

2021-12-16

FULL DRAINAGE REPORT
for
BRAVA LIGHT INDUSTRIAL
12313 Cyrus Way
Mukilteo, WA 98275

PREAPP 2020-002

ISSUE DATE: October 8, 2021
REVISION DATE: December 13, 2021

PREPARED & REVIEWED BY:
TIMOTHY SARKELA, P.E.



12-13-21

CLIENT

Estfin, LLC
12303 Cyrus Way
Mukilteo, WA 98275

ENGINEER

Western Engineers & Surveyors, Inc.
Job # 19-1836-A

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Minimum Requirement # 1: Stormwater Site Plan

Executive Summary

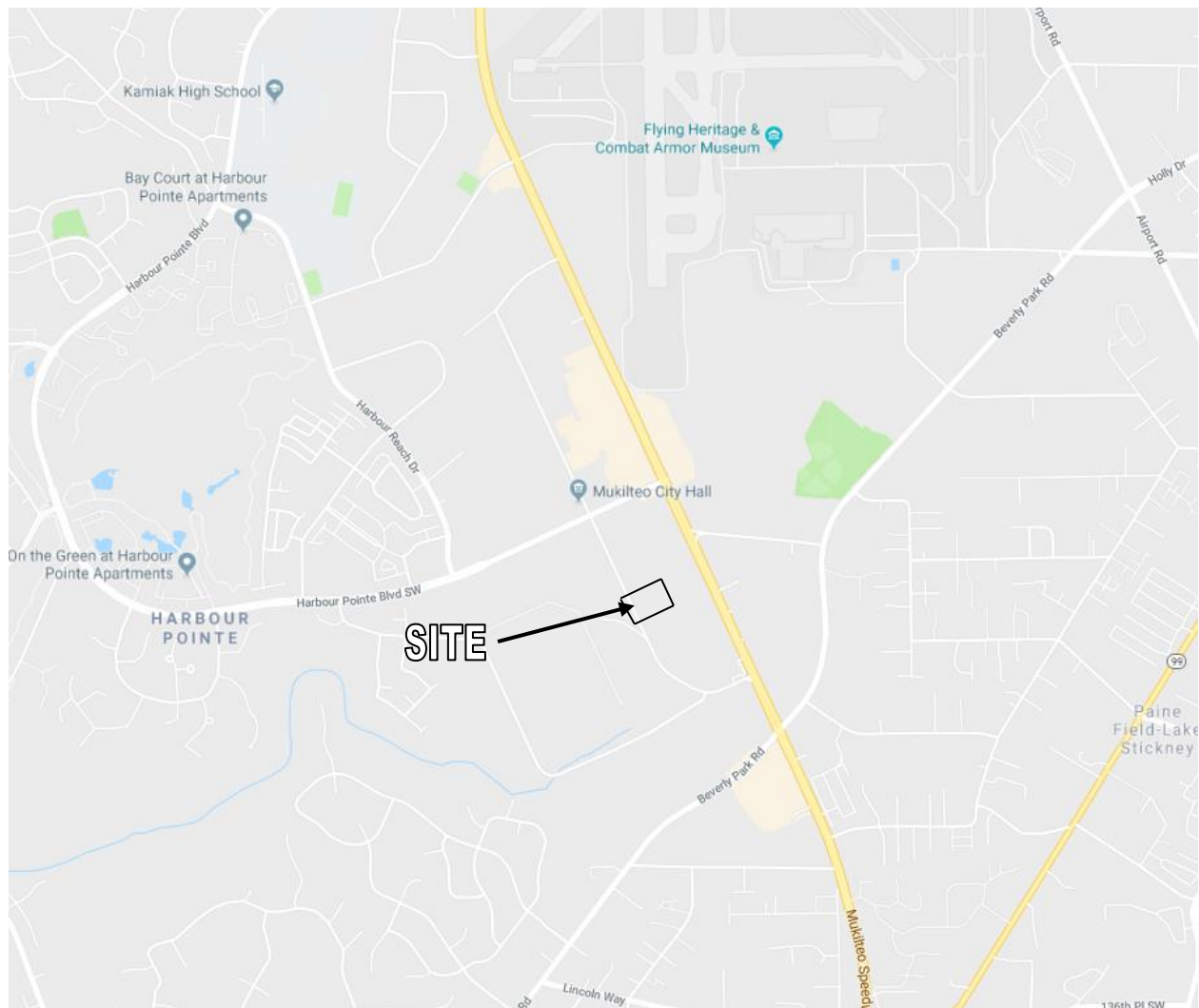
Project consists of site improvements for the installation of four detached Light Industrial buildings with associated parking, drainage and utilities. Property is to be accessed from the easterly side of Cyrus Way. All utilities, excluding sewer, are available from existing services on Cyrus Way. Sewer currently exists along the northern property line of the site.

Total on-site clearing estimated at 77,500 sf. across two on-site drainage basins. New/replaced hardscape is estimated at 70,805 sf. which includes frontage improvements along Cyrus Way. Due to site consisting of steeper slopes and areas of non-native fill, all new developed hardscape to be tight-lined into new on-site stormwater system. Storm system to drain to one of two new underground detention facilities located in the southwestern and central area of the site. Water quality treatment to be provided for northerly drainage basin which outlets into existing piped stream located along the northern property line of the site. Disturbed pervious areas will be amended per BMP T5.13. The project is to be designed to the 2012 (With 2014 Updates) WADOE Stormwater Design Manual, and 2019 City of Mukilteo Development Standard.

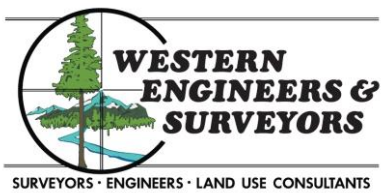
Existing Conditions Summary

The property is two tax parcels, mostly consisting of forest area. The property is accessed via the east side of Cyrus Way, which lies to the southwest of the site. On-site slopes are moderate to steep ranging from 2% to 40%. Property slopes in all directions due to area high point located in the south-central area of the site. A Category III wetland exists in the back area of the property and a Type Ns stream (partially piped) travels through the rear area of the site and along the north property line of the site draining into the existing storm system in Cyrus Way. Per Geotech report provided Associated Earth Sciences, soils on-site consist of gravelly silty sand with areas of non-native fill.

VICINITY MAP



MAP TAKEN FROM GOOGLE MAPS



9740 Evergreen Way, Everett WA 98204
(425) 356-2700 ✦ (425) 356-2708 (FAX)
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MUKILTEO, WA 98275

SCALE:
1" = ~ 2350'

DATE: 10/29/20

CHECKED: JAJ

BY: EMH

JOB NUMBER:
19-1836-A

FILE NAME:
191836A/VICINITYMAP

Upstream Analysis

The topography of the surrounding area is moderately sloped. Due to the site containing a neighborhood high point in the south-central area of the site, upstream flows mainly consist of a Type Ns stream which travels northwesterly through the rear of the site and then turns southwesterly and follows the northern property line of the site. Note that a large portion of the stream is piped along the northerly property line and currently being replaced/upgraded by the adjacent property owner to the north for better conveyance.

Downstream Analysis

A downstream analysis was provided by Jesse Jarrell, P.E. of Western Engineers & Surveyors Inc., on November 6, 2020. Weather was partly cloudy with a temperature around 50 degrees.

Project contains two separate drainage basins. Basin A, which consists of the northerly and easterly portions of the site and Basin B which consists of the southwestern portion of the site. Refer to below for downstream paths from each basin. Refer to the following pages for basin map depiction and downstream mapping.

