 85 | Pass |
| 0.1390 | 470 | 404 | 85 | Pass |
| 0.1418 | 446 | 388 | 86 | Pass |
| 0.1446 | 425 | 378 | 88 | Pass |
| 0.1474 | 402 | 370 | 92 | Pass |
| 0.1502 | 383 | 362 | 94 | Pass |
| 0.1530 | 363 | 353 | 97 | Pass |
| 0.1557 | 351 | 343 | 97 | Pass |
| 0.1585 | 336 | 334 | 99 | Pass |
| 0.1613 | 327 | 324 | 99 | Pass |
| 0.1641 | 319 | 316 | 99 | Pass |
| 0.1669 | 310 | 306 | 98 | Pass |
| 0.1696 | 301 | 295 | 98 | Pass |
| 0.1724 | 292 | 282 | 96 | Pass |
| 0.1752 | 278 | 270 | 97 | Pass |
| 0.1780 | 269 | 260 | 96 | Pass |
| 0.1808 | 257 | 245 | 95 | Pass |
| 0.1835 | 245 | 228 | 93 | Pass |
| 0.1863 | 232 | 211 | 90 | Pass |
| 0.1891 | 221 | 197 | 89 | Pass |
| 0.1919 | 212 | 185 | 87 | Pass |
| 0.1947 | 199 | 163 | 81 | Pass |
| 0.1975 | 186 | 149 | 80 | Pass |
| 0.2002 | 177 | 130 | 73 | Pass |
| 0.2030 | 167 | 116 | 69 | Pass |
| 0.2058 | 158 | 111 | 70 | Pass |
| 0.2086 | 151 | 107 | 70 | Pass |
| 0.2114 | 144 | 103 | 71 | Pass |
| 0.2141 | 134 | 89 | 66 | Pass |
| 0.2169 | 126 | 73 | 57 | Pass |
| 0.2197 | 117 | 68 | 58 | Pass |
| 0.2225 | 100 | 63 | 63 | Pass |
| 0.2253 | 85 | 58 | 68 | Pass |
| 0.2281 | 74 | 54 | 72 | Pass |
| 0.2308 | 60 | 50 | 83 | Pass |
| 0.2336 | 51 | 45 | 88 | Pass |
| 0.2364 | 48 | 39 | 81 | Pass |
| 0.2392 | 39 | 28 | 71 | Pass |
| 0.2420 | 37 | 24 | 64 | Pass |
| 0.2447 | 35 | 19 | 54 | Pass |
| 0.2475 | 30 | 7 | 23 | Pass |
| 0.2503 | 27 | 7 | 25 | Pass |
| 0.2531 | 20 | 6 | 30 | Pass |
| 0.2559 | 16 | 5 | 31 | Pass |
| 0.2586 | 15 | 5 | 33 | Pass |
| 0.2614 | 10 | 5 | 50 | Pass |
| 0.2642 | 7 | 4 | 57 | Pass |
| 0.2670 | 6 | 4 | 66 | Pass |
| 0.2698 | 4 | 3 | 75 | Pass |
| 0.2726 | 4 | 2 | 50 | Pass |
| 0.2753 | 4 | 0 | 0 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.2781 | 4 | 0 | 0 | Pass |
| 0.2809 | 4 | 0 | 0 | Pass |
| 0.2837 | 4 | 0 | 0 | Pass |
| 0.2865 | 4 | 0 | 0 | Pass |
| 0.2892 | 3 | 0 | 0 | Pass |
| 0.2920 | 3 | 0 | 0 | Pass |
| 0.2948 | 3 | 0 | 0 | Pass |
| 0.2976 | 3 | 0 | 0 | Pass |
| 0.3004 | 3 | 0 | 0 | Pass |
| 0.3031 | 3 | 0 | 0 | Pass |
| 0.3059 | 3 | 0 | 0 | Pass |
| 0.3087 | 3 | 0 | 0 | Pass |
| 0.3115 | 3 | 0 | 0 | Pass |
| 0.3143 | 3 | 0 | 0 | Pass |
| 0.3171 | 3 | 0 | 0 | Pass |
| 0.3198 | 3 | 0 | 0 | Pass |
| 0.3226 | 3 | 0 | 0 | Pass |
| 0.3254 | 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 Treatment? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft.) | Cumulative Volume Infiltration Credit | Percent Water Quality | Comment |
|---|---|---|---|---|---|---|---|
| Vault 1 POC | N | 359.63 | | | N | | |
| 0.00 | | | | | | | |
| Total Volume Infiltrated | | 359.63 | 0.00 | 0.00 | 0.00 | | |
| 0.00 | 0% | No Treat. Credit | | | | | |

Compliance with LID Standard 8
Duration Analysis Result = Passed

---

## Perlnd and Implnd Changes

No changes have been made.

