Tapert Arlington Stillaguamish

Preliminary Drainage Report

Presented to: City of Arlington

Tapert Arlington Stillaguamish

Drainage Report

Prepared for

Corestone Contractors, LLC

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Prepared by

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Approved by

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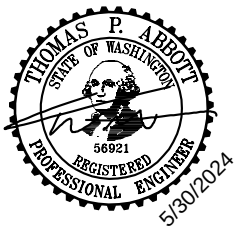

May 2024 ***Job No: 24-0053***

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Appendices

Figures

SECTION 1: PROJECT OVERVIEW

The proposed Tapert Arlington Stillaguamish project is an approximately 0.47-acre site. The proposed project is a unit lot subdivision townhome development on one parcel located on parcel #00756900000600 and addressed at 607 S Stillaguamish Ave, Arlington, WA 98223. The project proposes to construct 7 single-family townhome units as well as a private drive for private access to the lots. Emergency and standard access drives along with associated private and public utilities are proposed to serve project development. See the Vicinity Map in Appendix 1 for visual representation of the subject property.

Existing Site

The parcel #00756900000600 is currently occupied by a single-family residence with associated out buildings. The project parcels are currently zoned RHC (Residential High Capacity) and will remain with this designation. The existing ground cover is a combination of trees, grass, and driveway.

Proposed Development

The proposed single-family development project will construct 7 townhome units. Emergency and standard access drives along with associated private and public utilities are proposed to serve project development.

Proposed Drainage System

This project is designed to comply with the 2019 Department of Ecology Stormwater Manual for Western Washington (2019 DOE SWMMWW). Stormwater will be mitigated via an internal detention vault that is proposed to be located along the western portion of the site underneath Drive A, running parallel to S Stillaguamish Ave.

Prior to discharge, a stormfilter water quality treatment unit will be used to treat stormwater runoff to water quality treatment requirements. Onsite development will disturb 0.47 AC (with an additional 0.13 AC attributed to offsite sewer connection area) that will be collected to the internal detention vault for mitigation and stormwater quality treatment. This area is considered to be within the Onsite Basin for stormwater modeling.

Proposed new pollution generating impervious surfaces (PGIS) will exceed the 5,000 SF threshold and thus basic water quality treatment will be provided via a water quality treatment structure that treats stormwater runoff after discharge from the stormwater detention vault. A stormfilter water quality treatment unit is proposed for this purpose. See Section 4.0 for additional discussion regarding proposed stormwater management and water quality treatment measures.

The proposed detention vault and water quality treatment system will discharge into an existing catch basin along the southwestern portion of the site along S Stillaguamish Ave. The existing drainage system flows generally south through existing catch basins before draining into Portage Creek. Once the flow meets Portage Creek it continues along Portage Creek beyond the quarter mile boundary and eventually drains into the Stillaguamish River.

Erosion/Sedimentation Control

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

Minimum Requirements

Per the 2019 DOE Stormwater Management Manual for Western Washington (SWMMWW), Minimum Requirements 1-9 apply to the proposed development.

Minimum Requirement #1: Preparation of Stormwater Site Plans

This report along with the preliminary plans satisfies the minimum requirement.

Minimum Requirement #2: Construction Stormwater Pollution Prevention

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

Minimum Requirement #3: Source of Pollution

Permanent source control BMPs are not applicable for the subject site since the associated activities for the new residence do not fall within the types of facilities listed within Volume IV of the DOE Manual (Residential developments are not required to

implement source control BMP's). BMPs for erosion and sedimentation control will be specified in the Construction Plans and the CSWPP.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
Flow from the site will preserve its natural drainage pattern from the north toward the south. Runoff flows towards Portage Creek, which then eventually discharges into the Stillaguamish River.

Minimum Requirement #5: On-Site Stormwater Management
The project proposes BMP T5.13 soils to be underlain within all pervious areas that are disturbed by development. Generally, all other infiltration related BMPs are infeasible due to the site soils not being ideal for infiltration. Generally, other dispersion related BMPs are considered infeasible due to the proximity of slopes to the developed impervious coverage of the site and the lack of available dispersion length. Please see Section 4.5 for additional discussion of Onsite Stormwater Management and Low Impact Development BMP feasibility.

Minimum Requirement #6: Runoff Treatment
As the project will exceed the 5,000 SF threshold of new/replaced PGIS, the project is required to provide basic water quality treatment per the DOE Manual. A Stormfilter water quality treatment unit will be installed downstream of the detention vault to meet this requirement.

Minimum Requirement #7: Flow Control
The project will exceed the 10,000 SF new/replaced impervious threshold and is required to provide flow control. A concrete detention vault will be installed on site, accessible via the new private Drive A. This vault will gravity discharge at a historic, mitigated rate into an existing drainage structure to the south of the property. Please see Section 4.0 for additional flow control modeling and parameters for detention sizing.

Minimum Requirement #8: Wetlands Protection
There are no wetlands located on or near the project site.

Minimum Requirement #9: Operation and Maintenance
See Operations and Maintenance in Section 6 of this report.

SECTION 2: TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

SWPPP Design Elements

A Construction Stormwater Pollution Prevention Plan (SWPPP) will be provided prior to construction. The SWPPP report is modeled under the guidelines of the DOE Manual. Construction SWPPP Elements #1 through #13 are addressed below.

Element #1 – Mark Clearing Limits

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

Element #2 – Establish Construction Access

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

Element #3 – Control Flow Rates

Detention of construction period runoff will be provided by means of sediment ponds on the site. See sheets ER-01 of the construction plans for location and details for flow and sediment control BMP's.

Element #4 – Install Sediment Controls

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

Element #5 – Stabilize Soils

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

Element #6 – Protect Slopes

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

Element #7 – Protect Drain Inlets

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

Element #8 – Stabilize Channels and Outlets

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

Element #9 – Control Pollutants

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

Element #10 – Control De-Watering

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

Element #11 – Maintain BMPs

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

Element #12: Manage the Project

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

Element #13: Protect on-site stormwater management BMPs

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

SECTION 3: DOWNSTREAM ANALYSIS

Task 1. Study Area Definition and Maps

Snohomish County Bare Earth LiDAR, survey, and 2022 aerial photography were the best topographical references available for the area containing the site. The limits of the downstream analysis extend roughly 0.25 miles beyond the subject property's natural discharge location.

Task 2. Resource Review

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

Adopted Basin Plans

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

Drainage Basin

This site is in the Portage Creek subbasin, within the Skagit Bay watershed. Discharge from the proposed development will discharge into Portage Creek via existing catch basins and culverts.

Floodplain / Floodway (FEMA) maps

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

Critical Areas Map

There are no noted critical areas on the proposed site.

Drainage Complaints

No relevant issues were identified near the proposed site.

Road Drainage Problems

No issues were identified near the proposed site.

Soil Survey

Site soils are classified as Alderwood gravelly sandy loam (0 to 8 percent slopes) which is classified as Hydrologic Soil Group B, Everett very gravelly sandy loam (0 to 8 percent slopes) which is classified as Hydrologic Soil Group A, Everett very gravelly sandy loam (15 to 30 percent) which is classified as Hydrologic Soil Group A, Norma loam which is classified as Hydrologic Soil Group B/D, Pastik silt loam (8 to 25 percent slopes) which is classified as Hydrologic Soil Group C, and Ragnar fine sandy loam (0 to 8 percent slopes) which is classified as Hydrologic Soil Group A.

Wetland Inventory Maps

No wetlands have been identified in or around the proposed development.

Migrating River Studies

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

Section 303d List of Polluted Waters

Washington State Department of Ecology's Water Quality Assessment for Washington contains no category 5 listings for Portage Creek downstream of the project.

Water Quality Problems

There are no known water quality problems within Portage Creek which the site runoff is discharged into.

Stormwater Compliance Plans

Not applicable to the proposed project.

Task 3. Field Inspection/Downstream Analysis
On May 15th, 2024, a Downstream Analysis was performed at the site. The weather consisted of 69ºF and sunny skies. The following observations were verified during the visit.

The site is currently occupied by a single-family residence with associated out buildings. The existing ground cover is a combination of trees, grass, driveway, as well as a rockery retaining wall along the frontage of the property (Images 1 &2).

One flow path has been identified leaving the site and traveling to the southwest and converging within one quarter mile of the site, to form one threshold discharge area. The Flowpath is formed where runoff from the site enters an existing catch basin along the frontage of the property (Image 3) and travels south for approximately 335ft through existing storm drainage structures (Image 4). Flow then travels across the street through existing catch basins and storm drainage structures (Image 5) and then flows into Portage Creek via an existing 15" drainage pipe (Image 6) and continues to the west via Portage Creek past the quarter mile boundary. Flow eventually reaches the Stillaguamish River. See Figure 3.0, "Downstream Analysis Map" in Appendix 3 for a visual representation of current discharge.

Task 4. Drainage System Description and Problem Descriptions
Based on the information available and all the resources available including visual inspection of the downstream flow path to the ¼-mile boundary, there is no evidence of existing or anticipated downstream drainage problems. All flows are adequately carried through natural channels to the quarter mile buffer of analysis.

Task 5. Mitigation of Existing or Potential Drainage Problems
No evidence of existing or potential problems with downstream drainage conveyance infrastructure was found. Mitigation is not required.

SECTION 4: DETENTION AND WATER QUALITY TREATMENT DESIGN

4.1 Predeveloped Site Hydrology

The pre-developed and developed conditions were modeled in WWHM for the purpose of peak flow determination for direct discharge. Based on the site location, the WWHM used the Everett Gage with a Precipitation Scale factor of 1.200. For visual representation of the listed basins, see Figure 4.0, "Predeveloped Hydrology Map".

Onsite Basin:

The predeveloped condition applied to the Onsite Basin results in a forested land cover condition. The values as modeled in WWHM are as follows:

Table 1: Predeveloped Conditions: Onsite Basin

Onsite Basin	
Ground Cover	Area (acre)
Forest, flat	0.47
Total	**0.47**

4.2 Developed Site Hydrology

In the developed condition, the proposed townhome project will construct 7 single-family townhomes. Emergency and standard access drives along with associated private and public utilities are proposed to serve project development.

Onsite Basin:

The developed Onsite Basin is 0.47 acres and includes the entire developed site within its boundaries. In the developed condition, the Onsite Basin has been modeled using WWHM with the following areas and ground cover designations:

Table 2: Developed Conditions: Onsite Basin

Onsite Basin	
Ground Cover	Area (acre)
Roof, flat	0.11
Driveway, flat	0.04
Sidewalks, flat	0.04
Roads, flat	0.12
Pasture, flat	0.16
Total	**0.47**

4.3 Detention Facility Design

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

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

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

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

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

Detention Vault Facility

The proposed cast in place concrete detention facility detains, and releases collected storm water runoff from the Onsite Basin. The facility is located underneath the proposed private Drive A and will be accessible and maintainable via the same private Drive A. Flows from the Onsite Basin are collected and conveyed to the internal detention vault via a proposed network of catch basins and storm water conveyance pipes. Detailed WWHM output is provided in Appendix 4. A summary of the detailed statistics and inputs used for modeling the system in WWHM2012 can be found below.