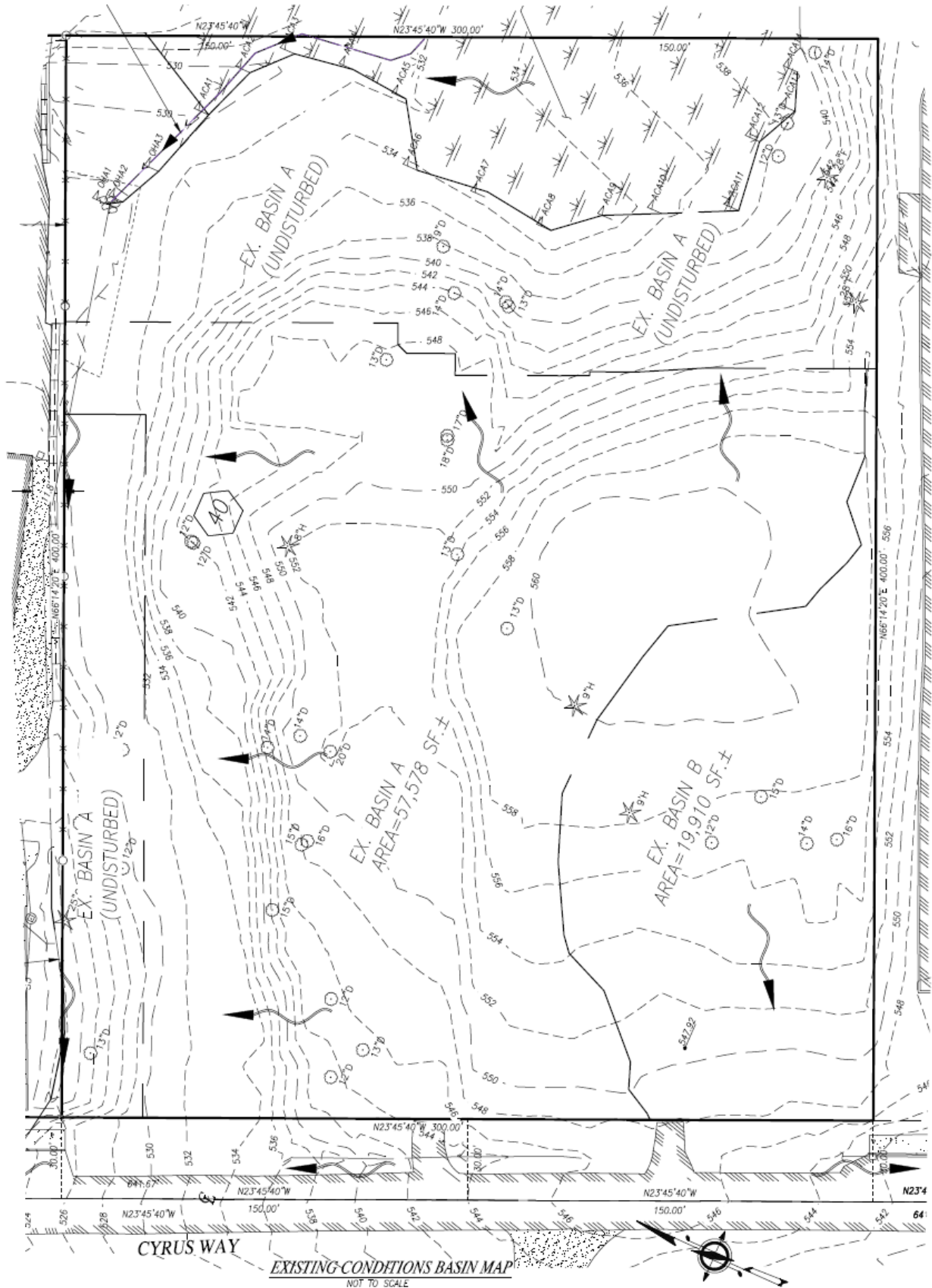
Basin A

Runoff from Basin A appears to flow easterly to the rear area of the site along with northerly towards the northerly property line. As runoff reaches the easterly and northerly property lines of the site, it drains into a stream which travels northerly through the back half of the site and westerly along the northern border where it drains into the existing storm system on Cyrus Way near the northwestern corner of the site. From there, runoff continues northerly for approximately 160' where it then turns west under Cyrus Way and outlets into a small ravine located in the northwesterly area of 12230 Cyrus Way.

From the northwestern area of 12230 Cyrus Way, the runoff continues westerly through forested areas where it eventually turns south and connects into Picnic Point Creek approximately 0.75 miles downstream of the site. As Picnic Point Creek is the closest receiving body of water no further downstream analysis is required. Note that due to limited access, visual inspection of stream area could not be made. Downstream description based on aerial and City stormwater mapping.

Basin B

Runoff from Basin B appears to flow westerly towards Cyrus Way where it enters into the existing storm system along the north side of the road. From there, runoff flows southeasterly along the north side of the road for approximately 450' where it turns southwest under Cyrus Way and enters into the property at 12516 Evergreen Dr. From there, runoff continues westerly through the property and outlets into a drainage swale located in the rear portion of 12521 Harbour Reach Dr. Runoff from the swale is then conveyed into an underground storm pipe which travels northwesterly and westerly for approximately 1,000' where it then crosses under Harbour Reach Dr. and daylights into an open ditch area directly west of Harbour Reach Dr. From there, the runoff continues southerly and westerly where it meets up with the downstream path from Basin A approximately 0.75 miles downstream from the site.

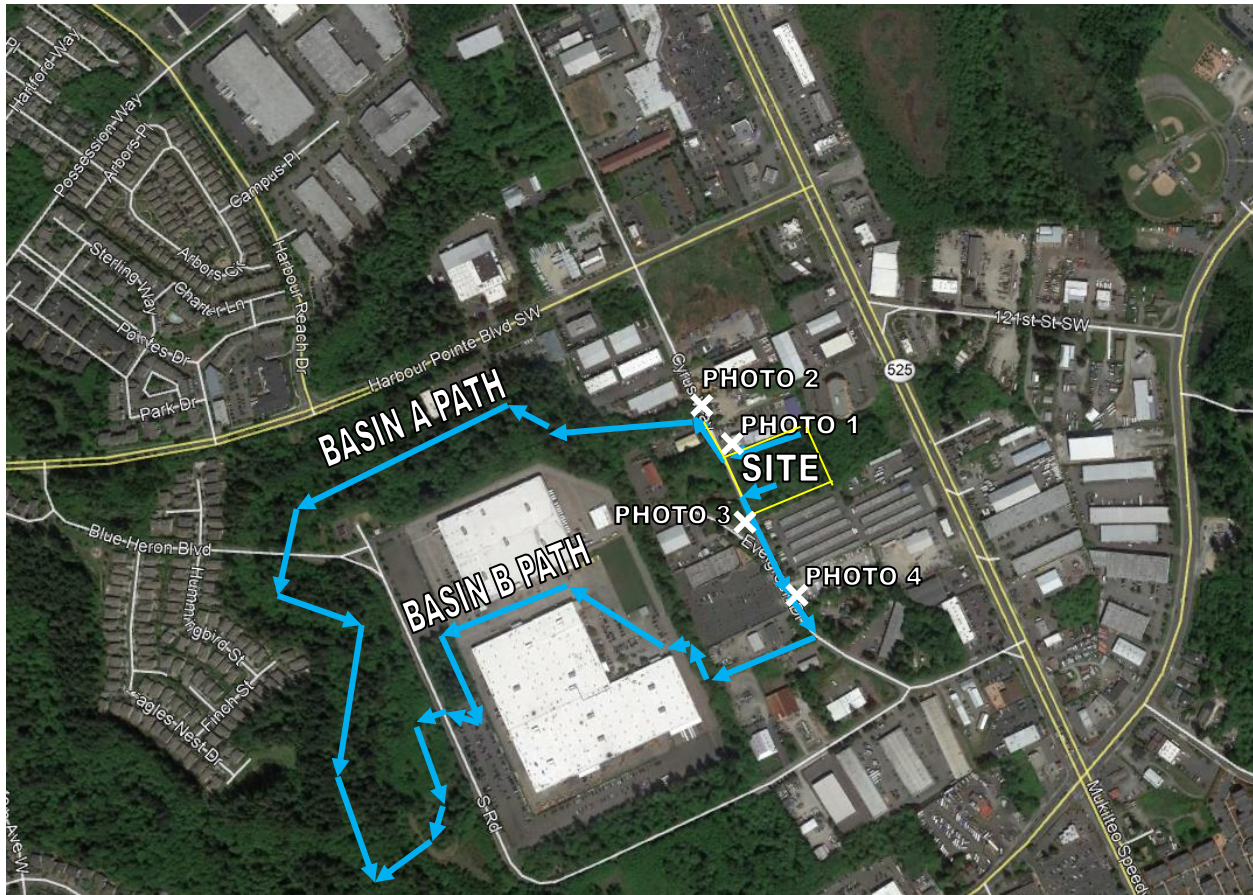


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DOWNSTREAM AND AERIAL MAPS

DOWNSTREAM AND PHOTO MAP

Photo Taken from Google Earth



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SCALE:
1" = ~1000'

DATE: 04/29/21

CHECKED: JAJ

BY: JAJ

JOB NUMBER:
19-1836-A

FILE NAME:
Aerial Map

DOWNSTREAM PHOTOGRAPHS

BASIN A DOWNSTREAM PHOTOGRAPHS



PHOTO 1:

Figure to the Left:

Looking easterly at the open stream in the southwest corner of the site



PHOTO 2:

Figure to the Right:

Looking north along Cyrus Way at the proposed flow



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SCALE:	None	DATE:	04/29/21	SHEET:	1 OF 3
BY:	JAJ	JOB NUMBER:	19-1836-A	FILE NAME:	Downstream 1.DOC

BASIN B DOWNSTREAM PHOTOGRAPHS



PHOTO 3:

Figure Above:

Looking easterly at the open stream in the southwest corner of the site



PHOTO 4:

Figure Above:

Looking north along Cyrus Way at the proposed flow



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SCALE:	None	DATE:	04/29/21	SHEET:	2 OF 3
BY:	JAJ	JOB NUMBER:	19-1836-A	FILE NAME:	Downstream 2.DOC

BASIN B DOWNSTREAM PHOTOGRAPHS



PHOTO 3:

Figure Above:

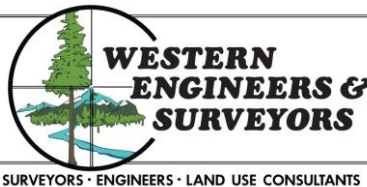
Looking easterly at the open stream in the southwest corner of the site



PHOTO 4:

Figure Above:

Looking north along Cyrus Way at the proposed flow



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SCALE:	None	DATE:	04/29/21	SHEET:	3 OF 3
BY:	JAJ	JOB NUMBER:	19-1836-A	FILE NAME:	Downstream 3.DOC

Minimum Requirement # 2: SWPPP Narrative

Element #1: Mark Clearing Limits

Clearing limits have been shown on the SWPPP Plan. Open streams and sensitive areas will be protected with well-marked clearing limits.

Element #2: Establish Construction Entrance

A temporary construction entrance is to be installed into the site from the east side of Cyrus Way. All vehicles shall be free of debris prior to leaving the site.

Element # 3: Control Flow Rates

Flow rates during construction will be managed with the use of temporary sediment traps for each drainage basin.

Element # 4: Install Sediment Controls

Sediment controls mainly consist of the installation of temporary sediment traps within each basin of the site. Temporary interceptor ditches with rock check dams will collect construction runoff and direct it to the sediment traps. Also, silt fences will be installed along the downslope boundaries of the project clearing area.

Element # 5: Stabilize Soils

All soils disturbed during site grading will be stabilized by use of the most appropriate BMP method available. These consist of short-term and long-term solutions. Short-term methods consist of compaction of the soils by vibratory roller or bulldozer. Long-term methods consist of straw covering over the soils (this is in the case of the project becoming dormant for greater than 1 month). At this time no wintertime grading or construction activities will occur. During construction periods longer than 1 working week (7 days) where the soils are exposed and un-worked will use the proscribed methods in the Storm Water Management Manual for Western Washington, and City of Mukilteo 2017 Development Standard Manual to reduce sedimentation transported offsite. If winter grading is conducted, all exposed soils shall be covered within 2 days.

Element # 6: Protect Slopes

On-site slopes left unworked will be protected with nets or blankets per BMP C122.

Element # 7: Protect Drain Inlets

Catch basin inlets within the project vicinity will be protected with catch basin sediment inserts. Catch basins installed on-site will also be protected with inserts until final site stabilization.

Element # 8: Stabilize Channels and Outlets

Channels and drainage outlets are not expected around the proposed development area on site. If alterations to existing channels are needed, disturbed channel areas will be protected with channel liner. Existing channels or drainage outlets located within 500-feet of the property should be routinely inspected for debris that may dam and/or aid erosion.