---

**WWHM2012**
**PROJECT REPORT**

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**Project Name:** West Basin prior to detention
**Site Name:** Kallicott
**Site Address:**
**City** : Marysville
**Report Date:** 2/20/2023
**Gage** : Everett
**Data Start :** 1948/10/01
**Data End :** 2009/09/30
**Precip Scale:** 1.20
**Version Date:** 2017/07/05
**Version :** 4.2.13

---

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

---

**High Flow Threshold for POC 1:** 50 year

---

**PREDEVELOPED LAND USE**

**Name** : Undeveloped West Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Forest, Flat | 1.06 |
| C, Forest, Mod | 1.267 |
| C, Forest, Steep | .33 |
| Pervious Total | 2.657 |

| Impervious Land Use | acre |
|---|---|
| Impervious Total | 0 |
| Basin Total | 2.657 |

---

**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|

---

**MITIGATED LAND USE**

**Name** : Unmitigated Developed West Basin
**Bypass:** No

**GroundWater:** No

| Pervious Land Use | acre |
|---|---|
| C, Pasture, Flat | 1.02 |
| Pervious Total | 1.02 |

| Impervious Land Use | acre |
|---|---|
| ROADS FLAT | 0.296 |
| ROADS MOD | 0.35 |
| ROOF TOPS FLAT | 0.977 |
| DRIVEWAYS FLAT | 0.014 |
| Impervious Total | 1.637 |
| Basin Total | 2.657 |

---

**Element Flows To:**

| Surface | Interflow | Groundwater |
|---|---|---|

---

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**ANALYSIS RESULTS**

**Stream Protection Duration**

---

**Predeveloped Landuse Totals for POC #1**
**Total Pervious Area:2.657**
**Total Impervious Area:0**

---

**Mitigated Landuse Totals for POC #1**
**Total Pervious Area:1.02**
**Total Impervious Area:1.637**

---

**Flow Frequency Return Periods for Predeveloped. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.100088 |
| 5 year | 0.157857 |
| 10 year | 0.203351 |
| 25 year | 0.269513 |
| 50 year | 0.325399 |
| 100 year | 0.387193 |

**Flow Frequency Return Periods for Mitigated. POC #1**

| Return Period | Flow(cfs) |
|---|---|
| 2 year | 0.936775 |
| 5 year | 1.281256 |

| | |
|---|---|
| **10 year** | 1.535277 |
| **25 year** | 1.887009 |
| **50 year** | 2.172214 |
| **100 year** | 2.478014 |

---

**Stream Protection Duration**
**Annual Peaks for Predeveloped and Mitigated. POC #1**

| Year | Predeveloped | Mitigated |
|---|---|---|
| 1949 | 0.106 | 1.041 |
| 1950 | 0.111 | 1.076 |
| 1951 | 0.092 | 1.150 |
| 1952 | 0.076 | 0.875 |
| 1953 | 0.063 | 1.112 |
| 1954 | 0.366 | 1.571 |
| 1955 | 0.124 | 1.127 |
| 1956 | 0.107 | 0.496 |
| 1957 | 0.141 | 0.842 |
| 1958 | 0.159 | 2.181 |
| 1959 | 0.097 | 0.824 |
| 1960 | 0.091 | 0.891 |
| 1961 | 0.226 | 2.964 |
| 1962 | 0.094 | 1.033 |
| 1963 | 0.156 | 1.200 |
| 1964 | 0.117 | 0.634 |
| 1965 | 0.080 | 0.802 |
| 1966 | 0.049 | 0.802 |
| 1967 | 0.098 | 1.720 |
| 1968 | 0.120 | 0.923 |
| 1969 | 0.337 | 2.063 |
| 1970 | 0.067 | 0.737 |
| 1971 | 0.118 | 0.998 |
| 1972 | 0.079 | 1.311 |
| 1973 | 0.075 | 1.058 |
| 1974 | 0.190 | 1.242 |
| 1975 | 0.075 | 1.036 |
| 1976 | 0.076 | 0.728 |
| 1977 | 0.058 | 0.715 |
| 1978 | 0.070 | 0.536 |
| 1979 | 0.211 | 1.200 |
| 1980 | 0.099 | 0.871 |
| 1981 | 0.069 | 0.728 |
| 1982 | 0.091 | 0.751 |
| 1983 | 0.173 | 1.003 |
| 1984 | 0.091 | 0.889 |
| 1985 | 0.118 | 1.198 |
| 1986 | 0.269 | 1.292 |
| 1987 | 0.123 | 1.080 |
| 1988 | 0.065 | 0.904 |
| 1989 | 0.076 | 0.881 |
| 1990 | 0.086 | 0.718 |
| 1991 | 0.089 | 0.896 |
| 1992 | 0.067 | 0.888 |
| 1993 | 0.063 | 0.683 |
| 1994 | 0.062 | 0.779 |
| 1995 | 0.091 | 0.635 |
| 1996 | 0.169 | 1.089 |

| | | |
|---|---|---|
| 1997 | 0.328 | 1.123 |
| 1998 | 0.058 | 1.191 |
| 1999 | 0.074 | 0.525 |
| 2000 | 0.060 | 1.941 |
| 2001 | 0.023 | 0.613 |
| 2002 | 0.084 | 0.594 |
| 2003 | 0.066 | 0.848 |
| 2004 | 0.111 | 1.609 |
| 2005 | 0.078 | 0.731 |
| 2006 | 0.239 | 1.046 |
| 2007 | 0.183 | 0.996 |
| 2008 | 0.232 | 0.768 |
| 2009 | 0.069 | 0.732 |