Table 3: Detention Vault Design Summary

Detention Vault	
Live Storage Bottom Area (modeled)	*1,280 SF*
Live Storage Bottom Area (provided)	*1,280 SF*
Number of Cells	*1*
Cell Dimensions	*(1 x 20' x 64')*
Begin Live Storage Elevation	164.00
Riser Height	6.00'
Volume (modeled)	7,680 CF
Volume (provided)	7,680 CF
Top of Riser Elevation	171.50
Top Outside of Vault Elevation	173.00

See table below for the flow rates and water surface elevations by storm event for the detention vault.

Table 4: Flow Rates and Water Surface Elevations by Storm Event

Storm Event	Predeveloped Rate (cfs)	Mitigated Rates (cfs)	Water Surface Elevation (ft)
2-Year	0.0157	0.0099	267.56
10-Year	0.0307	0.0179	268.58
50-Year	0.0477	0.0275	269.56
100-Year	0.0562	0.0325	270.41

4.4 Water Quality Treatment

Stormfilter

Water Quality Treatment for the Onsite Basin is accomplished through a Stormfilter structure located downstream of the detention vault. A summary of design criteria is provided below:

Table 5: Stormfilter Design Summary

48" Ø Stormfilter Manhole	
Tributary Area	*0.47 AC*
Tributary PGIS Area	*0.31 AC*
Water Quality Flow Rate (2 yr mitigated peak)	0.0099 cfs
Number of Cartridges	1
Cartridge Height	Low Drop
Internal Drop	1.8'
Peak Flow Rate	0.0325 cfs
Peak Flow Storm Event	100-year

4.5 Onsite Stormwater Management

The project does not the LID performance standard and minimum requirements 1-9 are required for the project but choose to implement List #2 to evaluate low impact design. The following BMP's below are assessed for implementation:

Lawn and Landscaped Areas:

1. *Post-Construction Soil Quality and Depth*
    - BMP T5.13 soils will be applied to all permeable and landscaped areas in developed condition.
        i. **Conclusion: feasible**

Roofs:

1. *Downspout Full Infiltration per BMP T5.10A or Downspout Full Dispersion per BMP T5.30*
    - Infiltration is not feasible on site per the City of Bellevue mapped area, which has been confirmed by testing found in the geotechnical report and thus BMP T5.10A is infeasible. Due to site specific constraints including building and location of drive aisle, there is inadequate flow path to disperse on site per BMP T5.30.
        i. **Conclusion: Infeasible**

2. *Bioretention*
    - Per the recommendation of the geotechnical report, infiltration is not feasible onsite and as such, bioretention facilities are not recommended.
        i. **Conclusion: Infeasible**

3. *Downspout Dispersion per BMP T5.10B.*
    - Due to site specific constraints including building and location of drive aisle, there is inadequate flow path to disperse on site.
        i. **Conclusion: Infeasible**

4. *Perforated Stub-Out Connections per BMP T5.10C.*
    - No stub-out connections will be implemented in the design as soils are not suitable for infiltration as well as the site's proximity to steep slopes.
        i. **Conclusion: Infeasible**

Other Hard Surfaces:

1. *Full Dispersion per BMP T5.30*

- Due to site specific constraints including building and location of drive aisle, there is inadequate flow path to disperse on site.
    - **i. Conclusion: Infeasible**

2. *BMP T5.15 Permeable Pavement*
    - Per the recommendation of the geotechnical report, infiltration is not feasible onsite and as such, pervious pavement facilities are not recommended.
        - **i. Conclusion: Infeasible**

3. *Bioretention*
    - Per the recommendation of the geotechnical report, infiltration is not feasible onsite and as such, bioretention facilities are not recommended.
        - **i. Conclusion: Infeasible**

4. *Sheet Flow Dispersion or Concentrated Flow Dispersion in accordance with BMP T5.12 or BMP T5.11*
    - Due to site specific constraints including building and location of drive aisle, there is inadequate flow path to disperse on site.
        - **i. Conclusion: Infeasible**

SECTION 5: CONVEYANCE DESIGN

The stormwater conveyance system is comprised of a network of open/closed grate catch basins, buried pipe, a concrete detention vault and a Stormfilter water quality unit. Catch basins have been located such that each section of storm drainage pipe may adequately convey associated tributary area flows.

SECTION 6: OPERATIONS AND MAINTENANCE MANUAL

The proposed storm drainage system consists of buried pipes, catch basins, a detention vault, and a stormfilter water quality treatment structure. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained on the following pages.

SECTION 7: SPECIAL REPORTS AND STUDIES

There are no special reports or studies to include at this time.

Appendix 1: Project Overview

1. Vicinity Map
2. Existing Conditions Map
3. Proposed Development Map

NW 1/4, SW 1/4, SEC. 12, T. 31N, R5E, W.M. ARLINGTON, WASHINGTON

TAPERT ARLINGTON STILLAGUAMISH

PRELIMINARY PLANS

ARLINGTON, SNOHOMISH, WA

LEGEND AND ABBREVIATIONS

EXISTING SYMBOLS	DESCRIPTION
	FOUND MONUMENT AS NOTED
	SET 1/2" x 24" REBAR W/ CAP "PCS 37536"
	EXISTING CORNER MONUMENT AS NOTED
	QUARTER SECTION TIE
	CATCH BASIN
	CULVERT
	FIRE HYDRANT
	GAS METER
	GAS VALVE
	GUY ANCHOR
	HOSE BIB
	SEWER MANHOLE
	TELCO MANHOLE
	TELCO RISER
	UTILITY POLE
	WATER METER
	WATER VALVE
	IRRIGATION CONTROL VALVE
	CONIFEROUS TREE
	DECIDUOUS TREE

ABBREVIATIONS	
EPM	ELECTRIC PAINT MARK
GPM	GAS PAINT MARK
OHP	OVERHEAD POWER LINE
SPM	SEWER PAINT MARK
WPM	WATER PAINT MARK
C	CEDAR
F	FIR
M	MAPLE
P	PINE

PROPOSED STORM SYMBOLS

SYMBOL	DESCRIPTION
	SD CAP
	TYPE 1 CATCH BASIN, GRATED LID
	TYPE 1 CATCH BASIN, SOLID LID
	TYPE 2 CATCH BASIN, GRATED LID
	TYPE 2 CATCH BASIN, SOLID LID
	BEEHIVE MANHOLE COVER
	SQUARE YARD DRAIN
	ROUND YARD DRAIN
	STORM CLEAN OUT
	STORM PIPE

PROPOSED WATER SYMBOLS

SYMBOL	DESCRIPTION
	WATER CAP
	CONCRETE BLOCKING
	11.25° BEND
	22.5° BEND
	45° BEND
	90° BEND
	VALVE
	HYDRANT ASSEMBLY
	BLOW-OFF VALVE
	REDUCER
	AIR-VAC ASSEMBLY
	WATER METER
	WATER PIPE

PROPOSED SEWER SYMBOLS

SYMBOL	DESCRIPTION
	SEWER CAP
	SEWER CLEANOUT
	SEWER MANHOLE
	SEWER PIPE

PROPOSED SURVEY SYMBOLS

SYMBOL	DESCRIPTION
	SURVEY MONUMENT IN PROPOSED ROAD

CONTACT LIST

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EMAIL: origindg@gmail.com

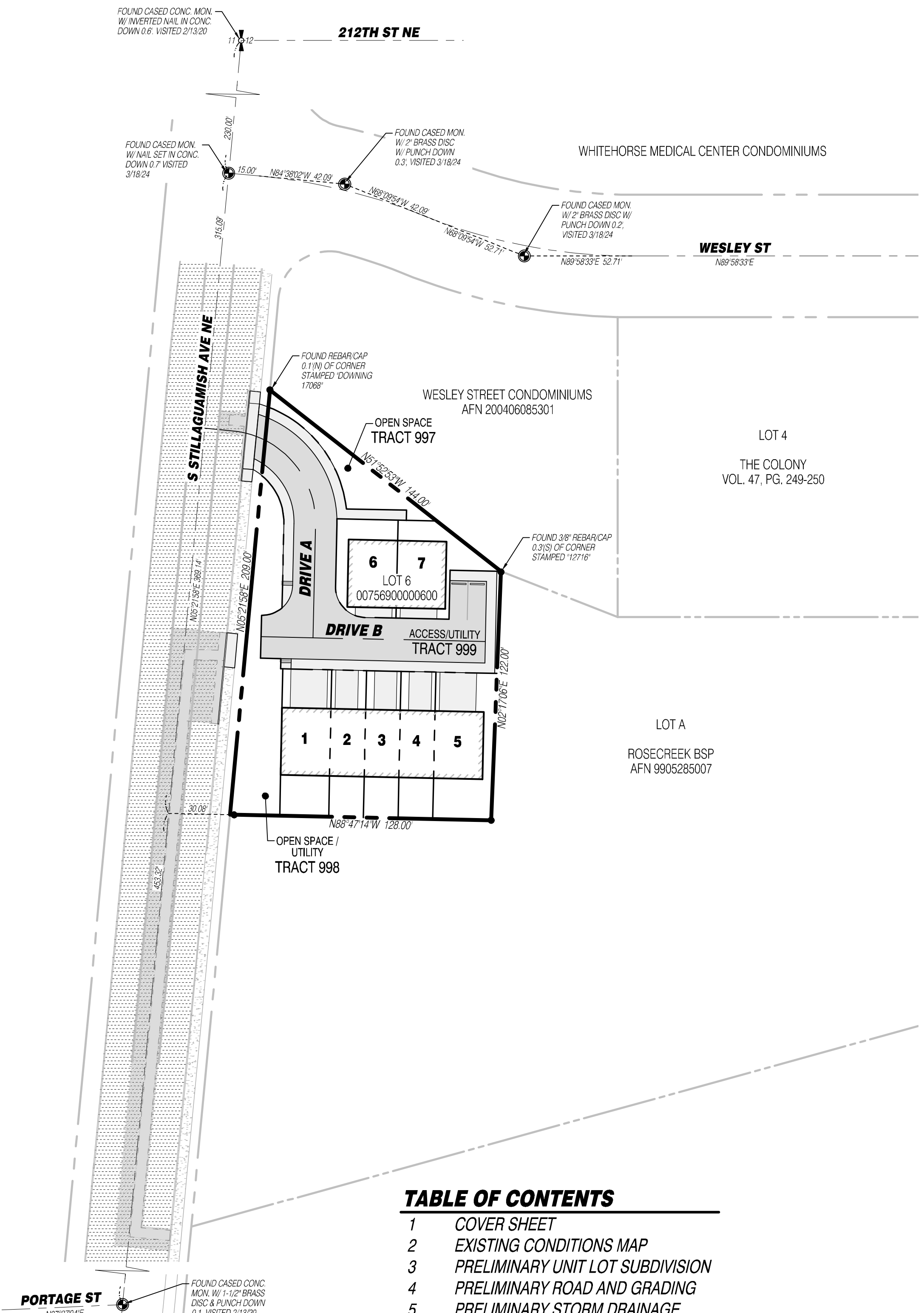
SURVEYOR:
PACIFIC COAST SURVEYS, INC.
P.O. BOX 13619
MILL CREEK, WASHINGTON 98082
CONTACT: DARREN RIDDLE, PLS
PHONE: (425) 512-7099
FAX: (425) 357-3577
EMAIL: darren@pcsurveys.net