Element # 9: Control Pollutants

All pollutants from construction vehicles will be contained and disposed of in the approved manner consistent with state environmental policies. Any vehicle maintenance will be performed by authorized mechanics using drip pans and waste containment vessels. All pollutants will be disposed offsite at approved facilities.

Element # 10: Control De-Watering

De-watering of the site is not expected. If dewatering of the site is needed, all groundwater removed shall be retained and recharged into the ground or taken offsite via water truck and disposed at an approved site, after de-watering has been finalized.

Element # 11: Maintain BMP's

All Temporary Erosion and Sedimentation Control (TESC) devices and equipment will be inspected and maintained on a weekly basis if not sooner, based on storm events contributing to runoff. When construction is complete and the site is stabilized, any existing sediment will be removed and stabilized onsite.

Element # 12: Manage the Project

A general construction manager will manage the project for or by the owners. The construction manager shall maintain all of the above items in order to minimize sediment transport and turbid water leaving the site. His job will entail continual observation of the grading operations to ensure minimal effects to adjacent properties and offsite waterways.

Element # 13: Protect On-Site Stormwater Management BMPs

Soil amendment areas will be protected from compaction where feasible. No other stormwater BMP's proposed for development.

Minimal Requirement # 3: Water Pollution Source Control

All floor drains install within future buildings shall drain to an approved treatment system with overflow connections to sewer line.

Minimum Requirement # 4: Preservation of Natural Drainage Systems and Outfalls, and provisions of off-site mitigation

The project will continue to drain to the northwest and southwest as current existing. Site grading and drainage is to be designed to match developed basin areas to existing areas to the maximum extent feasible in order to maintain downstream hydrology for each downstream drainage basin. Refer to developed basin map following MR#7 for depiction of developed basin areas.

Minimum Requirement #5 On-Site Storm Water Management

The project results in more than 5,000 square feet of new/replaced hard surfaces, Minimum Requirements 1 through 9 apply to the project and on-site stormwater BMPs shall be selected according to List 2 for each proposed hard surface. Refer to List 2 below for appropriate BMP selection or infeasibility description:

Lawn and landscaped areas:

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V. (To be used in disturbed vegetated areas)

Roofs feasibility description:

1. Full Dispersion per BMP T5.30 or Downspout Full Infiltration per BMP T5.10A.
 - i. Full Dispersion is infeasible due to insufficient flow path length and lack of native forest vegetation. Full Infiltration is infeasible due to excess grading on-site, limited depths to restrictive layers and scattered areas of non-native fill on-site.
2. Bioretention per Volume V, Chapter 7.
 - i. Bioretention is infeasible due to unsuitable receptor soils located through the site. Infiltration is not recommended per the Geotechnical report.
3. Downspout Dispersion Systems in accordance with BMP T5.10B.
 - i. Downspout Dispersion is infeasible due to existing grades downstream of roof areas either consisting of slopes greater than 15% or have existing retaining walls downstream.
4. Perforated Stub-out Connections in accordance with BMP T5.10C.
 - i. Perforated stub-out connections are infeasible due to unsuitable receptor soils located through the site. Infiltration is not recommended per the Geotechnical report. Instead, all new roof areas to be directly connected to new on-site stormwater and detention system.

Other Hard Surfaces feasibility description:

1. Full Dispersion per BMP T5.30
 - i. As noted above, Full Dispersion is infeasible due to insufficient flow path length and lack of native forest vegetation.
2. Permeable Pavement per BMP T5.15
 - i. Permeable Pavement is infeasible due to unsuitable receptor soils located through the site. Infiltration is not recommended per the Geotechnical report.

3. Bioretention per Volume V, Chapter 7.
 - i. Bioretention is infeasible due to unsuitable receptor soils located through the site. Infiltration is not recommended per the Geotechnical report.
4. Sheet Flow Dispersion in accordance with BMP T5.12 or BMP T5.11.
 - i. Downspout Dispersion is infeasible due to existing grades downstream of roof areas either consisting of slopes greater than 15% or have existing or new retaining walls downstream. Instead, all hard surfaces areas to be directly connected to new on-site stormwater and detention system.

Minimum Requirement # 6: Runoff Treatment

Due to more than 5,000 sf. of new/replaced PGIS expected for the site, Water Quality Treatment is required. Due to project consisting of commercial development, Water Quality Treatment is to consist of enhanced treatment. Note that PGIS for Basin B totals approximately 2,000 sf. Due to less than 5,000 sf. of PGIS for Basin B, Water Quality Treatment is only required for developed Basin A.

Water Quality Treatment for the Basin is preliminarily designed utilizing a Biopod premanufactured vault from Old Castle downstream of detention for Basin A. As such, treatment rate shall be equal to the detained 2-year runoff rate. Per preliminary WWHM calculations, a 2-year detained flow rate of 0.0584 cfs. (26.2 GPM) has been calculated. Refer to WWHM calcs following MR#7 description below for additional information.

Minimum Requirement # 7: Flow Control

Due to the site proposing more than 10,000 sf. of new/replaced effective hard surfaces, flow control is required for each developed basin. Based on preliminary WWHM calculations, 610 LF of 6' diameter circular pipe with 6" dead storage and 3.6" freeboard is required for Basin A based and 218 LF of 6' diameter circular pipe with 6" dead storage and 3.6" freeboard is required for Basin B. Note that due to small size of Basin B, a minimum 0.5" orifice cannot be achieved for restrictor sizing. Designed lower orifice for Basin B to be rounded up to 0.50". Refer to basin break down below and the following WWHM flow control exemption calculations for additional information in addition to Appendix III for verification that a 0.5" minimum lower orifice can't be achieved with a minimal 3' Live Storage Depth.

Total Property Area = 120,000 sf. (2.755 Ac.)

Basin A Summary:

Total On-Site Basin Clearing	= 57,578 sf.
Total Frontage Clearing	= 4,000 sf.
Total Basin Clearing Area	= 61,578 sf. (1.414 Ac.)

Existing/Undeveloped Site

Entire Basin A (1.414 Ac.) to be analyzed with forested conditions.

Proposed Basin A**On-Site Impervious area:**

Building A & B Roofs	= 15,600 sf.
New On-site Parking & Walks	= 33,743 sf.
Total	= 49,343 sf.

Off-Site Impervious area:

Cyrus Way Curb & S/W	= 1,750 sf.
Cyrus Way Asphalt Shoulder	= 1,752 sf.
Total	= 3,502 sf.

Total New/Replaced Hardscape = 52,845 sf. (1.213 Ac.)

Pervious area:

Basin Area (61,578 sf.) – New Hardscape (52,845 sf.) = 8,733 sf. (0.200 Ac.)

Detention Sizing Notes:

1. Pervious areas will be modeled as pasture area in WWHM due to soil amendment application.
2. All pervious areas, excluding landscape areas in parking area (820 sf.), and frontage to account as bypass in detention sizing.

Basin B Summary:

Total On-Site Basin Clearing	= 19,910 sf.
Total Frontage Clearing	= 1,500 sf.
Total Basin Clearing Area	= 21,410 sf. (0.492 Ac.)

Existing/Undeveloped Site

Entire Basin B (0.492 Ac.) to be analyzed with forested conditions.

Proposed Basin B**On-Site Impervious area:**

Building C & D Roofs	= 15,360 sf.
New On-site Parking & Walks	= 1,515 sf.
Total	= 16,875 sf.

Off-Site Impervious area:

Cyrus Way Curb & S/W	= 638 sf.
Cyrus Way Asphalt Shoulder	= 447 sf.
Total	= 1,085 sf.

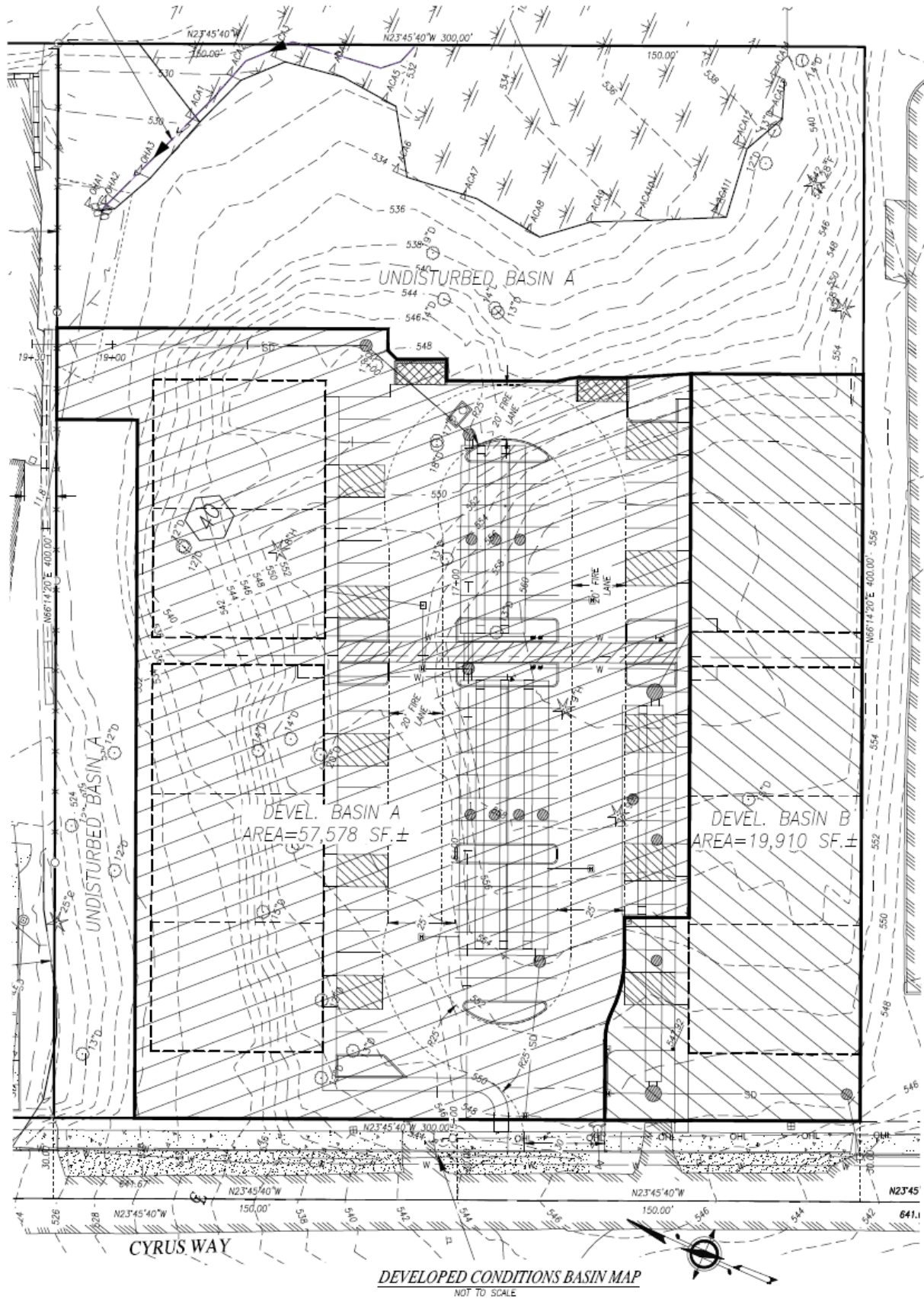
Total New/Replaced Hardscape = 17,960 sf. (0.412 Ac.)