---

**Stream Protection Duration**
**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| Rank | Predeveloped | Mitigated |
|---|---|---|
| 1 | 0.3659 | 2.9642 |
| 2 | 0.3373 | 2.1806 |
| 3 | 0.3275 | 2.0632 |
| 4 | 0.2691 | 1.9415 |
| 5 | 0.2386 | 1.7202 |
| 6 | 0.2321 | 1.6089 |
| 7 | 0.2260 | 1.5712 |
| 8 | 0.2114 | 1.3107 |
| 9 | 0.1896 | 1.2916 |
| 10 | 0.1830 | 1.2421 |
| 11 | 0.1729 | 1.2001 |
| 12 | 0.1686 | 1.1997 |
| 13 | 0.1591 | 1.1981 |
| 14 | 0.1562 | 1.1911 |
| 15 | 0.1414 | 1.1500 |
| 16 | 0.1236 | 1.1266 |
| 17 | 0.1235 | 1.1229 |
| 18 | 0.1201 | 1.1122 |
| 19 | 0.1181 | 1.0889 |
| 20 | 0.1180 | 1.0798 |
| 21 | 0.1168 | 1.0760 |
| 22 | 0.1109 | 1.0576 |
| 23 | 0.1107 | 1.0456 |
| 24 | 0.1073 | 1.0411 |
| 25 | 0.1058 | 1.0365 |
| 26 | 0.0991 | 1.0332 |
| 27 | 0.0985 | 1.0027 |
| 28 | 0.0971 | 0.9984 |
| 29 | 0.0938 | 0.9962 |
| 30 | 0.0923 | 0.9228 |
| 31 | 0.0909 | 0.9039 |
| 32 | 0.0908 | 0.8959 |
| 33 | 0.0908 | 0.8914 |
| 34 | 0.0906 | 0.8892 |
| 35 | 0.0893 | 0.8877 |
| 36 | 0.0860 | 0.8810 |
| 37 | 0.0845 | 0.8750 |
| 38 | 0.0803 | 0.8712 |
| 39 | 0.0795 | 0.8484 |

| | | |
|---|---|---|
| 40 | 0.0779 | 0.8424 |
| 41 | 0.0765 | 0.8243 |
| 42 | 0.0763 | 0.8023 |
| 43 | 0.0757 | 0.8018 |
| 44 | 0.0752 | 0.7791 |
| 45 | 0.0748 | 0.7682 |
| 46 | 0.0740 | 0.7511 |
| 47 | 0.0696 | 0.7366 |
| 48 | 0.0693 | 0.7323 |
| 49 | 0.0693 | 0.7307 |
| 50 | 0.0675 | 0.7284 |
| 51 | 0.0674 | 0.7276 |
| 52 | 0.0663 | 0.7177 |
| 53 | 0.0650 | 0.7150 |
| 54 | 0.0635 | 0.6831 |
| 55 | 0.0632 | 0.6353 |
| 56 | 0.0623 | 0.6340 |
| 57 | 0.0596 | 0.6126 |
| 58 | 0.0582 | 0.5939 |
| 59 | 0.0579 | 0.5359 |
| 60 | 0.0488 | 0.5249 |
| 61 | 0.0229 | 0.4962 |

---

**Stream Protection Duration**
**POC #1**
**The Facility FAILED**

**Facility FAILED duration standard for 1+ flows.**

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0500 | 15297 | 98517 | 644 | Fail |
| 0.0528 | 12957 | 93747 | 723 | Fail |
| 0.0556 | 10919 | 89341 | 818 | Fail |
| 0.0584 | 9176 | 85256 | 929 | Fail |
| 0.0612 | 7738 | 81598 | 1054 | Fail |
| 0.0640 | 6521 | 78091 | 1197 | Fail |
| 0.0667 | 5491 | 74861 | 1363 | Fail |
| 0.0695 | 4712 | 71888 | 1525 | Fail |
| 0.0723 | 4060 | 68957 | 1698 | Fail |
| 0.0751 | 3422 | 66241 | 1935 | Fail |
| 0.0779 | 2928 | 63674 | 2174 | Fail |
| 0.0806 | 2541 | 61258 | 2410 | Fail |
| 0.0834 | 2235 | 58883 | 2634 | Fail |
| 0.0862 | 1934 | 56595 | 2926 | Fail |
| 0.0890 | 1677 | 54541 | 3252 | Fail |
| 0.0918 | 1490 | 52574 | 3528 | Fail |
| 0.0945 | 1336 | 50627 | 3789 | Fail |
| 0.0973 | 1197 | 48809 | 4077 | Fail |
| 0.1001 | 1064 | 46948 | 4412 | Fail |
| 0.1029 | 985 | 45237 | 4592 | Fail |
| 0.1057 | 918 | 43590 | 4748 | Fail |
| 0.1085 | 853 | 41965 | 4919 | Fail |
| 0.1112 | 786 | 40425 | 5143 | Fail |
| 0.1140 | 744 | 38906 | 5229 | Fail |
| 0.1168 | 689 | 37644 | 5463 | Fail |
| 0.1196 | 642 | 36318 | 5657 | Fail |