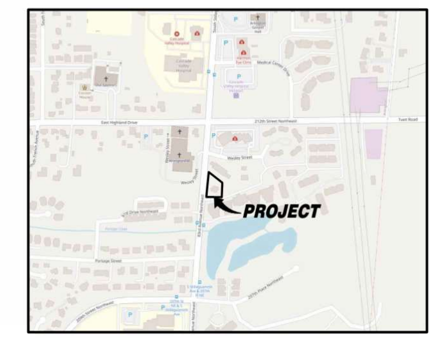
EARTHWORK QUANTITIES

STRIPPING:	400 CY
CUT:	2500 CY
FILL:	2000 CY
NET:	500 CY (CUT)
DISTURBED AREA:	25,828 SF (0.59 AC)

THE ABOVE QUANTITIES ARE FOR PERMITTING PURPOSES. CONTRACTOR TO VERIFY.

C:\Users\ryan\DC\ACCDocs\Solid Ground Engineering\24-0053 Tapert Arlington Stillaguamish\Project Files\Drawings\Preliminary\24-0053P-CS-PL.dwg 6/7/2024 6:10:42 AM





VICINITY MAP

SCALE: 1"=2000'

PROJECT INFORMATION

TAX PARCELS:	00756900000600
SITE ADDRESS:	607 S STILLAGUAMISH AVE, ARLINGTON WA 98223-1677
SITE AREA:	20,473 SF (0.47 AC)
PROPOSED ZONING:	RHC (RESIDENTIAL HIGH CAPACITY)
PROPOSED LOTS:	7 LOTS
BUILDING SETBACKS:	20' FRONT 5' SIDE 20' REAR
WATER:	CITY OF ARLINGTON
SEWER:	CITY OF ARLINGTON
POWER:	SNOHOMISH PUD
GAS:	PUGET SOUND ENERGY
TELEPHONE:	COMCAST
CABLE:	COMCAST
SCHOOL DISTRICT:	ARLINGTON SCHOOL DIST NO 16
FIRE DISTRICT:	NORTH COUNTY REGIONAL FIRE AUTHORITY

SURVEY INFORMATION

EQUIPMENT & PROCEDURES

METHOD OF SURVEY:
SURVEY PERFORMED BY FIELD TRAVERSE AND REAL TIME KINEMATIC GPS POSITIONING UTILIZING THE HxGN SMARTNET NETWORK

INSTRUMENTATION:
LEICA TS16 ROBOTIC ELECTRONIC TOTAL STATION
LEICA VIVA GNSS GS08 RECEIVER
ALL EQUIPMENT HAS BEEN MAINTAINED IN ADJUSTMENT T0 MANUFACTURER'S SPECIFICATIONS AS REQUIRED BY WAC 332-130-100

PRECISION:
MEETS OR EXCEEDS STATE STANDARDS SET BY WAC 332-130-080 THROUGH 332-130-110

BASIS OF BEARING:
THE MONUMENTED CENTERLINE OF S STILLAGUAMISH AVE NE, AS THE BEARING NORTH 05°21'58" EAST PER GPS OBSERVATIONS.
WASHINGTON STATE PLANE, NORTH ZONE, NAD 83/91

LEGAL DESCRIPTION

LOT 6, THE COLONY, ACCORDING TO THE PLAT THEREOF RECORDED IN VOLUME 47 OF PLATS, PAGES 249 AND 250, RECORDS OF SNOHOMISH COUNTY.

SITUATE IN THE CITY OF ARLINGTON, COUNTY OF SNOHOMISH, STATE OF WASHINGTON.

VERTICAL DATUM

NAVD 88 *(NAVD88 -3.67'= NGVD29)*

FOUND CASED CONC. MON. AT THE INTERSECTION OF E. HIGHLAND DR. & S. STILLAGUAMISH AVE. N.E.
WGS SURVEY DATA WAREHOUSE I.D.#20563

ELEV. = 110.64'

SURVEY REFERENCES

(R1) PLAT OF THE COLONY - VOL. 47, PG. 249-250.
(R2) ROSECREEK BSP - AFN 9905285007
(R3) WESLEY STREET CONDOMINIUMS - AFN 200406085301

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SURVEY DISCLAIMER

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UTILITY NOTE

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

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THOMAS P. ABBOTT STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER 6-7-24

ENGINEER'S STAMP

REVISIONS

#	DATE	DESCRIPTION

Solid Ground Engineering
8105 166th Ave NE
Redmond, WA 98052

COVER SHEET

CORSTONE CONTRACTORS, LLC.
TAPERT ARLINGTON STILLAGUAMISH
ARLINGTON, WA

DRAWN BY:	AJP
CHECKED BY:	TPA
DATE:	6-7-24
JURISDICTION:	CITY OF ARLINGTON
JOB NUMBER:	24-0053

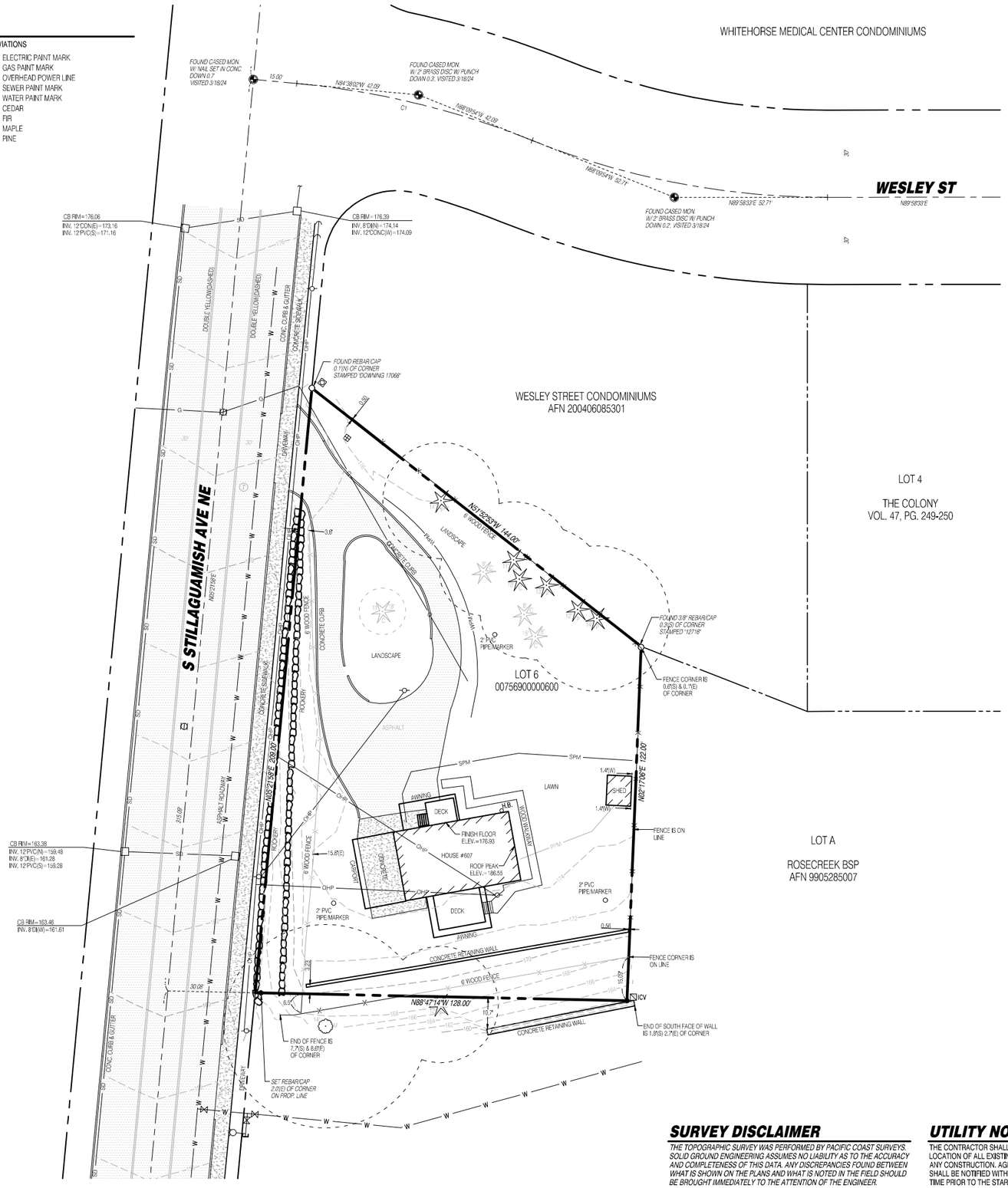
CS-01

NW 1/4, SW 1/4, SEC. 12, T. 31N, R5E, W.M. ARLINGTON, WASHINGTON

LEGEND AND ABBREVIATIONS

EXISTING SYMBOLS	DESCRIPTION
●	FOUND MONUMENT AS NOTED
●	SET 1/2" x 24" REBAR W/ CAP "PCS 37536"
○	EXISTING CORNER MONUMENT AS NOTED
	QUARTER SECTION TIE
	CATCH BASIN
	CULVERT
	FIRE HYDRANT
GM	GAS METER
	GAS VALVE
	GUY ANCHOR
H.B.	HOSE BIB
S	SEWER MANHOLE
T	TELCO MANHOLE
	TELCO RISER
	UTILITY POLE
	WATER METER
	WATER VALVE
	IRRIGATION CONTROL VALVE
	CONIFEROUS TREE
	DECIDUOUS TREE

ABBREVIATIONS	
EPM	ELECTRIC PAINT MARK
GPM	GAS PAINT MARK
OHP	OVERHEAD POWER LINE
SPM	SEWER PAINT MARK
WPM	WATER PAINT MARK
C	CEDAR
F	FIR
M	MAPLE
P	PINE



N

0 20' 40'

SURVEY INFORMATION

EQUIPMENT & PROCEDURES

METHOD OF SURVEY:
SURVEY PERFORMED BY FIELD TRAVERSE AND REAL TIME KINEMATIC GPS POSITIONING UTILIZING THE HIGN SMARTNET NETWORK

INSTRUMENTATION:
LEICA TS16 ROBOTIC ELECTRONIC TOTAL STATION
LEICA VIVA GNSS GS08 RECEIVER
ALL EQUIPMENT HAS BEEN MAINTAINED IN ADJUSTMENT TO MANUFACTURER'S SPECIFICATIONS AS REQUIRED BY WAC 332-130-100

PRECISION:
MEETS OR EXCEEDS STATE STANDARDS SET BY WAC 332-130-080 THROUGH 332-130-110

BASIS OF BEARING:
THE MONUMENTED CENTERLINE OF S STILLAGUAMISH AVE NE, AS THE BEARING NORTH 05°21'58" EAST PER GPS OBSERVATIONS.
WASHINGTON STATE PLANE, NORTH ZONE, NAD 83/91

LEGAL DESCRIPTION

LOT 6, THE COLONY, ACCORDING TO THE PLAT THEREOF RECORDED IN VOLUME 47 OF PLATS, PAGES 249 AND 250, RECORDS OF SNOHOMISH COUNTY.