Pervious area:

Basin Area (21,410 sf.) – New Hardscape (17,960 sf.) = 3,450 sf. (0.079 Ac.)

Detention Sizing Notes:

1. Pervious areas will be modeled as pasture area in WWHM due to soil amendment application.
2. All pervious areas, excluding 832 sf. between Buildings C & D, and frontage to account as bypass in detention sizing.



Basin A Flow Rate Calculations prior to Detention

**WWHM2012
PROJECT REPORT**

Project Name: Basin A_REV TESC 02-26-21
Site Name: Brava Basin A
Site Address: 124XX Cyrus Way
City : Mukilteo
Report Date: 2/26/2021
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

PREDEVELOPED LAND USE

Name : Undeveloped Basin A
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Steep	1.414

Pervious Total	1.414
----------------	-------

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

Basin Total	1.414
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MITIGATED LAND USE

Name : Devel Basin A
Bypass: No

GroundWater: No

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

<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.358
PARKING FLAT	0.775

Impervious Total	1.133
------------------	-------

Basin Total	1.133
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Name : Basin A Bypass

Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.2
Pervious Total	0.2
<u>Impervious Land Use</u>	<u>acre</u>
ROADS MOD	0.04
SIDEWALKS MOD	0.041
Impervious Total	0.081
Basin Total	0.281

ANALYSIS RESULTS
Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.414
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.2
Total Impervious Area:1.214

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.046731
5 year	0.06993
10 year	0.087107
25 year	0.110851
50 year	0.130022
100 year	0.150466

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.524819
5 year	0.710837
10 year	0.846978
25 year	1.034347
50 year	1.185466
100 year	1.346812

Basin A Detention Sizing Calculations

**WWHM2012
PROJECT REPORT**

Project Name: Basin A_REV 02-26-21
Site Name: Brava Basin A
Site Address: 124XX Cyrus Way
City : Mukilteo
Report Date: 2/26/2021
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Undeveloped Basin A
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Steep	1.414

Pervious Total	1.414
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<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0

Basin Total	1.414
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MITIGATED LAND USE

Name : Devel Basin A
Bypass: No

GroundWater: No

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

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<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.358
PARKING FLAT	0.775

Impervious Total 1.133

Basin Total 1.133

Element Flows To:

Surface	Interflow	Groundwater
Tank A	Tank A	

Name : Tank A

Tank Name: Tank A

Dimensions

Depth: 6 ft.
 Tank Type : Circular
 Diameter : 6 ft.
 Length : 610 ft.

Discharge Structure

Riser Height: 5.7 ft.
 Riser Diameter: 12 in.
 Orifice 1 Diameter: 0.65 in. Elevation: 0.5 ft.
 Orifice 2 Diameter: 1.156 in. Elevation: 3.5 ft.
 Orifice 3 Diameter: 0.656 in. Elevation: 4.5 ft.

Element Flows To:

Outlet 1 Outlet 2

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
539.00	0.000	0.000	0.000	0.000
539.07	0.017	0.000	0.000	0.000
539.13	0.024	0.002	0.000	0.000
539.20	0.030	0.004	0.000	0.000
539.27	0.034	0.006	0.000	0.000
539.33	0.038	0.008	0.000	0.000
539.40	0.041	0.011	0.000	0.000
539.47	0.045	0.014	0.000	0.000
539.53	0.047	0.017	0.002	0.000
539.60	0.050	0.020	0.003	0.000
539.67	0.052	0.024	0.004	0.000
539.73	0.055	0.027	0.005	0.000
539.80	0.057	0.031	0.006	0.000
539.87	0.059	0.035	0.006	0.000
539.93	0.060	0.039	0.007	0.000
540.00	0.062	0.043	0.008	0.000
540.07	0.064	0.047	0.008	0.000
540.13	0.065	0.051	0.009	0.000
540.20	0.067	0.056	0.009	0.000
540.27	0.068	0.060	0.010	0.000
540.33	0.069	0.065	0.010	0.000
540.40	0.071	0.070	0.010	0.000
540.47	0.072	0.075	0.011	0.000

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540.53	0.073	0.079	0.011	0.000
540.60	0.074	0.084	0.012	0.000
540.67	0.075	0.089	0.012	0.000
540.73	0.076	0.094	0.012	0.000
540.80	0.077	0.099	0.013	0.000
540.87	0.077	0.105	0.013	0.000
540.93	0.078	0.110	0.013	0.000
541.00	0.079	0.115	0.014	0.000
541.07	0.079	0.120	0.014	0.000
541.13	0.080	0.126	0.014	0.000
541.20	0.081	0.131	0.014	0.000
541.27	0.081	0.137	0.015	0.000
541.33	0.081	0.142	0.015	0.000
541.40	0.082	0.147	0.015	0.000
541.47	0.082	0.153	0.016	0.000
541.53	0.083	0.158	0.016	0.000
541.60	0.083	0.164	0.016	0.000
541.67	0.083	0.170	0.016	0.000
541.73	0.083	0.175	0.017	0.000
541.80	0.083	0.181	0.017	0.000
541.87	0.083	0.186	0.017	0.000
541.93	0.084	0.192	0.017	0.000
542.00	0.084	0.198	0.018	0.000
542.07	0.084	0.203	0.018	0.000
542.13	0.083	0.209	0.018	0.000
542.20	0.083	0.214	0.018	0.000
542.27	0.083	0.220	0.019	0.000
542.33	0.083	0.225	0.019	0.000
542.40	0.083	0.231	0.019	0.000
542.47	0.083	0.237	0.019	0.000
542.53	0.082	0.242	0.026	0.000
542.60	0.082	0.248	0.031	0.000
542.67	0.081	0.253	0.035	0.000
542.73	0.081	0.259	0.038	0.000
542.80	0.081	0.264	0.040	0.000
542.87	0.080	0.269	0.043	0.000
542.93	0.079	0.275	0.045	0.000
543.00	0.079	0.280	0.047	0.000
543.07	0.078	0.285	0.049	0.000
543.13	0.077	0.290	0.050	0.000
543.20	0.077	0.296	0.052	0.000
543.27	0.076	0.301	0.054	0.000
543.33	0.075	0.306	0.055	0.000
543.40	0.074	0.311	0.057	0.000
543.47	0.073	0.316	0.058	0.000
543.53	0.072	0.321	0.062	0.000
543.60	0.071	0.325	0.064	0.000
543.67	0.069	0.330	0.067	0.000
543.73	0.068	0.335	0.069	0.000
543.80	0.067	0.339	0.071	0.000
543.87	0.065	0.344	0.073	0.000
543.93	0.064	0.348	0.075	0.000
544.00	0.062	0.352	0.077	0.000
544.07	0.060	0.356	0.078	0.000
544.13	0.059	0.360	0.080	0.000
544.20	0.057	0.364	0.081	0.000
544.27	0.055	0.368	0.083	0.000

BRAVA L.I.

544.33	0.052	0.371	0.085	0.000
544.40	0.050	0.375	0.086	0.000
544.47	0.047	0.378	0.087	0.000
544.53	0.045	0.381	0.089	0.000
544.60	0.041	0.384	0.090	0.000
544.67	0.038	0.387	0.092	0.000
544.73	0.034	0.389	0.157	0.000
544.80	0.030	0.391	0.428	0.000
544.87	0.024	0.393	0.799	0.000
544.93	0.017	0.395	1.212	0.000
545.00	0.000	0.395	1.608	0.000
545.07	0.000	0.000	1.934	0.000

Name : Basin A Bypass

Bypass: Yes

GroundWater: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Mod	.2
 Pervious Total	 0.2
<u>Impervious Land Use</u>	<u>acre</u>
ROADS MOD	0.04
SIDEWALKS MOD	0.041
 Impervious Total	 0.081
 Basin Total	 0.281

ANALYSIS RESULTS
Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.414
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.2
Total Impervious Area:1.214

Flow Frequency Return Periods for Predeveloped. POC #1	
<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.046731
5 year	0.06993
10 year	0.087107
25 year	0.110851
50 year	0.130022
100 year	0.150466

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.058447
5 year	0.082676
10 year	0.102166
25 year	0.131154
50 year	0.156222
100 year	0.184542

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

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.032	0.058
1950	0.054	0.061
1951	0.041	0.061
1952	0.036	0.053
1953	0.031	0.056
1954	0.133	0.100
1955	0.068	0.059
1956	0.056	0.058
1957	0.064	0.062
1958	0.054	0.108
1959	0.051	0.049
1960	0.046	0.053
1961	0.047	0.146
1962	0.041	0.055
1963	0.065	0.067
1964	0.045	0.045
1965	0.039	0.042
1966	0.026	0.043
1967	0.058	0.086
1968	0.069	0.054
1969	0.092	0.123
1970	0.035	0.047
1971	0.054	0.061
1972	0.047	0.074
1973	0.035	0.057
1974	0.074	0.075
1975	0.034	0.059
1976	0.035	0.050
1977	0.030	0.044
1978	0.037	0.041
1979	0.080	0.075
1980	0.044	0.056
1981	0.036	0.043
1982	0.044	0.057
1983	0.071	0.059
1984	0.042	0.067
1985	0.058	0.063
1986	0.140	0.126
1987	0.059	0.080
1988	0.037	0.054
1989	0.034	0.051
1990	0.042	0.045
1991	0.044	0.050
1992	0.038	0.052

BRAVA L.I.