| | | | | |
|---|---|---|---|---|
| 0.1224 | 610 | 34971 | 5732 | Fail |
| 0.1251 | 586 | 33752 | 5759 | Fail |
| 0.1279 | 565 | 32575 | 5765 | Fail |
| 0.1307 | 545 | 31442 | 5769 | Fail |
| 0.1335 | 522 | 30351 | 5814 | Fail |
| 0.1363 | 490 | 29260 | 5971 | Fail |
| 0.1390 | 470 | 28297 | 6020 | Fail |
| 0.1418 | 446 | 27313 | 6123 | Fail |
| 0.1446 | 425 | 26330 | 6195 | Fail |
| 0.1474 | 402 | 25410 | 6320 | Fail |
| 0.1502 | 383 | 24512 | 6400 | Fail |
| 0.1530 | 363 | 23677 | 6522 | Fail |
| 0.1557 | 351 | 22843 | 6507 | Fail |
| 0.1585 | 336 | 22030 | 6556 | Fail |
| 0.1613 | 327 | 21271 | 6504 | Fail |
| 0.1641 | 319 | 20548 | 6441 | Fail |
| 0.1669 | 310 | 19851 | 6403 | Fail |
| 0.1696 | 301 | 19175 | 6370 | Fail |
| 0.1724 | 292 | 18561 | 6356 | Fail |
| 0.1752 | 278 | 17915 | 6444 | Fail |
| 0.1780 | 269 | 17314 | 6436 | Fail |
| 0.1808 | 257 | 16756 | 6519 | Fail |
| 0.1835 | 245 | 16202 | 6613 | Fail |
| 0.1863 | 232 | 15712 | 6772 | Fail |
| 0.1891 | 221 | 15180 | 6868 | Fail |
| 0.1919 | 212 | 14703 | 6935 | Fail |
| 0.1947 | 199 | 14183 | 7127 | Fail |
| 0.1975 | 186 | 13706 | 7368 | Fail |
| 0.2002 | 177 | 13280 | 7502 | Fail |
| 0.2030 | 167 | 12825 | 7679 | Fail |
| 0.2058 | 158 | 12384 | 7837 | Fail |
| 0.2086 | 151 | 11993 | 7942 | Fail |
| 0.2114 | 144 | 11599 | 8054 | Fail |
| 0.2141 | 134 | 11208 | 8364 | Fail |
| 0.2169 | 126 | 10827 | 8592 | Fail |
| 0.2197 | 117 | 10485 | 8961 | Fail |
| 0.2225 | 100 | 10147 | 10147 | Fail |
| 0.2253 | 85 | 9815 | 11547 | Fail |
| 0.2281 | 74 | 9497 | 12833 | Fail |
| 0.2308 | 60 | 9221 | 15368 | Fail |
| 0.2336 | 51 | 8930 | 17509 | Fail |
| 0.2364 | 48 | 8639 | 17997 | Fail |
| 0.2392 | 39 | 8365 | 21448 | Fail |
| 0.2420 | 37 | 8096 | 21881 | Fail |
| 0.2447 | 35 | 7860 | 22457 | Fail |
| 0.2475 | 30 | 7608 | 25360 | Fail |
| 0.2503 | 27 | 7356 | 27244 | Fail |
| 0.2531 | 20 | 7131 | 35655 | Fail |
| 0.2559 | 16 | 6930 | 43312 | Fail |
| 0.2586 | 15 | 6708 | 44720 | Fail |
| 0.2614 | 10 | 6483 | 64830 | Fail |
| 0.2642 | 7 | 6282 | 89742 | Fail |
| 0.2670 | 6 | 6087 | 101450 | Fail |
| 0.2698 | 4 | 5910 | 147750 | Fail |
| 0.2726 | 4 | 5734 | 143350 | Fail |
| 0.2753 | 4 | 5544 | 138600 | Fail |
| 0.2781 | 4 | 5345 | 133625 | Fail |

| | | | | |
|---|---|---|---|---|
| 0.2809 | 4 | 5202 | 130050 | Fail |
| 0.2837 | 4 | 5058 | 126450 | Fail |
| 0.2865 | 4 | 4902 | 122550 | Fail |
| 0.2892 | 3 | 4750 | 158333 | Fail |
| 0.2920 | 3 | 4616 | 153866 | Fail |
| 0.2948 | 3 | 4494 | 149800 | Fail |
| 0.2976 | 3 | 4391 | 146366 | Fail |
| 0.3004 | 3 | 4282 | 142733 | Fail |
| 0.3031 | 3 | 4158 | 138600 | Fail |
| 0.3059 | 3 | 4038 | 134600 | Fail |
| 0.3087 | 3 | 3942 | 131400 | Fail |
| 0.3115 | 3 | 3841 | 128033 | Fail |
| 0.3143 | 3 | 3734 | 124466 | Fail |
| 0.3171 | 3 | 3649 | 121633 | Fail |
| 0.3198 | 3 | 3548 | 118266 | Fail |
| 0.3226 | 3 | 3450 | 115000 | Fail |
| 0.3254 | 3 | 3367 | 112233 | 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 BMP Flow and Volume for POC #1**
**On-line facility volume:** 0.2205 **acre-feet**
**On-line facility target flow:** 0.3089 **cfs.**
**Adjusted for 15 min:** 0.3089 **cfs.**
**Off-line facility target flow:** 0.1746 **cfs.**
**Adjusted for 15 min:** 0.1746 **cfs.**