SITUATE IN THE CITY OF ARLINGTON, COUNTY OF SNOHOMISH, STATE OF WASHINGTON.

VERTICAL DATUM

NAVD 88 *(NAVD88 -3.67= NGVD29)*

FOUND CASED CONC. MON. AT THE INTERSECTION OF E. HIGHLAND DR. & S. STILLAGUAMISH AVE. N.E.
WGS SURVEY DATA WAREHOUSE I.D. #20563

ELEV. = 110.64'

SURVEY REFERENCES

(R1) PLAT OF THE COLONY - VOL. 47, PG. 249-250.
(R2) ROSECREEK BSP - AFN 9905285007
(R3) WESLEY STREET CONDOMINIUMS - AFN 200406085301

SURVEY DISCLAIMER

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY PACIFIC COAST SURVEYS. SOLID GROUND ENGINEERING ASSUMES NO LIABILITY AS TO THE ACCURACY AND COMPLETENESS OF THIS DATA. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.

UTILITY NOTE

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

811 SAFETY IS IN YOUR HANDS. EVERY DIG. EVERY TIME.

THOMAS P. ABBOTT — STATE OF WASHINGTON — 24841 — REGISTERED PROFESSIONAL ENGINEER
6-7-24

ENGINEER'S STAMP

REVISIONS		
#	DATE	DESCRIPTION

Solid Ground Engineering
8105 166th Ave NE
Redmond, WA 98052

EXISTING CONDITIONS MAP

CORSTONE CONTRACTORS, LLC.

TAPERT ARLINGTON
STILLAGUAMISH

ARLINGTON, WA

DRAWN BY:	AJP
CHECKED BY:	TPA
DATE:	6-7-24
JURISDICTION:	CITY OF ARLINGTON
JOB NUMBER:	24-0053

EC-01
2 OF 7

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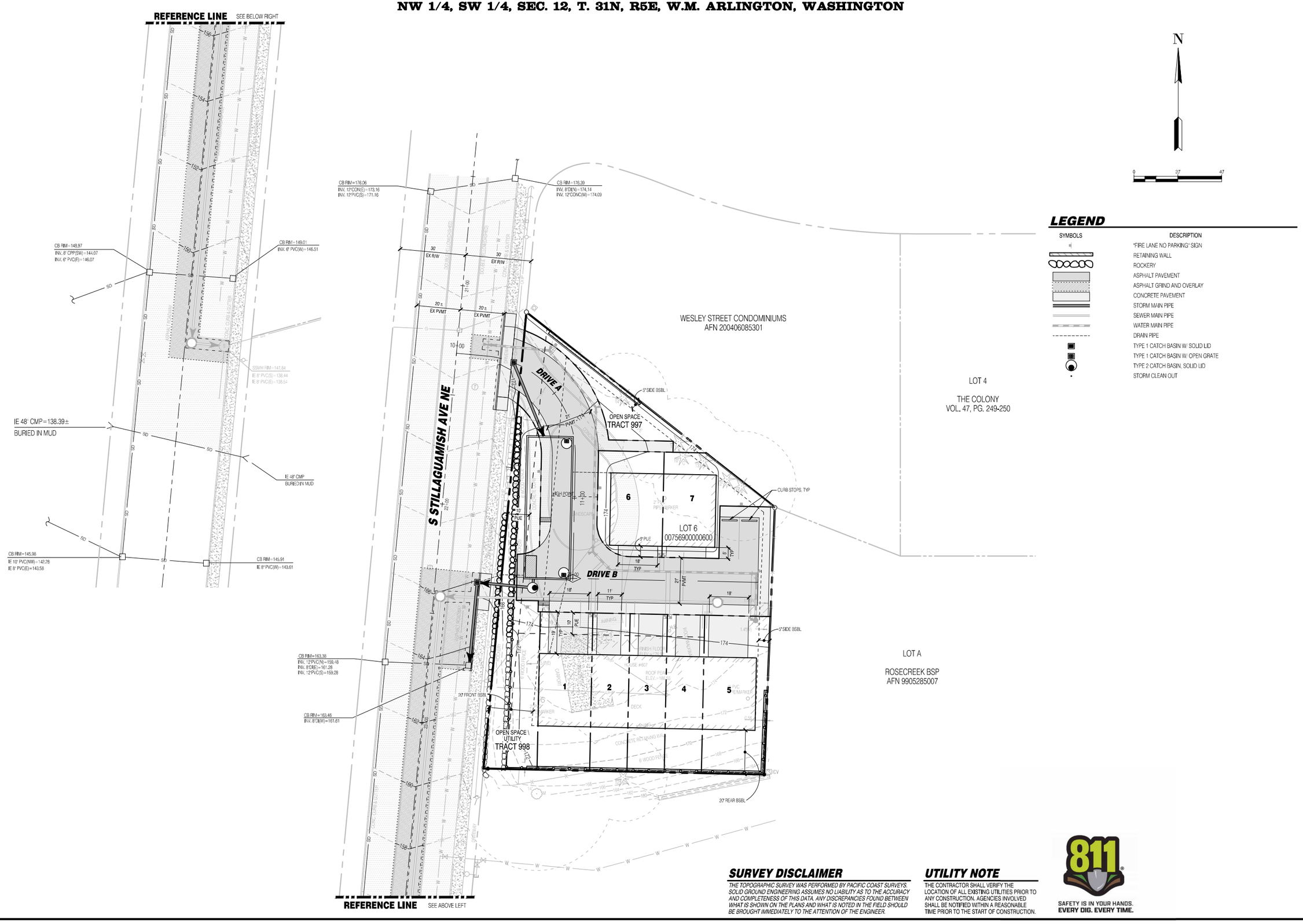
NW 1/4, SW 1/4, SEC. 12, T. 31N, R5E, W.M. ARLINGTON, WASHINGTON



LEGEND

SYMBOLS	DESCRIPTION
	"FIRE LANE NO PARKING" SIGN
	RETAINING WALL
	ROCKERY
	ASPHALT PAVEMENT
	ASPHALT GRIND AND OVERLAY
	CONCRETE PAVEMENT
	STORM MAIN PIPE
	SEWER MAIN PIPE
	WATER MAIN PIPE
	DRAIN PIPE
	TYPE 1 CATCH BASIN W/ SOLID LID
	TYPE 1 CATCH BASIN W/ OPEN GRATE
	TYPE 2 CATCH BASIN, SOLID LID
	STORM CLEAN OUT

SURVEY DISCLAIMER

THE TOPOGRAPHIC SURVEY WAS PERFORMED BY PACIFIC COAST SURVEYS. SOLID GROUND ENGINEERING ASSUMES NO LIABILITY AS TO THE ACCURACY AND COMPLETENESS OF THIS DATA. ANY DISCREPANCIES FOUND BETWEEN WHAT IS SHOWN ON THE PLANS AND WHAT IS NOTED IN THE FIELD SHOULD BE BROUGHT IMMEDIATELY TO THE ATTENTION OF THE ENGINEER.

UTILITY NOTE

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

811 SAFETY IS IN YOUR HANDS. EVERY DIG. EVERY TIME.

THOMAS P. ABBOTT — STATE OF WASHINGTON — 24662 — REGISTERED PROFESSIONAL ENGINEER — 6-7-24

ENGINEER'S STAMP

REVISIONS

#	DATE	DESCRIPTION

Solid Ground Engineering
8105 166th Ave NE
Redmond, WA 98052

PRELIMINARY STORM DRAINAGE

CORSTONE CONTRACTORS, LLC.