1993	0.029	0.044
1994	0.025	0.043
1995	0.045	0.052
1996	0.093	0.061
1997	0.159	0.307
1998	0.031	0.063
1999	0.038	0.037
2000	0.026	0.103
2001	0.011	0.038
2002	0.042	0.037
2003	0.032	0.045
2004	0.051	0.087
2005	0.039	0.040
2006	0.091	0.083
2007	0.081	0.072
2008	0.122	0.115
2009	0.035	0.050

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

Rank	Predeveloped	Mitigated
1	0.1590	0.3069
2	0.1402	0.1459
3	0.1329	0.1259
4	0.1216	0.1233
5	0.0927	0.1146
6	0.0919	0.1082
7	0.0906	0.1025
8	0.0806	0.0998
9	0.0796	0.0871
10	0.0745	0.0856
11	0.0710	0.0828
12	0.0687	0.0805
13	0.0679	0.0751
14	0.0650	0.0745
15	0.0640	0.0735
16	0.0592	0.0720
17	0.0584	0.0673
18	0.0581	0.0666
19	0.0557	0.0633
20	0.0539	0.0629
21	0.0536	0.0616
22	0.0536	0.0614
23	0.0510	0.0610
24	0.0506	0.0606
25	0.0471	0.0605
26	0.0470	0.0592
27	0.0459	0.0592
28	0.0452	0.0588
29	0.0445	0.0582
30	0.0445	0.0579
31	0.0444	0.0574
32	0.0437	0.0567
33	0.0418	0.0562
34	0.0417	0.0556
35	0.0417	0.0552

BRAVA L.I.

36	0.0412	0.0545
37	0.0411	0.0538
38	0.0394	0.0534
39	0.0393	0.0527
40	0.0381	0.0523
41	0.0375	0.0522
42	0.0369	0.0511
43	0.0366	0.0499
44	0.0361	0.0498
45	0.0356	0.0496
46	0.0352	0.0489
47	0.0349	0.0471
48	0.0349	0.0448
49	0.0346	0.0445
50	0.0342	0.0445
51	0.0339	0.0444
52	0.0317	0.0442
53	0.0317	0.0434
54	0.0312	0.0432
55	0.0307	0.0430
56	0.0297	0.0423
57	0.0291	0.0415
58	0.0261	0.0401
59	0.0258	0.0375
60	0.0248	0.0373
61	0.0110	0.0368

Stream Protection Duration

POC #1

The Facility PASSED

The Facility **PASSED.**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0234	14910	14724	98	Pass
0.0244	13340	11834	88	Pass
0.0255	11905	9779	82	Pass
0.0266	10617	8215	77	Pass
0.0277	9432	6996	74	Pass
0.0288	8397	6023	71	Pass
0.0298	7497	5309	70	Pass
0.0309	6660	4699	70	Pass
0.0320	5910	4205	71	Pass
0.0331	5217	3784	72	Pass
0.0341	4624	3450	74	Pass
0.0352	4096	3181	77	Pass
0.0363	3681	2930	79	Pass
0.0374	3260	2697	82	Pass
0.0384	2926	2485	84	Pass
0.0395	2627	2289	87	Pass
0.0406	2372	2121	89	Pass
0.0417	2143	1943	90	Pass
0.0428	1946	1759	90	Pass
0.0438	1790	1604	89	Pass
0.0449	1619	1494	92	Pass
0.0460	1468	1397	95	Pass

BRAVA L.I.

0.0471	1336	1304	97	Pass
0.0481	1228	1215	98	Pass
0.0492	1120	1141	101	Pass
0.0503	1034	1053	101	Pass
0.0514	945	973	102	Pass
0.0525	866	906	104	Pass
0.0535	812	842	103	Pass
0.0546	755	789	104	Pass
0.0557	709	736	103	Pass
0.0568	671	689	102	Pass
0.0578	627	654	104	Pass
0.0589	603	618	102	Pass
0.0600	583	581	99	Pass
0.0611	566	551	97	Pass
0.0621	549	525	95	Pass
0.0632	526	503	95	Pass
0.0643	502	472	94	Pass
0.0654	484	447	92	Pass
0.0665	468	429	91	Pass
0.0675	456	415	91	Pass
0.0686	441	398	90	Pass
0.0697	428	379	88	Pass
0.0708	420	367	87	Pass
0.0718	409	356	87	Pass
0.0729	398	345	86	Pass
0.0740	385	334	86	Pass
0.0751	373	316	84	Pass
0.0762	354	305	86	Pass
0.0772	344	294	85	Pass
0.0783	330	283	85	Pass
0.0794	312	272	87	Pass
0.0805	296	262	88	Pass
0.0815	288	256	88	Pass
0.0826	279	250	89	Pass
0.0837	272	238	87	Pass
0.0848	266	232	87	Pass
0.0859	258	223	86	Pass
0.0869	254	214	84	Pass
0.0880	249	204	81	Pass
0.0891	245	198	80	Pass
0.0902	239	188	78	Pass
0.0912	232	181	78	Pass
0.0923	225	175	77	Pass
0.0934	218	167	76	Pass
0.0945	214	162	75	Pass
0.0955	210	154	73	Pass
0.0966	203	145	71	Pass
0.0977	197	141	71	Pass
0.0988	192	133	69	Pass
0.0999	188	124	65	Pass
0.1009	185	118	63	Pass
0.1020	179	110	61	Pass
0.1031	175	100	57	Pass
0.1042	170	94	55	Pass
0.1052	157	89	56	Pass
0.1063	145	78	53	Pass
0.1074	141	71	50	Pass

BRAVA L.I.

0.1085	137	64	46	Pass
0.1096	130	55	42	Pass
0.1106	123	52	42	Pass
0.1117	117	51	43	Pass
0.1128	112	46	41	Pass
0.1139	107	42	39	Pass
0.1149	104	36	34	Pass
0.1160	97	35	36	Pass
0.1171	91	34	37	Pass
0.1182	86	34	39	Pass
0.1192	74	33	44	Pass
0.1203	65	33	50	Pass
0.1214	55	33	60	Pass
0.1225	52	31	59	Pass
0.1236	47	30	63	Pass
0.1246	43	30	69	Pass
0.1257	39	28	71	Pass
0.1268	38	27	71	Pass
0.1279	32	27	84	Pass
0.1289	27	26	96	Pass
0.1300	23	25	108	Pass

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Basin B Flow Rate Calculations prior to Detention

**WWHM2012
PROJECT REPORT**

Project Name: Basin B
Site Name: Brava
Site Address: 124XX Cyrus Way
City : Mukilteo
Report Date: 11/5/2020
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Undeveloped Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	.289
C, Forest, Steep	.203
Pervious Total	0.492
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.492

Element Flows To:		
Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Developed Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.08
Pervious Total	0.08
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.01

BRAVA L.I.

ROOF TOPS FLAT	0.353
SIDEWALKS FLAT	0.014
PARKING FLAT	0.035
Impervious Total	0.412
Basin Total	0.492

Element Flows To:		
Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.492
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.08
Total Impervious Area:0.412

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.011718
5 year	0.017881
10 year	0.022302
25 year	0.028226
50 year	0.032866
100 year	0.037687

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.119928
5 year	0.159622
10 year	0.187698
25 year	0.225288
50 year	0.254867
100 year	0.285831

Basin B Detention Sizing Calculations

**WWHM2012
PROJECT REPORT**

Project Name: Basin B
Site Name: Brava
Site Address: 124XX Cyrus Way
City : Mukilteo
Report Date: 11/5/2020
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Undeveloped Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	.289
C, Forest, Steep	.203
Pervious Total	0.492
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.492

Element Flows To:		
Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Developed Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.02
Pervious Total	0.02

BRAVA L.I.

<u>Impervious Land Use</u>	<u>acre</u>
ROOF TOPS FLAT	0.353
PARKING FLAT	0.035

Impervious Total 0.388

Basin Total 0.408

Element Flows To:

Surface	Interflow	Groundwater
Tank 1	Tank 1	

Name : Basin B Detention Pipe

Tank Name: Tank 1

Dimensions

Depth: 6 ft.

Tank Type : Circular

Diameter : 6 ft.

Length : 220 ft.

Discharge Structure

Riser Height: 5.8 ft.

Riser Diameter: 12 in.

Orifice 1 Diameter: 0.33 in. **Elevation:** 0.5 ft.

Orifice 2 Diameter: 0.6875 in. **Elevation:** 4.25 ft.

Element Flows To:

Outlet 1	Outlet 2
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Tank Hydraulic Table

<u>Stage(feet)</u>	<u>Area(ac.)</u>	<u>Volume(ac-ft.)</u>	<u>Discharge(cfs)</u>	<u>Infilt(cfs)</u>
0.0000	0.000	0.000	0.000	0.000
0.0667	0.006	0.000	0.000	0.000
0.1333	0.008	0.000	0.000	0.000
0.2000	0.010	0.001	0.000	0.000
0.2667	0.012	0.002	0.000	0.000
0.3333	0.013	0.003	0.000	0.000
0.4000	0.015	0.004	0.000	0.000
0.4667	0.016	0.005	0.000	0.000
0.5333	0.017	0.006	0.000	0.000
0.6000	0.018	0.007	0.000	0.000
0.6667	0.019	0.008	0.001	0.000
0.7333	0.019	0.010	0.001	0.000
0.8000	0.020	0.011	0.001	0.000
0.8667	0.021	0.012	0.001	0.000
0.9333	0.022	0.014	0.001	0.000
1.0000	0.022	0.015	0.002	0.000
1.0667	0.023	0.017	0.002	0.000
1.1333	0.023	0.018	0.002	0.000
1.2000	0.024	0.020	0.002	0.000
1.2667	0.024	0.022	0.002	0.000
1.3333	0.025	0.023	0.002	0.000
1.4000	0.025	0.025	0.002	0.000
1.4667	0.026	0.027	0.002	0.000

BRAVA L.I.