---

**LID Report**

| LID Technique | Used for Water Quality? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft.) | Cumulative Volume Infiltration Credit | Percent Volume Infiltrated | Percent Treated | Comment |
|---|---|---|---|---|---|---|---|---|
| Total Volume Infiltrated | | 0.00 | 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 ANALYSIS AND DESIGN

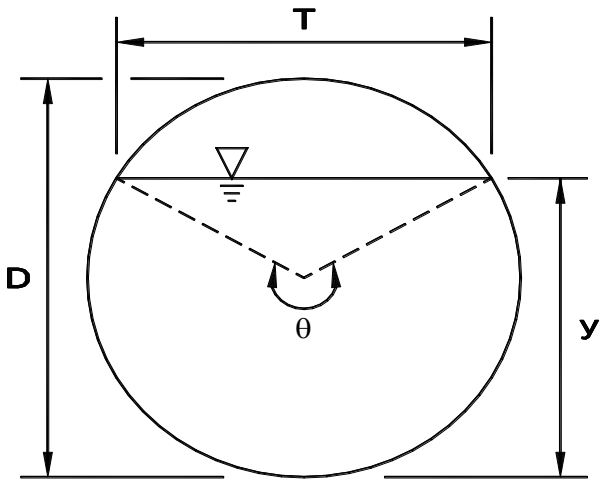
The proposed collection and conveyance systems are comprised of catch basins, storm drainage pipes, detention facilities, and BayFilter water quality catch basin structures. Catch basins are located such that each section of storm drainage pipe will adequately convey associated tributary area flows. Conveyance analysis has been performed for the proposed pipe network. The pipe was analyzed against the peak 100-year mitigated flow for the West Basin, as this is the most critical event. The following page shows the conveyance analysis calculations and results.

| Open Channel Flow Calculator<br>For Circular Pipes | Land Development Consultants, Inc. | |
|---|---|---|
| | 14201 NE 200th St. Ste. 100<br>Woodinville, WA 98072 | Tel: (425) 806-1869<br>Fax: (425) 482-2893 |

Project Name: Kallicott
Description: West basin developed 100 yr flow

Project No.: 21-202
Date: 2/21/2023
Calc. By: NJM

| | | |
|---|---|---|
| Pipe Diameter (D) = | 12 | in |
| Pipe Slope (S) = | 0.50 | % |
| Flow Depth (y) = | 0.91 | ft |
| **Flowrate (Q) =** | **2.93** | **cfs** |
| Mannings Coeff. (n) = | 0.012 | |
| Theta Angle (θ) = | 5.06 | rad |
| Wetted Area (A) = | 0.75 | $ft^2$ |
| Wet. Perimeter (P) = | 2.53 | ft |
| Hydraulic Radius (R) = | 0.30 | ft |
| Top Width (T) = | 0.57 | ft |
| Flow Velocity = | 3.90 | fps |




**Formulas:**

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

Top Width (T): $T = \sin\left(\theta/2\right)d$

## SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, detention facilities, and water quality treatment using BayFilter catch basin structures. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages. This information was taken from the 2019 SWMMWW. Maintenance information specific to the proprietary media filter drains is provided.

## Table V-4.5.2(3) Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| Storage Area | Plugged Air Vents | One-half of the cross section of a vent is blocked at any point or the vent is damaged. | Vents open and functioning. |
| | Debris and Sediment | Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter.<br>(Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.) | All sediment and debris removed from storage area. |
| | Joints Between Tank/Pipe Section | Any openings or voids allowing material to be transported into facility.<br>(Will require engineering analysis to determine structural stability). | All joint between tank/pipe sections are sealed. |
| | Tank Pipe Bent Out of Shape | Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability). | Tank/pipe repaired or replaced to design. |
| | Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab | Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.<br>Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls. | Vault replaced or repaired to design specifications and is structurally sound.<br>No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe. |
| Manhole | Cover Not in Place | Cover is missing or only partially in place. Any open manhole requires maintenance. | Manhole is closed. |

## Table V-4.5.2(3) Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| | 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 (may not apply to self-locking lids). | Mechanism opens with proper tools. |
| | 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 and reinstalled by one maintenance person. |
| | Ladder Rungs Unsafe | Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks. | Ladder meets design standards. Allows maintenance person safe access. |
| Catch Basins | See "Catch Basins" (No. 5) | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). |

## Table V-4.5.2(4) Maintenance Standards - Control Structure/Flow Restrictor

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| General | Trash and Debris (Includes Sediment) | Material exceeds 25% of sump depth or 1 foot below orifice plate. | Control structure orifice is not blocked. All trash and debris removed. |
| | Structural Damage | Structure is not securely attached to manhole wall.<br>Structure is not in upright position (allow up to 10% from plumb).<br>Connections to outlet pipe | Structure securely attached to wall and outlet pipe.<br>Structure in correct position.<br>Connections to outlet pipe are water tight; structure repaired or replaced and works as |