TAPERT ARLINGTON STILLAGUAMISH

ARLINGTON, WA

DRAWN BY:	AJP
CHECKED BY:	TPA
DATE:	6-7-24
JURISDICTION:	CITY OF ARLINGTON
JOB NUMBER:	24-0053

DR-01

5 OF 7

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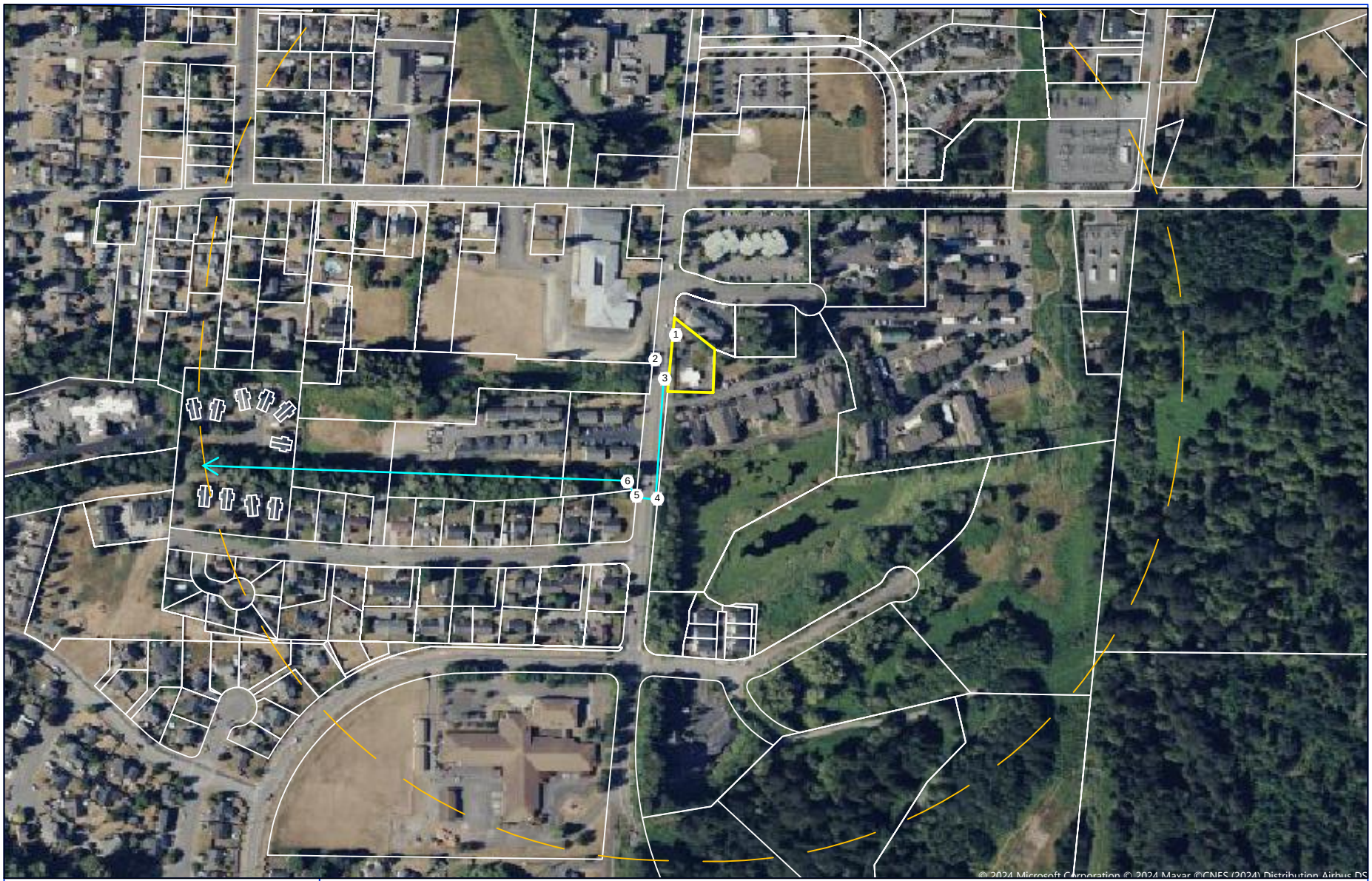
Appendix 2: Temporary Erosion and Sediment Control Design

1. TESC Plans

Appendix 3: Downstream Analysis

1. Downstream Analysis Map
2. Downstream Analysis Site Visit Pictures
3. USDA Soils Map & Description



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8105 166th Ave NE
Redmond, WA 98052

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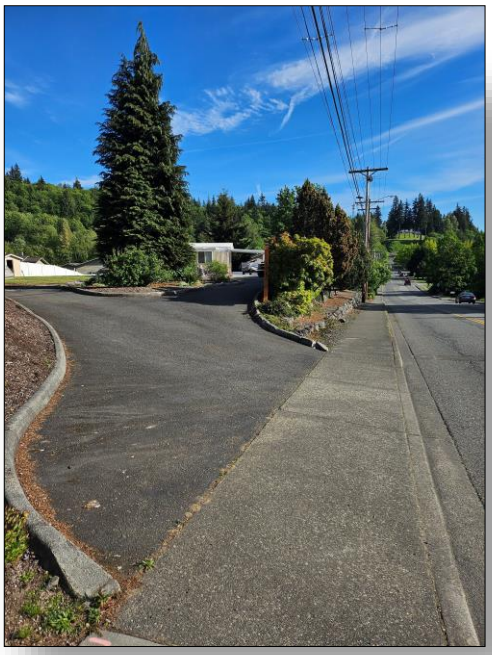
TAPERT ARLINGTON STILLAGUAMISH

DOWNSTREAM ANALYSIS MAP

JOB NUMBER:	24-0053	DATE:	5-20-24
JURISDICTION:	Arlington	DRAWN BY:	CJD

C:\Users\CooperDanby\Documents\CAD-GIS\Maps\Tapert Arlington\Tapert Downstream Map.dwg

Downstream Analysis Photographs



Images 1 & 2: Front of property looking towards the south (Image 1) and front of property straight on, looking east (Image 2)

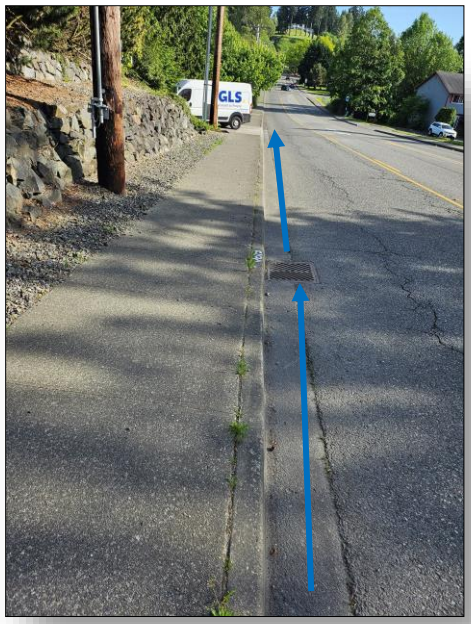


Image 3: Catch Basin along frontage of property. Flow from site travels south through this catch basin.

Image 4: Flow continues for approximately 335 ft to the south through existing catch basins.

Image 5: Flow then travels across the street to the west via existing drainage structures.

Image 6: Flow then joins Portage Creek via existing drainage structures and continues to the west beyond the quarter mile boundary.

Soil Map—Snohomish County Area, Washington
(Tapert Arlington Stillaguamish)

Map Scale: 1:3,940 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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 25, Aug 29, 2023

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

Date(s) aerial images were photographed: Aug 14, 2022—Sep 1, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Alderwood gravelly sandy loam, 0 to 8 percent slopes	2.5	3.8%
17	Everett very gravelly sandy loam, 0 to 8 percent slopes	4.1	6.4%
19	Everett very gravelly sandy loam, 15 to 30 percent slopes	3.1	4.9%
39	Norma loam	28.9	45.2%
48	Pastik silt loam, 8 to 25 percent slopes	11.2	17.4%
57	Ragnar fine sandy loam, 0 to 8 percent slopes	12.0	18.7%
77	Tokul-Winston gravelly loams, 25 to 65 percent slopes	0.1	0.1%
83	Water	2.3	3.5%
Totals for Area of Interest		**64.0**	**100.0%**

Appendix 4: Detention and Water Quality Design Analysis

1. Predeveloped Hydrology Map
2. Developed Hydrology Map
3. Stormfilter Detail
4. WWHM2012 Output – Detention Vault

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8105 166th Ave NE
Redmond, WA 98052

CORSTONE CONTRACTORS, LLC

TAPERT ARLINGTON STILLAGUAMISH

PREDEVELOPED HYDROLOGY MAP

JOB NUMBER:	24-0053	DATE:	5-20-24
JURISDICTION:	Arlington	DRAWN BY:	CJD

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Onsite Basin	
Ground Cover	Area (acre)
Roof, flat	0.11
Driveway, flat	0.04
Sidewalks, flat	0.04
Roads, flat	0.12
Pasture, flat	0.16
Total	**0.47**

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8105 166th Ave NE
Redmond, WA 98052

CORSTONE CONTRACTORS, LLC

TAPERT ARLINGTON STILLAGUAMISH

DEVELOPED HYDROLOGY MAP

JOB NUMBER:	24-0053	DATE:	5-20-24
JURISDICTION:	Arlington	DRAWN BY:	CJD

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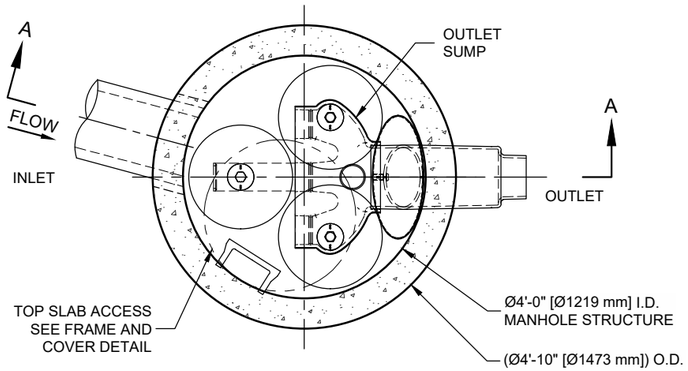
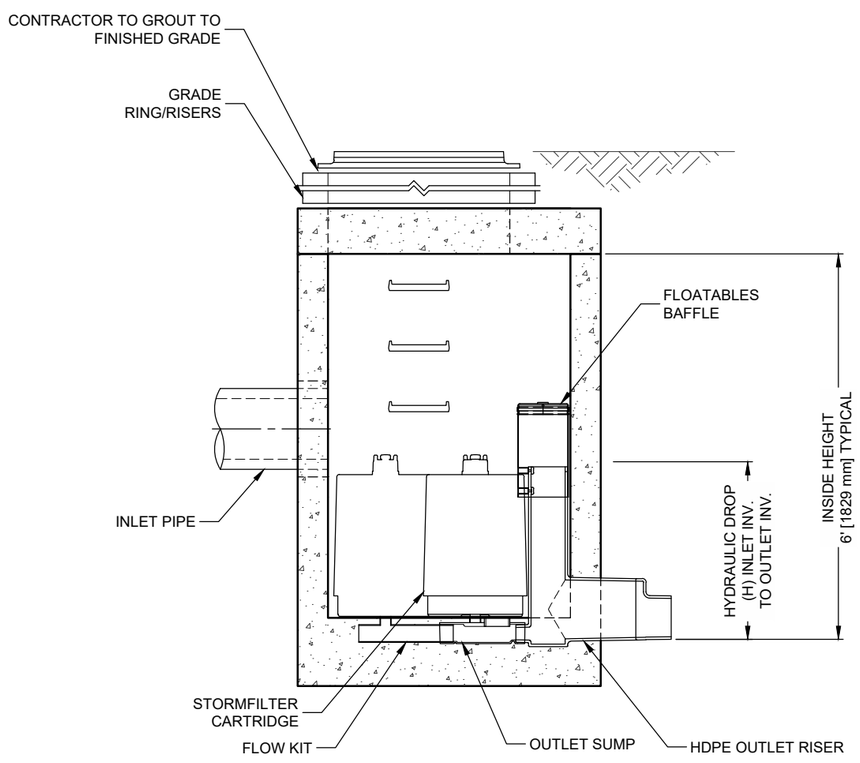