1.5333	0.026	0.028	0.003	0.000
1.6000	0.026	0.030	0.003	0.000
1.6667	0.027	0.032	0.003	0.000
1.7333	0.027	0.034	0.003	0.000
1.8000	0.027	0.036	0.003	0.000
1.8667	0.028	0.037	0.003	0.000
1.9333	0.028	0.039	0.003	0.000
2.0000	0.028	0.041	0.003	0.000
2.0667	0.028	0.043	0.003	0.000
2.1333	0.029	0.045	0.003	0.000
2.2000	0.029	0.047	0.003	0.000
2.2667	0.029	0.049	0.003	0.000
2.3333	0.029	0.051	0.004	0.000
2.4000	0.029	0.053	0.004	0.000
2.4667	0.029	0.055	0.004	0.000
2.5333	0.029	0.057	0.004	0.000
2.6000	0.030	0.059	0.004	0.000
2.6667	0.030	0.061	0.004	0.000
2.7333	0.030	0.063	0.004	0.000
2.8000	0.030	0.065	0.004	0.000
2.8667	0.030	0.067	0.004	0.000
2.9333	0.030	0.069	0.004	0.000
3.0000	0.030	0.071	0.004	0.000
3.0667	0.030	0.073	0.004	0.000
3.1333	0.030	0.075	0.004	0.000
3.2000	0.030	0.077	0.004	0.000
3.2667	0.030	0.079	0.004	0.000
3.3333	0.030	0.081	0.005	0.000
3.4000	0.030	0.083	0.005	0.000
3.4667	0.029	0.085	0.005	0.000
3.5333	0.029	0.087	0.005	0.000
3.6000	0.029	0.089	0.005	0.000
3.6667	0.029	0.091	0.005	0.000
3.7333	0.029	0.093	0.005	0.000
3.8000	0.029	0.095	0.005	0.000
3.8667	0.029	0.097	0.005	0.000
3.9333	0.028	0.099	0.005	0.000
4.0000	0.028	0.101	0.005	0.000
4.0667	0.028	0.103	0.005	0.000
4.1333	0.028	0.104	0.005	0.000
4.2000	0.027	0.106	0.005	0.000
4.2667	0.027	0.108	0.007	0.000
4.3333	0.027	0.110	0.009	0.000
4.4000	0.026	0.112	0.010	0.000
4.4667	0.026	0.114	0.011	0.000
4.5333	0.026	0.115	0.012	0.000
4.6000	0.025	0.117	0.013	0.000
4.6667	0.025	0.119	0.014	0.000
4.7333	0.024	0.120	0.015	0.000
4.8000	0.024	0.122	0.015	0.000
4.8667	0.023	0.124	0.016	0.000
4.9333	0.023	0.125	0.016	0.000
5.0000	0.022	0.127	0.017	0.000
5.0667	0.022	0.128	0.017	0.000
5.1333	0.021	0.130	0.018	0.000
5.2000	0.020	0.131	0.018	0.000
5.2667	0.019	0.132	0.019	0.000

BRAVA L.I.

5.3333	0.019	0.134	0.019	0.000
5.4000	0.018	0.135	0.020	0.000
5.4667	0.017	0.136	0.020	0.000
5.5333	0.016	0.137	0.021	0.000
5.6000	0.015	0.138	0.021	0.000
5.6667	0.013	0.139	0.022	0.000
5.7333	0.012	0.140	0.022	0.000
5.8000	0.010	0.141	0.022	0.000
5.8667	0.008	0.142	0.205	0.000
5.9333	0.006	0.142	0.533	0.000
6.0000	0.000	0.142	0.931	0.000
6.0667	0.000	0.000	1.342	0.000

Name : Basin B Bypass

Bypass: Yes

<u>Pervious Land Use</u>	<u>acre</u>
C, Pasture, Flat	.06
Pervious Total	0.06
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.01
SIDEWALKS FLAT	0.014
Impervious Total	0.024
Basin Total	0.084

Element Flows To:

Surface	Interflow	Groundwater
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ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1

Total Pervious Area:0.492

Total Impervious Area:0

Mitigated Landuse Totals for POC #1

Total Pervious Area:0.08

Total Impervious Area:0.412

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.013086
5 year	0.019807
10 year	0.024712
25 year	0.031398

BRAVA L.I.

50 year	0.036722
100 year	0.042333

Flow Frequency Return Periods for Mitigated.	POC #1
<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.015482
5 year	0.024278
10 year	0.03195
25 year	0.044176
50 year	0.055428
100 year	0.068801

Stream Protection Duration		
Annual Peaks for Predeveloped and Mitigated.		
POC #1		
<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.008	0.015
1950	0.015	0.018
1951	0.012	0.013
1952	0.010	0.014
1953	0.008	0.015
1954	0.037	0.025
1955	0.019	0.018
1956	0.016	0.020
1957	0.018	0.016
1958	0.014	0.027
1959	0.014	0.012
1960	0.012	0.013
1961	0.013	0.037
1962	0.011	0.014
1963	0.017	0.019
1964	0.012	0.011
1965	0.012	0.010
1966	0.007	0.010
1967	0.016	0.023
1968	0.019	0.015
1969	0.022	0.031
1970	0.010	0.012
1971	0.016	0.019
1972	0.013	0.020
1973	0.010	0.015
1974	0.021	0.018
1975	0.010	0.015
1976	0.010	0.013
1977	0.008	0.011
1978	0.010	0.011
1979	0.022	0.020
1980	0.012	0.012
1981	0.010	0.011
1982	0.012	0.013
1983	0.020	0.015
1984	0.012	0.021
1985	0.017	0.017
1986	0.041	0.081
1987	0.017	0.024
1988	0.010	0.013
1989	0.010	0.014

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1990	0.012	0.012
1991	0.013	0.011
1992	0.010	0.012
1993	0.008	0.010
1994	0.007	0.012
1995	0.013	0.013
1996	0.025	0.016
1997	0.046	0.189
1998	0.009	0.016
1999	0.011	0.010
2000	0.007	0.022
2001	0.003	0.010
2002	0.012	0.015
2003	0.009	0.011
2004	0.014	0.021
2005	0.011	0.011
2006	0.029	0.020
2007	0.024	0.018
2008	0.034	0.036
2009	0.010	0.014

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

Rank	Predeveloped	Mitigated
1	0.0460	0.1895
2	0.0407	0.0809
3	0.0374	0.0367
4	0.0339	0.0361
5	0.0286	0.0310
6	0.0255	0.0271
7	0.0238	0.0249
8	0.0222	0.0238
9	0.0219	0.0234
10	0.0215	0.0222
11	0.0202	0.0215
12	0.0192	0.0211
13	0.0187	0.0201
14	0.0183	0.0198
15	0.0173	0.0197
16	0.0171	0.0196
17	0.0170	0.0192
18	0.0162	0.0187
19	0.0159	0.0178
20	0.0155	0.0178
21	0.0145	0.0177
22	0.0145	0.0175
23	0.0142	0.0169
24	0.0137	0.0163
25	0.0132	0.0160
26	0.0129	0.0159
27	0.0127	0.0154
28	0.0127	0.0153
29	0.0125	0.0153
30	0.0124	0.0152
31	0.0123	0.0151
32	0.0121	0.0151

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33	0.0121	0.0146
34	0.0120	0.0143
35	0.0120	0.0139
36	0.0118	0.0137
37	0.0118	0.0136
38	0.0114	0.0132
39	0.0111	0.0132
40	0.0108	0.0131
41	0.0102	0.0126
42	0.0101	0.0126
43	0.0100	0.0126
44	0.0099	0.0125
45	0.0099	0.0125
46	0.0098	0.0124
47	0.0097	0.0121
48	0.0097	0.0116
49	0.0097	0.0116
50	0.0096	0.0114
51	0.0096	0.0113
52	0.0091	0.0113
53	0.0086	0.0112
54	0.0080	0.0111
55	0.0080	0.0111
56	0.0079	0.0107
57	0.0076	0.0104
58	0.0070	0.0103
59	0.0068	0.0102
60	0.0067	0.0100
61	0.0027	0.0099

Stream Protection Duration

POC #1

The Facility PASSED

The Facility **PASSED.**

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0065	17325	17199	99	Pass
0.0068	15383	13524	87	Pass
0.0072	13629	10964	80	Pass
0.0075	12136	9062	74	Pass
0.0078	10812	7546	69	Pass
0.0081	9631	6408	66	Pass
0.0084	8647	5508	63	Pass
0.0087	7706	4815	62	Pass
0.0090	6825	4237	62	Pass
0.0093	6070	3769	62	Pass
0.0096	5390	3375	62	Pass
0.0099	4819	3093	64	Pass
0.0102	4312	2853	66	Pass
0.0105	3867	2661	68	Pass
0.0108	3459	2453	70	Pass
0.0111	3125	2301	73	Pass
0.0114	2802	2182	77	Pass
0.0117	2530	2045	80	Pass
0.0120	2259	1892	83	Pass

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0.0123	2041	1785	87	Pass
0.0126	1830	1675	91	Pass
0.0129	1670	1570	94	Pass
0.0132	1518	1480	97	Pass
0.0136	1408	1396	99	Pass
0.0139	1312	1329	101	Pass
0.0142	1219	1256	103	Pass
0.0145	1130	1181	104	Pass
0.0148	1026	1110	108	Pass
0.0151	958	1031	107	Pass
0.0154	892	965	108	Pass
0.0157	836	910	108	Pass
0.0160	800	849	106	Pass
0.0163	758	802	105	Pass
0.0166	727	767	105	Pass
0.0169	698	720	103	Pass
0.0172	667	684	102	Pass
0.0175	641	655	102	Pass
0.0178	617	613	99	Pass
0.0181	593	589	99	Pass
0.0184	566	559	98	Pass
0.0187	548	523	95	Pass
0.0190	532	483	90	Pass
0.0193	518	456	88	Pass
0.0197	503	427	84	Pass
0.0200	487	404	82	Pass
0.0203	472	386	81	Pass
0.0206	458	367	80	Pass
0.0209	446	348	78	Pass
0.0212	430	333	77	Pass
0.0215	409	312	76	Pass
0.0218	391	298	76	Pass
0.0221	368	287	77	Pass
0.0224	350	271	77	Pass
0.0227	339	258	76	Pass
0.0230	333	239	71	Pass
0.0233	324	231	71	Pass
0.0236	315	221	70	Pass
0.0239	306	212	69	Pass
0.0242	298	199	66	Pass
0.0245	291	188	64	Pass
0.0248	285	181	63	Pass
0.0251	280	171	61	Pass
0.0254	272	163	59	Pass
0.0257	267	157	58	Pass
0.0261	260	152	58	Pass
0.0264	253	142	56	Pass
0.0267	249	128	51	Pass
0.0270	244	119	48	Pass
0.0273	238	106	44	Pass
0.0276	230	92	40	Pass
0.0279	219	80	36	Pass
0.0282	214	73	34	Pass
0.0285	205	69	33	Pass
0.0288	198	66	33	Pass
0.0291	192	63	32	Pass
0.0294	188	59	31	Pass