## Table V-4.5.2(4) Maintenance Standards - Control Structure/Flow Restrictor (continued)

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| | | are not watertight and show signs of rust.<br>Any holes - other than designed holes - in the structure. | designed.<br>Structure has no holes other than designed holes. |
| Cleanout Gate | Damaged or Missing | Cleanout gate is not watertight or is missing.<br>Gate cannot be moved up and down by one maintenance person.<br>Chain/rod leading to gate is missing or damaged.<br>Gate is rusted over 50% of its surface area. | Gate is watertight and works as designed.<br>Gate moves up and down easily and is watertight.<br>Chain is in place and works as designed.<br>Gate is repaired or replaced to meet design standards. |
| Orifice Plate | Damaged or Missing | Control device is not working properly due to missing, out of place, or bent orifice plate. | Plate is in place and works as designed. |
| | Obstructions | Any trash, debris, sediment, or vegetation blocking the plate. | Plate is free of all obstructions and works as designed. |
| Overflow Pipe | Obstructions | Any trash or debris blocking (or having the potential of blocking) the overflow pipe. | Pipe is free of all obstructions and works as designed. |
| Manhole | See "Closed Detention Systems" (No. 3). | See "Closed Detention Systems" (No. 3). | See "Closed Detention Systems" (No. 3). |
| Catch Basin | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). | See "Catch Basins" (No. 5). |

## Table V-4.5.2(5) Maintenance Standards - Catch Basins

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| General | Trash & 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%.<br>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.<br>Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.<br>Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane). | No Trash or debris located immediately in front of catch basin or on grate opening.<br>No trash or debris in the catch basin.<br>Inlet and outlet pipes free of trash or debris.<br>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.<br>Frame is sit- |

## Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| | | 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 | ting flush on the riser rings or top slab and firmly attached. |
| | Fractures or Cracks in Basin Walls/ Bottom | Maintenance person judges that structure is unsound.<br>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. | Basin replaced or repaired to design standards.<br>Pipe is regrouted and secure at basin wall. |
| | Settlement/ Misalignment | If failure of basin has created a safety, function, or design problem. | Basin replaced or repaired to design standards. |
| | Vegetation | Vegetation growing across and blocking more than 10% of the basin opening.<br>Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart. | No vegetation blocking opening to basin.<br>No vegetation or root growth present. |
| | Contamination and Pollution | See "Detention Ponds" (No. 1). | No pollution 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 | Mechanism cannot be opened by one maintenance person with proper tools. Bolts into | Mechanism opens with |

## Table V-4.5.2(5) Maintenance Standards - Catch Basins (continued)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is performed |
|---|---|---|---|
| | Working | frame have less than 1/2 inch of thread. | proper tools. |
| | Cover Difficult to Remove | One maintenance person cannot remove lid after applying normal lifting pressure.<br>(Intent is keep cover from sealing off access to maintenance.) | Cover can be removed by one maintenance person. |
| Ladder | Ladder Rungs Unsafe | Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges. | Ladder meets design standards and allows maintenance person safe access. |
| 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. |

### Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| Below Ground Vault | Sediment Accu- | Sediment depth exceeds 0.25-inches. | No sediment depos- |

## Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters (continued)

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| | mulation on Media. | | its which would impede permeability of the compost media. |
| | Sediment Accumulation in Vault | Sediment depth exceeds 6-inches in first chamber. | No sediment deposits in vault bottom of first chamber. |
| | Trash/Debris Accumulation | Trash and debris accumulated on compost filter bed. | Trash and debris removed from the compost filter bed. |
| | Sediment in Drain Pipes/Clean-Outs | When drain pipes, clean-outs, become full with sediment and/or debris. | Sediment and debris removed. |
| | Damaged Pipes | Any part of the pipes that are crushed or damaged due to corrosion and/or settlement. | Pipe repaired and/or replaced. |
| | Access Cover Damaged/Not Working | Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover. | Cover repaired to proper working specifications or replaced. |
| | Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab | 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.<br>Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks. | Vault replaced or repairs made so that vault meets design specifications and is structurally sound.<br>Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe. |
| | Baffles | Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person. | Baffles repaired or replaced to specifications. |

## Table V-4.5.2(15) Maintenance Standards - Manufactured Media Filters (continued)

| Maintenance Component | Defect | Condition When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| | Access Ladder Damaged | Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and mis-aligned. | Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel. |
| Below Ground Cartridge Type | Media | Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently. | Media cartridges replaced. |
| | Short Circuiting | Flows do not properly enter filter cartridges. | Filter cartridges replaced. |

## Table V-4.5.2(19) Maintenance Standards - Media Filter Drain (MFD) (continued)

| Maintenance Component | Defect | Conditions When Maintenance is Needed | Results Expected When Maintenance is Performed |
|---|---|---|---|
| | | embankment. | brushy vegetation on adjacent slopes. |
| | Trash and debris | Trash and debris have accumulated on embankment. | Remove trash and debris from embankment. |
| | Flooding of Media filter drain | When media filter drain is inundated by flood water | Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards. |

## BAYFILTER OPERATION

Stormwater runoff enters the manhole or concrete structure via an inlet pipe and begins to fill the structure. When the water surface elevation in the vault/manhole reaches the minimum operating level, water flows through the BayFilter driven by a hydrostatic head. Within the BayFilter, the water flows through a proprietary filter media and drains via a vertical pipe. The vertical pipe is connected to the under drain system, which conveys filtered water to the outfall.