PLAN VIEW

STANDARD OUTLET RISER
FLOWKIT: 40A



SECTION A-A

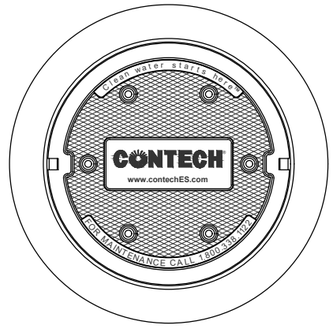
STORMFILTER DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (3). VOLUME SYSTEM IS ALSO AVAILABLE WITH MAXIMUM 3 CARTRIDGES.
Ø4 [1219 mm] MANHOLE STORMFILTER PEAK HYDRAULIC CAPACITY IS 1.0 CFS [28.3 L/s] . IF THE SITE CONDITIONS EXCEED 1.0 CFS [28.3 L/s] AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27" [686 mm]			18" [458 mm]			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05' [930 mm]			2.3' [700 mm]			1.8' [550 mm]		
SPECIFIC FLOW RATE (gpm/sf) [L/s/m^2]	2 [1.30]	1.67* [1.08]	1 [0.65]	2 [1.30]	1.67* [1.08]	1 [0.65]	2 [1.30]	1.67* [1.08]	1 [0.65]
CARTRIDGE FLOW RATE (gpm) [L/s]	22.5 [1.42]	18.79 [1.19]	11.25 [0.71]	15 [0.95]	12.53 [0.79]	7.5 [0.44]	10 [0.63]	8.35 [0.54]	5 [0.32]

* 1.67 gpm/sf [1.08 L/s/m^2] SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY



FRAME AND COVER

(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs) [L/s]	*
PEAK FLOW RATE (cfs) [L/s]	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (SEE TABLE ABOVE)	*
NUMBER OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (PERLITE, ZPG, PSORB)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' [1524 mm] AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
6. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES [178 mm]. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
7. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) [L/s] DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft)[m^2].
8. STORMFILTER STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET PIPE(S).
E. CONTRACTOR TO PROVIDE AND INSTALL CONNECTOR TO THE OUTLET RISER STUB. STORMFILTER EQUIPPED WITH A DUAL DIAMETER HDPE OUTLET STUB AND SAND COLLAR. IF OUTLET PIPE IS LARGER THAN 8 INCHES [200 mm], CONTRACTOR TO REMOVE THE 8 INCH [200 mm] OUTLET STUB AT MOLDED-IN CUT LINE. COUPLING BY FERNCO OR EQUAL AND PROVIDED BY CONTRACTOR.
F. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

The Stormwater Management StormFilter®

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SFMH48
STORMFILTER
STANDARD DETAIL

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Tapert Stillaguamish_20240514
Site Name:
Site Address:
City:
Report Date: 5/14/2024
Gage: Everett
Data Start: 1948/10/01
Data End: 2009/09/30
Timestep: 15 Minute
Precip Scale: 1.200
Version Date: 2023/01/27
Version: 4.2.19

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Onsite Basin

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.47
Pervious Total	0.47
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.47

Mitigated Land Use

Onsite Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Pasture, Flat	0.16
Pervious Total	0.16

Impervious Land Use	acre
ROADS FLAT	0.12
ROOF TOPS FLAT	0.11
DRIVEWAYS FLAT	0.04
SIDEWALKS FLAT	0.04
Impervious Total	0.31
Basin Total	0.47

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 64 ft.
Length: 20 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.438 in. Elevation:0 ft.
Orifice 2 Diameter: 0.500 in. Elevation:2.5 ft.
Orifice 3 Diameter: 0.500 in. Elevation:3.5 ft.
Element Flows To:
Outlet 1 Outlet 2

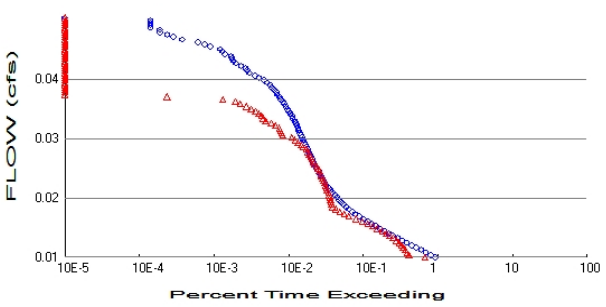
Vault Hydraulic Table

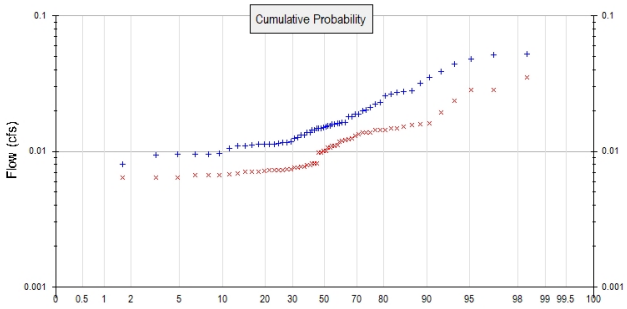
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.029	0.000	0.000	0.000
0.0778	0.029	0.002	0.001	0.000
0.1556	0.029	0.004	0.002	0.000
0.2333	0.029	0.006	0.002	0.000
0.3111	0.029	0.009	0.002	0.000
0.3889	0.029	0.011	0.003	0.000
0.4667	0.029	0.013	0.003	0.000
0.5444	0.029	0.016	0.003	0.000
0.6222	0.029	0.018	0.004	0.000
0.7000	0.029	0.020	0.004	0.000
0.7778	0.029	0.022	0.004	0.000
0.8556	0.029	0.025	0.004	0.000
0.9333	0.029	0.027	0.005	0.000
1.0111	0.029	0.029	0.005	0.000
1.0889	0.029	0.032	0.005	0.000
1.1667	0.029	0.034	0.005	0.000
1.2444	0.029	0.036	0.005	0.000
1.3222	0.029	0.038	0.006	0.000
1.4000	0.029	0.041	0.006	0.000
1.4778	0.029	0.043	0.006	0.000
1.5556	0.029	0.045	0.006	0.000
1.6333	0.029	0.048	0.006	0.000
1.7111	0.029	0.050	0.006	0.000
1.7889	0.029	0.052	0.006	0.000
1.8667	0.029	0.054	0.007	0.000
1.9444	0.029	0.057	0.007	0.000
2.0222	0.029	0.059	0.007	0.000
2.1000	0.029	0.061	0.007	0.000
2.1778	0.029	0.064	0.007	0.000
2.2556	0.029	0.066	0.007	0.000
2.3333	0.029	0.068	0.007	0.000
2.4111	0.029	0.070	0.008	0.000
2.4889	0.029	0.073	0.008	0.000
2.5667	0.029	0.075	0.010	0.000
2.6444	0.029	0.077	0.011	0.000
2.7222	0.029	0.080	0.011	0.000
2.8000	0.029	0.082	0.012	0.000
2.8778	0.029	0.084	0.013	0.000

2.9556	0.029	0.086	0.013	0.000
3.0333	0.029	0.089	0.014	0.000
3.1111	0.029	0.091	0.014	0.000
3.1889	0.029	0.093	0.014	0.000
3.2667	0.029	0.096	0.015	0.000
3.3444	0.029	0.098	0.015	0.000
3.4222	0.029	0.100	0.016	0.000
3.5000	0.029	0.102	0.016	0.000
3.5778	0.029	0.105	0.018	0.000
3.6556	0.029	0.107	0.019	0.000
3.7333	0.029	0.109	0.020	0.000
3.8111	0.029	0.112	0.021	0.000
3.8889	0.029	0.114	0.022	0.000
3.9667	0.029	0.116	0.023	0.000
4.0444	0.029	0.118	0.023	0.000
4.1222	0.029	0.121	0.024	0.000
4.2000	0.029	0.123	0.025	0.000
4.2778	0.029	0.125	0.025	0.000
4.3556	0.029	0.128	0.026	0.000
4.4333	0.029	0.130	0.026	0.000
4.5111	0.029	0.132	0.027	0.000
4.5889	0.029	0.134	0.028	0.000
4.6667	0.029	0.137	0.028	0.000
4.7444	0.029	0.139	0.029	0.000
4.8222	0.029	0.141	0.029	0.000
4.9000	0.029	0.144	0.030	0.000
4.9778	0.029	0.146	0.030	0.000
5.0556	0.029	0.148	0.031	0.000
5.1333	0.029	0.150	0.031	0.000
5.2111	0.029	0.153	0.031	0.000
5.2889	0.029	0.155	0.032	0.000
5.3667	0.029	0.157	0.032	0.000
5.4444	0.029	0.160	0.033	0.000
5.5222	0.029	0.162	0.033	0.000
5.6000	0.029	0.164	0.034	0.000
5.6778	0.029	0.166	0.034	0.000
5.7556	0.029	0.169	0.034	0.000
5.8333	0.029	0.171	0.035	0.000
5.9111	0.029	0.173	0.035	0.000
5.9889	0.029	0.176	0.036	0.000
6.0667	0.029	0.178	0.310	0.000
6.1444	0.029	0.180	0.905	0.000
6.2222	0.029	0.182	1.674	0.000
6.3000	0.029	0.185	2.538	0.000
6.3778	0.029	0.187	3.424	0.000
6.4556	0.029	0.189	4.254	0.000
6.5333	0.029	0.192	4.962	0.000
6.6111	0.029	0.194	5.507	0.000
6.6889	0.029	0.196	5.888	0.000
6.7667	0.029	0.198	6.244	0.000
6.8444	0.029	0.201	6.552	0.000
6.9222	0.029	0.203	6.846	0.000
7.0000	0.029	0.205	7.127	0.000
7.0778	0.029	0.208	7.398	0.000
7.1556	0.000	0.000	7.659	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.47
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.16
Total Impervious Area: 0.31

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.015792
5 year	0.024226
10 year	0.03073
25 year	0.040035
50 year	0.047786
100 year	0.056261

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.009932
5 year	0.014429
10 year	0.017976
25 year	0.023165
50 year	0.027585
100 year	0.032516

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.016	0.008
1950	0.016	0.011
1951	0.014	0.007
1952	0.011	0.007
1953	0.010	0.007
1954	0.052	0.008
1955	0.020	0.014
1956	0.018	0.015
1957	0.022	0.013
1958	0.016	0.008