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0.0297	174	57	32	Pass
0.0300	167	54	32	Pass
0.0303	161	54	33	Pass
0.0306	155	52	33	Pass
0.0309	150	52	34	Pass
0.0312	143	49	34	Pass
0.0315	139	48	34	Pass
0.0318	133	48	36	Pass
0.0321	127	48	37	Pass
0.0325	122	48	39	Pass
0.0328	117	48	41	Pass
0.0331	112	48	42	Pass
0.0334	106	47	44	Pass
0.0337	99	47	47	Pass
0.0340	92	47	51	Pass
0.0343	87	47	54	Pass
0.0346	82	45	54	Pass
0.0349	73	43	58	Pass
0.0352	62	42	67	Pass
0.0355	56	40	71	Pass
0.0358	53	40	75	Pass
0.0361	51	39	76	Pass
0.0364	48	39	81	Pass
0.0367	43	38	88	Pass

Minimum Requirement # 8: Wetland Protection

On-site wetland consists of a Category III wetland. Wetland to be protected during construction with construction and silt fencing in addition to retention of buffer areas.

Minimum Requirement # 9: Operation and Maintenance

BMP T5.13 Post-Construction Soil Quality and Depth

Maintenance

- Soil quality and depth should be established toward the end of construction and once established, should be protected from compaction, such as from large machinery use, and from erosion.
- Soil should be planted and mulched after installation.
- Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Sediment & Debris	Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No sediment or debris is located immediately in front of catch basin or on grate opening.
		Sediment, trash, and/or other debris material (located in the catch basin) exceeds 60 percent of the sump depth as measured from the bottom of the basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No sediment or debris is in the catch basin.
		Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height.	Inlet and outlet pipes are free of sediment and debris.
		Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation are present within 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 seeping into the catch basin).	Top slab is free of holes and cracks. No water and/or soil is seeping into the catch 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	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Catch basin is replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	Settlement of misalignment of the catch basin causes a safety, function, or design problem.	Catch basin is replaced or repaired to design standards.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed.
Access Hole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is fully in place
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, 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)	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

APPENDIX I

Drainage Plan

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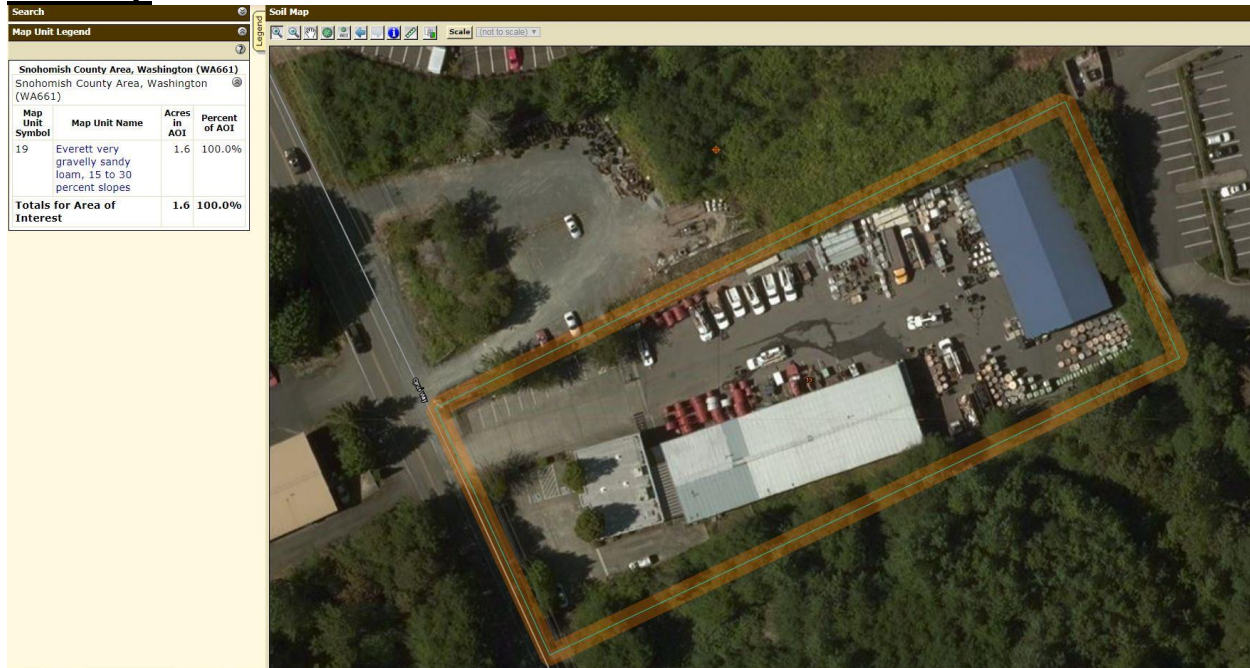
APPENDIX II

SOIL INFORMATION

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Refer to separate Geotechnical Engineering Report by Associated Earth Science, Inc. for subsurface exploration and an explanation of on-site soil characteristics.

Soil Map



19—Everett very gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t62c

Elevation: 30 to 900 feet

Mean annual precipitation: 35 to 91 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 180 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent

Minor components: 20 percent

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

Description of Everett

Setting

Landform: Kames, eskers, moraines

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Sandy and gravelly glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

A - 1 to 3 inches: very gravelly sandy loam

Bw - 3 to 24 inches: very gravelly sandy loam

C1 - 24 to 35 inches: very gravelly loamy sand

C2 - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High
(1.98 to 5.95 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: A

Forage suitability group: Droughty Soils (G002XS401WA), Droughty Soils
(G002XN402WA)

Hydric soil rating: No

Minor Components

Alderwood

Percent of map unit: 10 percent

Landform: Ridges, hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, nose slope, tal

Down-slope shape: Linear, convex

Across-slope shape: Convex

Hydric soil rating: No

Indianola

Percent of map unit: 10 percent

Landform: Eskers, kames, terraces

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

APPENDIX III

3” Live storage Detention calculation for 0.5” Lower Orifice Exemption

WWM2012

PROJECT REPORT

Project Name: Basin B 0.5" Lower Orifice Check
Site Name: Brava
Site Address: 124XX Cyrus Way
City : Mukilteo
Report Date: 11/2/2020
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Undeveloped Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
C, Forest, Mod	.289
C, Forest, Steep	.203
Pervious Total	0.492
<u>Impervious Land Use</u>	<u>acre</u>
Impervious Total	0
Basin Total	0.492

Element Flows To:		
Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Developed Basin B
Bypass: No

<u>Pervious Land Use</u>	<u>acre</u>
Pervious Total	0
<u>Impervious Land Use</u>	<u>acre</u>
ROADS FLAT	0.01
ROOF TOPS FLAT	0.353
SIDEWALKS FLAT	0.014

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PARKING FLAT	0.035
Impervious Total	0.412
Basin Total	0.412

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Name : 0.5" Lower Orifice Check with 3' Storage Depth

Width : 6 ft.

Length : 432.739234684123 ft.

Depth: 4 ft.

Discharge Structure

Riser Height: 3 ft.

Riser Diameter: 18 in.

Orifice 1 Diameter: 0.29 in. Elevation: 0 ft.

Orifice 2 Diameter: 0.53 in. Elevation: 2.061 ft.

Orifice 3 Diameter: 1.11 in. Elevation: 2.65875000000003 ft.

Element Flows To:

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

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.059	0.000	0.000	0.000
0.0444	0.059	0.002	0.000	0.000
0.0889	0.059	0.005	0.000	0.000
0.1333	0.059	0.007	0.000	0.000
0.1778	0.059	0.010	0.001	0.000
0.2222	0.059	0.013	0.001	0.000
0.2667	0.059	0.015	0.001	0.000
0.3111	0.059	0.018	0.001	0.000
0.3556	0.059	0.021	0.001	0.000
0.4000	0.059	0.023	0.001	0.000
0.4444	0.059	0.026	0.001	0.000
0.4889	0.059	0.029	0.001	0.000
0.5333	0.059	0.031	0.001	0.000
0.5778	0.059	0.034	0.001	0.000
0.6222	0.059	0.037	0.001	0.000
0.6667	0.059	0.039	0.001	0.000
0.7111	0.059	0.042	0.001	0.000
0.7556	0.059	0.045	0.002	0.000
0.8000	0.059	0.047	0.002	0.000
0.8444	0.059	0.050	0.002	0.000
0.8889	0.059	0.053	0.002	0.000
0.9333	0.059	0.055	0.002	0.000
0.9778	0.059	0.058	0.002	0.000
1.0222	0.059	0.060	0.002	0.000
1.0667	0.059	0.063	0.002	0.000
1.1111	0.059	0.066	0.002	0.000
1.1556	0.059	0.068	0.002	0.000
1.2000	0.059	0.071	0.002	0.000