During a typical storm event, the BayFilter system has four cycles:

**A.** BayFilter cartridge fills and releases air

**B.** Positive head filtration

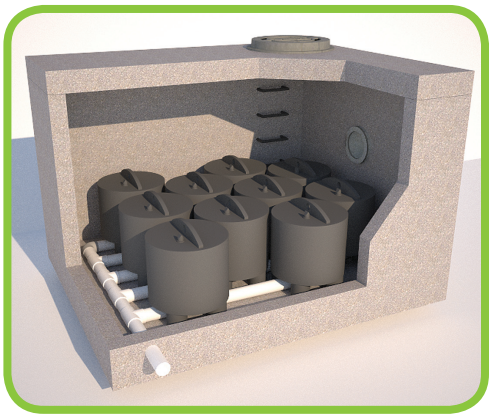
**C.** Siphon (negative head) filtration

**D.** Siphon break and hydrodynamic backwash

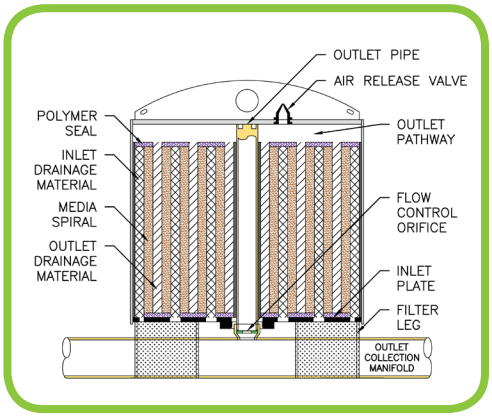
The cycle operation of a BayFilter is as follows:

**A.** BayFilter cartridge fill and air release: The BayFilter vault and BayFilter cartridges fill when stormwater flow enters the system. As the vault fills, water enters the BayFilter cartridge through the inlet plate on the bottom. Air is purged from the media spiral and filter housing during this process.

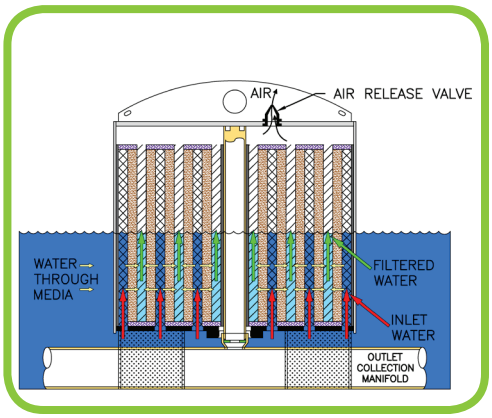
The air release is critical for the proper functioning of the siphon. The siphon draws flow through the BayFilter during periods of low water in the vault.



**BayFilter Vault**




**BayFilter Cutaway**



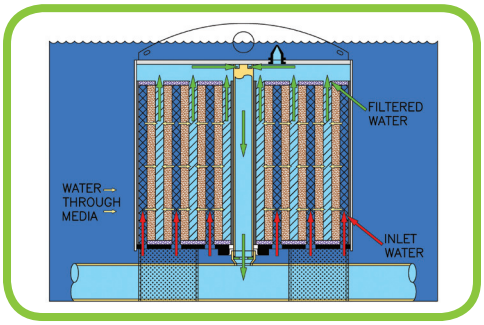

**Cartridge Filling**

**B.** Positive Head Filtration: Water enters the Filter from the bottom of the filter housing and travels upward through the inlet-flow conduit-spiral. From the inlet spiral, untreated water flows horizontally through the engineered media. Treated water exits the engineered media and flows into the outlet-flow conduit-spiral. Treated water flows vertically to the top of the cartridge where it can exit through the outlet pipe—please see product details (pg.6) for operating head levels. Finally, filtered water leaves the system via the outlet.

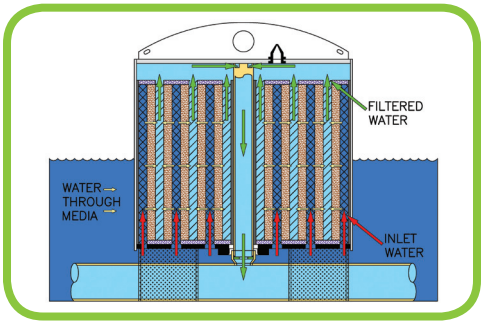
**C.** Siphon (Negative Head) Filtration: After the water level in the vault falls below the top of the filter cartridge-minimum operating head level, a siphon is established and water will continue to flow through the filter media until the siphon is broken. During siphon, the water level in the vault will decrease until it reaches the inlet plate of the BayFilter.

**D.** Siphon Break and Hydrodynamic Backwash: When the water level drops below the inlet plate, air enters the filter and the siphon breaks. Once the siphon breaks, a gravity-driven backwash occurs with all of the water flowing from the outlet pathway backwards through the filter media. This backwash has the effect of dislodging particles captured in the filtration layers and re-establishing porosity. Dislodged particles are transported back in to the filter vault and accumulate on the filter vault floor.