1959	0.016	0.010
1960	0.015	0.011
1961	0.028	0.014
1962	0.014	0.007
1963	0.023	0.007
1964	0.016	0.006
1965	0.014	0.011
1966	0.008	0.007
1967	0.016	0.007
1968	0.020	0.012
1969	0.048	0.008
1970	0.011	0.007
1971	0.018	0.016
1972	0.013	0.008
1973	0.013	0.010
1974	0.027	0.008
1975	0.011	0.007
1976	0.011	0.008
1977	0.010	0.007
1978	0.011	0.007
1979	0.032	0.008
1980	0.015	0.007
1981	0.012	0.007
1982	0.015	0.014
1983	0.026	0.007
1984	0.015	0.019
1985	0.019	0.013
1986	0.044	0.028
1987	0.021	0.024
1988	0.011	0.014
1989	0.011	0.006
1990	0.015	0.014
1991	0.015	0.011
1992	0.012	0.012
1993	0.010	0.006
1994	0.011	0.011
1995	0.015	0.015
1996	0.026	0.015
1997	0.052	0.035
1998	0.010	0.007
1999	0.013	0.012
2000	0.009	0.016
2001	0.004	0.006
2002	0.014	0.013
2003	0.011	0.008
2004	0.019	0.016
2005	0.013	0.010
2006	0.035	0.014
2007	0.028	0.012
2008	0.039	0.028
2009	0.012	0.010

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0523	0.0349
2	0.0516	0.0284
3	0.0481	0.0284

4	0.0441	0.0236
5	0.0389	0.0194
6	0.0350	0.0160
7	0.0316	0.0158
8	0.0281	0.0156
9	0.0277	0.0153
10	0.0271	0.0149
11	0.0263	0.0148
12	0.0257	0.0144
13	0.0228	0.0143
14	0.0222	0.0143
15	0.0210	0.0138
16	0.0203	0.0138
17	0.0198	0.0137
18	0.0189	0.0135
19	0.0188	0.0130
20	0.0179	0.0125
21	0.0179	0.0123
22	0.0164	0.0121
23	0.0163	0.0119
24	0.0161	0.0118
25	0.0161	0.0112
26	0.0159	0.0110
27	0.0158	0.0110
28	0.0155	0.0107
29	0.0154	0.0107
30	0.0152	0.0101
31	0.0150	0.0100
32	0.0148	0.0099
33	0.0148	0.0097
34	0.0147	0.0082
35	0.0144	0.0082
36	0.0143	0.0081
37	0.0138	0.0080
38	0.0137	0.0079
39	0.0132	0.0077
40	0.0132	0.0077
41	0.0126	0.0076
42	0.0125	0.0076
43	0.0118	0.0074
44	0.0116	0.0073
45	0.0116	0.0073
46	0.0114	0.0073
47	0.0114	0.0072
48	0.0114	0.0072
49	0.0113	0.0071
50	0.0112	0.0071
51	0.0111	0.0071
52	0.0110	0.0070
53	0.0109	0.0069
54	0.0105	0.0068
55	0.0096	0.0067
56	0.0096	0.0067
57	0.0096	0.0067
58	0.0095	0.0064
59	0.0094	0.0064
60	0.0080	0.0064
61	0.0038	0.0057

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0079	19590	14298	72	Pass
0.0083	16989	8684	51	Pass
0.0087	14668	8226	56	Pass
0.0091	12724	7747	60	Pass
0.0095	10923	7343	67	Pass
0.0099	9437	6934	73	Pass
0.0103	8173	6442	78	Pass
0.0107	7084	5925	83	Pass
0.0111	6149	5394	87	Pass
0.0115	5311	4862	91	Pass
0.0119	4658	4327	92	Pass
0.0123	4075	3831	94	Pass
0.0127	3548	3317	93	Pass
0.0131	3140	2855	90	Pass
0.0135	2763	2449	88	Pass
0.0139	2453	2068	84	Pass
0.0143	2145	1691	78	Pass
0.0147	1894	1359	71	Pass
0.0151	1657	1190	71	Pass
0.0156	1508	1032	68	Pass
0.0160	1370	911	66	Pass
0.0164	1253	833	66	Pass
0.0168	1154	799	69	Pass
0.0172	1069	788	73	Pass
0.0176	1009	773	76	Pass
0.0180	951	765	80	Pass
0.0184	888	751	84	Pass
0.0188	825	731	88	Pass
0.0192	777	704	90	Pass
0.0196	733	682	93	Pass
0.0200	687	668	97	Pass
0.0204	649	649	100	Pass
0.0208	622	633	101	Pass
0.0212	602	613	101	Pass
0.0216	583	592	101	Pass
0.0220	561	573	102	Pass
0.0224	538	551	102	Pass
0.0228	507	530	104	Pass
0.0232	488	507	103	Pass
0.0236	473	468	98	Pass
0.0240	457	454	99	Pass
0.0244	440	436	99	Pass
0.0248	424	420	99	Pass
0.0252	409	402	98	Pass
0.0256	394	385	97	Pass
0.0260	380	366	96	Pass
0.0264	368	331	89	Pass
0.0268	353	312	88	Pass
0.0272	341	283	82	Pass
0.0276	333	259	77	Pass
0.0280	322	235	72	Pass
0.0284	313	178	56	Pass
0.0288	303	171	56	Pass

0.0293	293	166	56	Pass
0.0297	284	160	56	Pass
0.0301	276	142	51	Pass
0.0305	265	125	47	Pass
0.0309	257	105	40	Pass
0.0313	241	98	40	Pass
0.0317	234	92	39	Pass
0.0321	225	84	37	Pass
0.0325	212	77	36	Pass
0.0329	205	67	32	Pass
0.0333	195	58	29	Pass
0.0337	187	48	25	Pass
0.0341	177	41	23	Pass
0.0345	166	28	16	Pass
0.0349	160	5	3	Pass
0.0353	150	0	0	Pass
0.0357	146	0	0	Pass
0.0361	135	0	0	Pass
0.0365	128	0	0	Pass
0.0369	120	0	0	Pass
0.0373	111	0	0	Pass
0.0377	99	0	0	Pass
0.0381	85	0	0	Pass
0.0385	75	0	0	Pass
0.0389	63	0	0	Pass
0.0393	59	0	0	Pass
0.0397	56	0	0	Pass
0.0401	49	0	0	Pass
0.0405	42	0	0	Pass
0.0409	39	0	0	Pass
0.0413	37	0	0	Pass
0.0417	36	0	0	Pass
0.0421	30	0	0	Pass
0.0425	28	0	0	Pass
0.0430	26	0	0	Pass
0.0434	19	0	0	Pass
0.0438	16	0	0	Pass
0.0442	13	0	0	Pass
0.0446	8	0	0	Pass
0.0450	6	0	0	Pass
0.0454	5	0	0	Pass
0.0458	4	0	0	Pass
0.0462	4	0	0	Pass
0.0466	3	0	0	Pass
0.0470	3	0	0	Pass
0.0474	3	0	0	Pass
0.0478	3	0	0	Pass

Water Quality

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 Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	☐	65.64			☐	0.00			
Total Volume Infiltrated		65.64	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

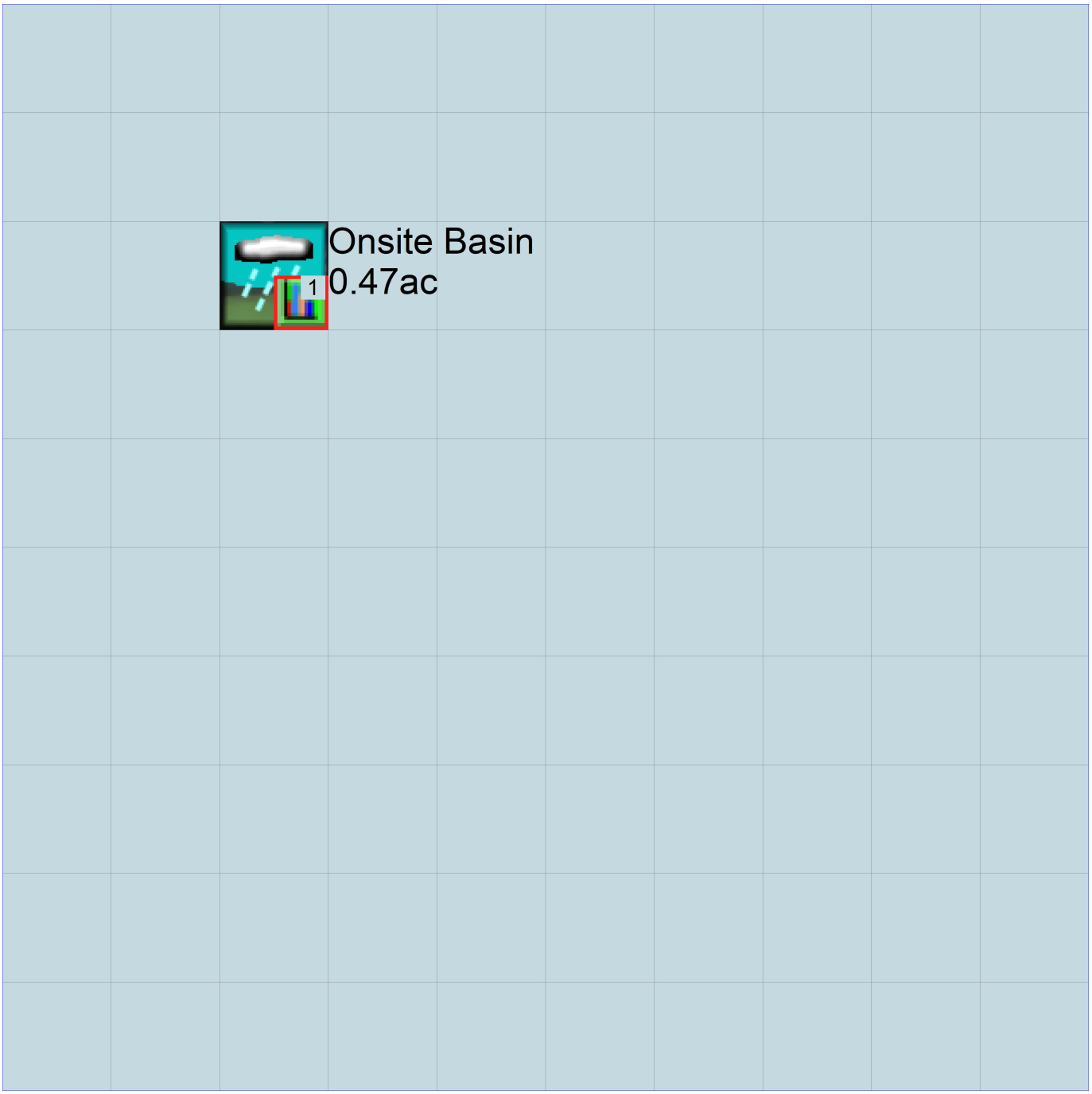
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Tapert Stillaguamish_20240514.wdm
MESSU       25   PreTapert Stillaguamish_20240514.MES
            27   PreTapert Stillaguamish_20240514.L61
            28   PreTapert Stillaguamish_20240514.L62
            30   POCTapert Stillaguamish_202405141.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Onsite Basin               MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Onsite Basin***
PERLND  10                       0.47     COPY   501     12
PERLND  10                       0.47     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><---><---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Tapert Stillaguamish_20240514.wdm
MESSU       25   MitTapert Stillaguamish_20240514.MES
            27   MitTapert Stillaguamish_20240514.L61
            28   MitTapert Stillaguamish_20240514.L62
            30   POCTapert Stillaguamish_202405141.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND       1
      IMPLND       4
      IMPLND       5
      IMPLND       8
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   13     C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13          0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
   13              0         0         0         0       2.5          1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    4    1    9
    4         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
```