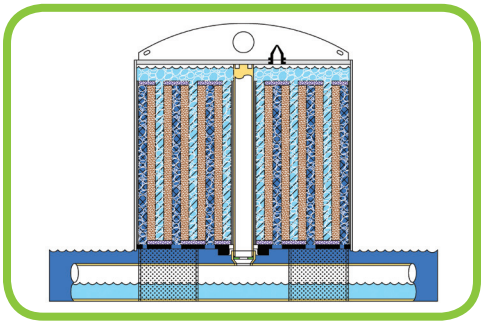
Each BayFilter has a maximum flow rating. At this flow, each cartridge can treat the specified total sediment load before requiring maintenance. BayFilter flow may also be custom regulated to meet specified design parameters by modifying the flow control orifice. Please contact BaySaver for custom design requirements.



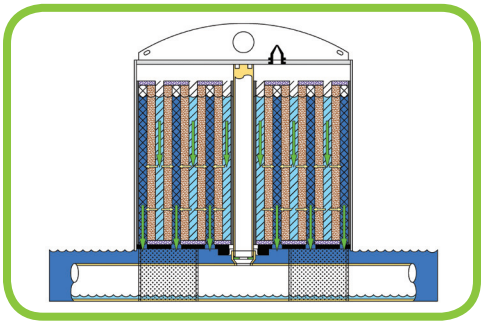

**Positive Filtration**




**Siphon Filtration**



**Siphon Break**



**Backwash**

### Pre-Assembled Manifold

In some areas the vaults can be provided with pre-installed manifold systems. Please contact your local ADS or BaySaver representatives for additional details.

BayFilter System Cleanout

### Inspection and Maintenance

The BayFilter system requires periodic maintenance to continue operating at the design efficiency. The maintenance process is comprised of the removal and replacement of each BayFilter cartridge, vertical drain down module; and the cleaning of the vault or manhole with a vacuum truck.

The maintenance cycle of the BayFilter system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

BayFilter systems in volume-based applications are designed to treat the WQv in 24 to 48 hours initially. Late in the operational cycle of the BayFilter, the flow rate will diminish as a result of occlusion. When the drain down exceeds the regulated standard, maintenance should be performed.

Vactor Truck Maintenance

When a BayFilter system is first installed, it is recommended that it be inspected every six (6) months. When the filter system exhibits flows below design levels the system should be maintained. Filter cartridge replacement should also be considered when sediment levels are at or above the level of the manifold system. Please contact the BaySaver Technologies Engineering Department for maintenance cycle estimations or assistance at **1.800.229.7283.**

### Maintenance Procedures

1. Contact BaySaver Technologies for replacement filter cartridge pricing and availability at 1-800-229-7283.
2. Remove the manhole covers and open all access hatches.
3. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low $O_2$, high CO, or other applicable warning devices per regulatory requirements.
4. Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.
5. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.
6. Any cartridges that cannot be readily lifted can be easily slid along the floor to a location

Jet Vactoring Through Access Hatch

they can be lifted via a boom lift.

7. When all the cartridges have been removed, it is not practical to remove the balance of the solids and water. Loosen the stainless clamps on the Fernco couplings for the manifold and remove the drain pipes as well. Carefully cap the manifold and the Ferncos and rinse the floor, washing away the balance of any remaining collected solids.
8. Clean the manifold pipes, inspect, and reinstall.
9. Install the exchange cartridgess and close all covers.
10. The used cartridges may be sent back to BaySaver Technologies for recycling.

**Manifold Tee View of a Cleaned System**

### BayFilter Availability and Cost

BayFilter systems are available throughout the United States from BaySaver Technologies. Material, installation, and maintenance costs vary with location. For BayFilter pricing in your area, please contact BaySaver Technologies at 1-800-229-7283.

BayFilter cartridges and outlet components can be shipped anywhere in the world. Manholes and precast vaults are also supplied by BaySaver Technologies as part of a complete stormwater filtration system.


**Cartridge Hoist Point**

### BayFilter Specifications

#### Products

**A.** Internal components: all components including concrete structure(s), PVC manifold piping and filter cartridges, shall be provided by BaySaver Technologies **1-800-229-7283**).

**B.** PVC manifold piping: all internal PVC pipe and fittings shall meet ASTM D1785. Manifold piping shall be provided to the contractor pre-cut and/or pre-assembled. Minor field modifications may be necessary.

**C.** Filter cartridges: external shell of the filter cartridges shall be substantially constructed of polyethylene or equivalent material acceptable to the manufacturer. Filtration media shall be arranged in a spiral layered fashion to maximize available filtration area. An orifice flow control (i.e. flow disk) shall be supplied with each cartridge to restrict the flow rate to a maximum of 45 gpm (170 l/min).

**D.** Filter media: filter media shall be a proprietary mix produced by BaySaver Technologies and may consist of the following materials: zeolite, perlite, and activated alumina and/or other materials required to meet the project pollutant removal requirements.

## SECTION 7: SPECIAL REPORTS AND STUDIES

The following studies were conducted in preparation of this Report:

- Geotechnical Investigation, Cobalt Geosciences, Dated December 20, 2021