```
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    5              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    5              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Onsite Basin***
PERLND  13                        0.16     RCHRES   1      2
PERLND  13                        0.16     RCHRES   1      3
IMPLND   1                        0.12     RCHRES   1      5
IMPLND   4                        0.11     RCHRES   1      5
IMPLND   5                        0.04     RCHRES   1      5
IMPLND   8                        0.04     RCHRES   1      5

******Routing******
PERLND  13                        0.16     COPY     1     12
IMPLND   1                        0.12     COPY     1     15
IMPLND   4                        0.11     COPY     1     15
IMPLND   5                        0.04     COPY     1     15
IMPLND   8                        0.04     COPY     1     15
PERLND  13                        0.16     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
```

```
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG            ***
                                      in  out                               ***
    1     Vault  1               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
    1               1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                      ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.029385  0.000000  0.000000
  0.077778  0.029385  0.002285  0.001449
  0.155556  0.029385  0.004571  0.002049
  0.233333  0.029385  0.006856  0.002509
  0.311111  0.029385  0.009142  0.002897
  0.388889  0.029385  0.011427  0.003239
  0.466667  0.029385  0.013713  0.003548
  0.544444  0.029385  0.015998  0.003833
  0.622222  0.029385  0.018284  0.004097
  0.700000  0.029385  0.020569  0.004346
  0.777778  0.029385  0.022855  0.004581
  0.855556  0.029385  0.025140  0.004804
  0.933333  0.029385  0.027426  0.005018
  1.011111  0.029385  0.029711  0.005223
  1.088889  0.029385  0.031997  0.005420
  1.166667  0.029385  0.034282  0.005610
  1.244444  0.029385  0.036568  0.005794
  1.322222  0.029385  0.038853  0.005973
  1.400000  0.029385  0.041139  0.006146
  1.477778  0.029385  0.043424  0.006314
  1.555556  0.029385  0.045710  0.006478
  1.633333  0.029385  0.047995  0.006638
```

1.711111	0.029385	0.050281	0.006794
1.788889	0.029385	0.052566	0.006947
1.866667	0.029385	0.054852	0.007097
1.944444	0.029385	0.057137	0.007243
2.022222	0.029385	0.059423	0.007386
2.100000	0.029385	0.061708	0.007527
2.177778	0.029385	0.063993	0.007665
2.255556	0.029385	0.066279	0.007801
2.333333	0.029385	0.068564	0.007934
2.411111	0.029385	0.070850	0.008065
2.488889	0.029385	0.073135	0.008194
2.566667	0.029385	0.075421	0.010073
2.644444	0.029385	0.077706	0.011025
2.722222	0.029385	0.079992	0.011768
2.800000	0.029385	0.082277	0.012407
2.877778	0.029385	0.084563	0.012981
2.955556	0.029385	0.086848	0.013509
3.033333	0.029385	0.089134	0.014001
3.111111	0.029385	0.091419	0.014465
3.188889	0.029385	0.093705	0.014906
3.266667	0.029385	0.095990	0.015328
3.344444	0.029385	0.098276	0.015733
3.422222	0.029385	0.100561	0.016124
3.500000	0.029385	0.102847	0.016502
3.577778	0.029385	0.105132	0.018760
3.655556	0.029385	0.107418	0.019899
3.733333	0.029385	0.109703	0.020847
3.811111	0.029385	0.111989	0.021692
3.888889	0.029385	0.114274	0.022469
3.966667	0.029385	0.116560	0.023196
4.044444	0.029385	0.118845	0.023883
4.122222	0.029385	0.121130	0.024538
4.200000	0.029385	0.123416	0.025166
4.277778	0.029385	0.125701	0.025772
4.355556	0.029385	0.127987	0.026357
4.433333	0.029385	0.130272	0.026924
4.511111	0.029385	0.132558	0.027475
4.588889	0.029385	0.134843	0.028011
4.666667	0.029385	0.137129	0.028535
4.744444	0.029385	0.139414	0.029046
4.822222	0.029385	0.141700	0.029545
4.900000	0.029385	0.143985	0.030035
4.977778	0.029385	0.146271	0.030515
5.055556	0.029385	0.148556	0.030986
5.133333	0.029385	0.150842	0.031448
5.211111	0.029385	0.153127	0.031902
5.288889	0.029385	0.155413	0.032349
5.366667	0.029385	0.157698	0.032788
5.444444	0.029385	0.159984	0.033221
5.522222	0.029385	0.162269	0.033647
5.600000	0.029385	0.164555	0.034068
5.677778	0.029385	0.166840	0.034482
5.755556	0.029385	0.169126	0.034891
5.833333	0.029385	0.171411	0.035294
5.911111	0.029385	0.173697	0.035693
5.988889	0.029385	0.175982	0.036086
6.066667	0.029385	0.178268	0.310170
6.144444	0.029385	0.180553	0.905850
6.222222	0.029385	0.182838	1.674184
6.300000	0.029385	0.185124	2.538876
6.377778	0.029385	0.187409	3.424269
6.455556	0.029385	0.189695	4.254445
6.533333	0.029385	0.191980	4.962914
6.611111	0.029385	0.194266	5.507419
6.688889	0.029385	0.196551	5.888228
6.766667	0.029385	0.198837	6.244838
6.844444	0.029385	0.201122	6.552334
6.922222	0.029385	0.203408	6.845980
7.000000	0.029385	0.205693	7.127494
7.077778	0.029385	0.207979	7.398266

```
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.2            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.2            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Appendix 5: Conveyance Analysis

Nothing is necessary for this appendix at this time

Appendix 6: Operations and Maintenance Manual

1. Operations and Maintenance Manual

CONTECH®
ENGINEERED SOLUTIONS

OPERATION AND MAINTENANCE

CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit. The steel CBSF is offered both as a standard and as a deep unit for additional internal overflow and sediment capacity.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. Steel and concrete units can accept surface and piped influent for roof leaders or similar applications.

The steel, concrete and plastic CBSF units have capacities of 4, 8 and 2 cartridges, respectively. Internal overflow capacity varies by system type from 0.5 cfs for the plastic, 1.3 cfs for the concrete and 1.0 or 1.8 cfs for the steel unit.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas or other non-traffic-bearing applications.

The steel CBSF consists of a sumped inlet chamber and cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed into the cartridge chamber through a port between the baffle and the overflow weir.

The concrete and plastic units operate similarly minus the presence of the inlet chamber or deep sump.

Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed to the outlet chamber and discharged to the outlet pipe on the downstream side of the overflow weir.

When influent flows exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that have little available hydraulic head. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF. The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re piping the storm system.

CatchBasin StormFilter™

Maintenance Guidelines

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight 100 lbs. each) or plastic grating.
3. Turn cartridge(s) approximately ¼ turn counter-clockwise to disconnect from pipe manifold.
4. Remove cartridge(s) from catch basin by hand or with appropriate hoisting equipment.
5. Remove accumulated sediment via vactor truck from all interior chambers.
6. Rinse interior of both bays and vactor remaining water and sediment.
7. Install fresh cartridge(s), by rotating ¼ turn clockwise, taking care not to damage cartridge connectors.
8. Replace cover(s).
9. Dispose of accumulated debris and spent media in accordance with local regulations.
10. Return used, empty cartridges to Contech for refurbishing.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure once the top cap and hood are removed. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance.

Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to Contech as appropriate.

Refurbished cartridges are available from Contech on an exchange basis. Contact the maintenance department of Contech at 513-645-7770 for more information.

Onsite maintenance is estimated at 26 minutes once setup for a single cartridge unit. Add approximately 5 minutes for each additional cartridge.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance.
3. Use of larvicides containing Bacillus thuringiensis israelensis (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer's recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit https://www.amvac.com/products/summit-bti-briquets.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following: https://anrcatalog.ucanr.edu/pdf/8125.pdf.

CONTECH®
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StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
   b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

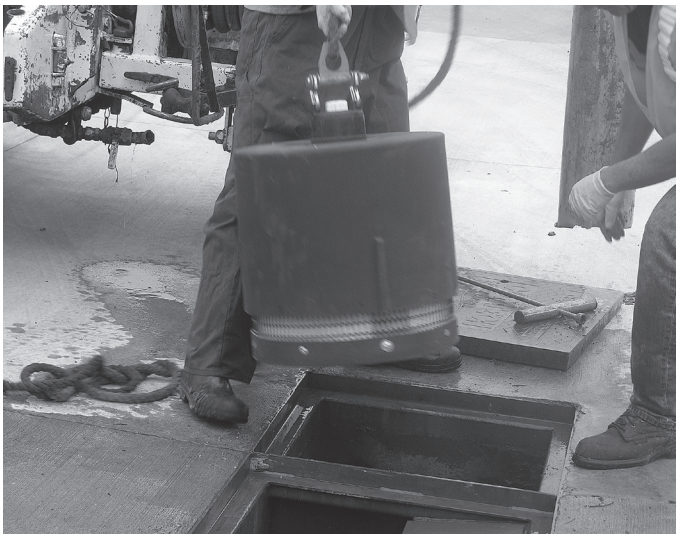
Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.



Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

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Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.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. (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. (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. 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. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (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 Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.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. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. 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 Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.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%. 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. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. 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. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. 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). 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	Top slab is free of holes and cracks. Frame is sitting 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. 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. 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. 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. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	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.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (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, meets the design standards, and is installed and aligned with the flow path.

Table V-A.6: Maintenance Standards - Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches. Bars are missing or entire barrier missing. Bars are loose and rust is causing 50% deterioration to any part of barrier.	Bars in place with no bends more than 3/4 inch. Bars in place according to design. Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

Table V-A.7: Maintenance Standards - Energy Dissipators

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.8: Maintenance Standards - Typical Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.

Appendix 7: Special Reports and Studies

1. N/A