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1.2444	0.059	0.074	0.002	0.000
1.2889	0.059	0.076	0.002	0.000
1.3333	0.059	0.079	0.002	0.000
1.3778	0.059	0.082	0.002	0.000
1.4222	0.059	0.084	0.002	0.000
1.4667	0.059	0.087	0.002	0.000
1.5111	0.059	0.090	0.002	0.000
1.5556	0.059	0.092	0.002	0.000
1.6000	0.059	0.095	0.002	0.000
1.6444	0.059	0.098	0.002	0.000
1.6889	0.059	0.100	0.003	0.000
1.7333	0.059	0.103	0.003	0.000
1.7778	0.059	0.106	0.003	0.000
1.8222	0.059	0.108	0.003	0.000
1.8667	0.059	0.111	0.003	0.000
1.9111	0.059	0.113	0.003	0.000
1.9556	0.059	0.116	0.003	0.000
2.0000	0.059	0.119	0.003	0.000
2.0444	0.059	0.121	0.003	0.000
2.0889	0.059	0.124	0.004	0.000
2.1333	0.059	0.127	0.005	0.000
2.1778	0.059	0.129	0.006	0.000
2.2222	0.059	0.132	0.006	0.000
2.2667	0.059	0.135	0.006	0.000
2.3111	0.059	0.137	0.007	0.000
2.3556	0.059	0.140	0.007	0.000
2.4000	0.059	0.143	0.008	0.000
2.4444	0.059	0.145	0.008	0.000
2.4889	0.059	0.148	0.008	0.000
2.5333	0.059	0.151	0.008	0.000
2.5778	0.059	0.153	0.009	0.000
2.6222	0.059	0.156	0.009	0.000
2.6667	0.059	0.158	0.012	0.000
2.7111	0.059	0.161	0.017	0.000
2.7556	0.059	0.164	0.020	0.000
2.8000	0.059	0.166	0.022	0.000
2.8444	0.059	0.169	0.025	0.000
2.8889	0.059	0.172	0.026	0.000
2.9333	0.059	0.174	0.028	0.000
2.9778	0.059	0.177	0.030	0.000
3.0222	0.059	0.180	0.084	0.000
3.0667	0.059	0.182	0.306	0.000
3.1111	0.059	0.185	0.622	0.000
3.1556	0.059	0.188	1.005	0.000
3.2000	0.059	0.190	1.441	0.000
3.2444	0.059	0.193	1.915	0.000
3.2889	0.059	0.196	2.413	0.000
3.3333	0.059	0.198	2.922	0.000
3.3778	0.059	0.201	3.427	0.000
3.4222	0.059	0.204	3.914	0.000
3.4667	0.059	0.206	4.369	0.000
3.5111	0.059	0.209	4.781	0.000
3.5556	0.059	0.211	5.142	0.000
3.6000	0.059	0.214	5.447	0.000
3.6444	0.059	0.217	5.696	0.000
3.6889	0.059	0.219	5.896	0.000
3.7333	0.059	0.222	6.062	0.000

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3.7778	0.059	0.225	6.299	0.000
3.8222	0.059	0.227	6.476	0.000
3.8667	0.059	0.230	6.648	0.000
3.9111	0.059	0.233	6.816	0.000
3.9556	0.059	0.235	6.980	0.000
4.0000	0.059	0.238	7.140	0.000
4.0444	0.059	0.241	7.297	0.000
4.0889	0.000	0.000	7.450	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.492
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.412

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.013086
5 year	0.019807
10 year	0.024712
25 year	0.031398
50 year	0.036722
100 year	0.042333

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.006672
5 year	0.014893
10 year	0.024099
25 year	0.042262
50 year	0.062428
100 year	0.090339

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	0.008	0.003
1950	0.015	0.009
1951	0.012	0.007
1952	0.010	0.003
1953	0.008	0.003
1954	0.037	0.008
1955	0.019	0.025
1956	0.016	0.022
1957	0.018	0.003
1958	0.014	0.008

BRAVA L.I.

1959	0.014	0.007
1960	0.012	0.003
1961	0.013	0.010
1962	0.011	0.003
1963	0.017	0.004
1964	0.012	0.003
1965	0.012	0.007
1966	0.007	0.003
1967	0.016	0.007
1968	0.019	0.008
1969	0.022	0.007
1970	0.010	0.005
1971	0.016	0.021
1972	0.013	0.003
1973	0.010	0.008
1974	0.021	0.009
1975	0.010	0.003
1976	0.010	0.007
1977	0.008	0.003
1978	0.010	0.003
1979	0.022	0.003
1980	0.012	0.003
1981	0.010	0.003
1982	0.012	0.007
1983	0.020	0.008
1984	0.012	0.023
1985	0.017	0.021
1986	0.041	0.058
1987	0.017	0.028
1988	0.010	0.009
1989	0.010	0.003
1990	0.012	0.007
1991	0.013	0.008
1992	0.010	0.005
1993	0.008	0.003
1994	0.007	0.007
1995	0.013	0.015
1996	0.025	0.019
1997	0.046	0.188
1998	0.009	0.006
1999	0.011	0.009
2000	0.007	0.009
2001	0.003	0.002
2002	0.012	0.021
2003	0.009	0.003
2004	0.014	0.008
2005	0.011	0.004
2006	0.029	0.027
2007	0.024	0.018
2008	0.034	0.028
2009	0.010	0.007

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

Rank	Predeveloped	Mitigated
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BRAVA L.I.

1	0.0460	0.1879
2	0.0407	0.0583
3	0.0374	0.0284
4	0.0339	0.0276
5	0.0286	0.0269
6	0.0255	0.0247
7	0.0238	0.0232
8	0.0222	0.0224
9	0.0219	0.0213
10	0.0215	0.0209
11	0.0202	0.0208
12	0.0192	0.0188
13	0.0187	0.0175
14	0.0183	0.0146
15	0.0173	0.0100
16	0.0171	0.0093
17	0.0170	0.0093
18	0.0162	0.0090
19	0.0159	0.0088
20	0.0155	0.0087
21	0.0145	0.0084
22	0.0145	0.0083
23	0.0142	0.0080
24	0.0137	0.0079
25	0.0132	0.0078
26	0.0129	0.0077
27	0.0127	0.0077
28	0.0127	0.0074
29	0.0125	0.0074
30	0.0124	0.0074
31	0.0123	0.0072
32	0.0121	0.0072
33	0.0121	0.0072
34	0.0120	0.0071
35	0.0120	0.0069
36	0.0118	0.0066
37	0.0118	0.0065
38	0.0114	0.0062
39	0.0111	0.0052
40	0.0108	0.0050
41	0.0102	0.0043
42	0.0101	0.0037
43	0.0100	0.0032
44	0.0099	0.0032
45	0.0099	0.0032
46	0.0098	0.0031
47	0.0097	0.0031
48	0.0097	0.0031
49	0.0097	0.0031
50	0.0096	0.0031
51	0.0096	0.0031
52	0.0091	0.0031
53	0.0086	0.0030
54	0.0080	0.0030
55	0.0080	0.0030
56	0.0079	0.0029
57	0.0076	0.0028

BRAVA L.I.

58	0.0070	0.0027
59	0.0068	0.0027
60	0.0067	0.0026
61	0.0027	0.0021

Stream Protection Duration

POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0065	17325	15610	90	Pass
0.0068	15383	13015	84	Pass
0.0072	13629	10577	77	Pass
0.0075	12136	8917	73	Pass
0.0078	10812	7403	68	Pass
0.0081	9631	6030	62	Pass
0.0084	8647	4785	55	Pass
0.0087	7706	3696	47	Pass
0.0090	6825	2665	39	Pass
0.0093	6070	1999	32	Pass
0.0096	5390	1714	31	Pass
0.0099	4819	1652	34	Pass
0.0102	4312	1581	36	Pass
0.0105	3867	1521	39	Pass
0.0108	3459	1462	42	Pass
0.0111	3125	1412	45	Pass
0.0114	2802	1347	48	Pass
0.0117	2530	1300	51	Pass
0.0120	2259	1247	55	Pass
0.0123	2041	1200	58	Pass
0.0126	1830	1155	63	Pass
0.0129	1670	1121	67	Pass
0.0132	1518	1094	72	Pass
0.0136	1408	1051	74	Pass
0.0139	1312	1003	76	Pass
0.0142	1219	957	78	Pass
0.0145	1130	919	81	Pass
0.0148	1026	885	86	Pass
0.0151	958	863	90	Pass
0.0154	892	829	92	Pass
0.0157	836	803	96	Pass
0.0160	800	777	97	Pass
0.0163	758	761	100	Pass
0.0166	727	742	102	Pass
0.0169	698	718	102	Pass
0.0172	667	700	104	Pass
0.0175	641	675	105	Pass
0.0178	617	654	105	Pass
0.0181	593	628	105	Pass
0.0184	566	606	107	Pass
0.0187	548	576	105	Pass
0.0190	532	553	103	Pass
0.0193	518	537	103	Pass
0.0197	503	509	101	Pass

BRAVA L.I.

0.0200	487	483	99	Pass
0.0203	472	464	98	Pass
0.0206	458	441	96	Pass
0.0209	446	404	90	Pass
0.0212	430	380	88	Pass
0.0215	409	362	88	Pass
0.0218	391	344	87	Pass
0.0221	368	327	88	Pass
0.0224	350	311	88	Pass
0.0227	339	298	87	Pass
0.0230	333	285	85	Pass
0.0233	324	263	81	Pass
0.0236	315	251	79	Pass
0.0239	306	238	77	Pass
0.0242	298	226	75	Pass
0.0245	291	216	74	Pass
0.0248	285	206	72	Pass
0.0251	280	197	70	Pass
0.0254	272	189	69	Pass
0.0257	267	181	67	Pass
0.0261	260	167	64	Pass
0.0264	253	161	63	Pass
0.0267	249	148	59	Pass
0.0270	244	136	55	Pass
0.0273	238	122	51	Pass
0.0276	230	112	48	Pass
0.0279	219	106	48	Pass
0.0282	214	101	47	Pass
0.0285	205	94	45	Pass
0.0288	198	92	46	Pass
0.0291	192	88	45	Pass
0.0294	188	79	42	Pass
0.0297	174	69	39	Pass
0.0300	167	53	31	Pass
0.0303	161	52	32	Pass
0.0306	155	52	33	Pass
0.0309	150	52	34	Pass
0.0312	143	52	36	Pass
0.0315	139	52	37	Pass
0.0318	133	52	39	Pass
0.0321	127	51	40	Pass
0.0325	122	51	41	Pass
0.0328	117	50	42	Pass
0.0331	112	50	44	Pass
0.0334	106	50	47	Pass
0.0337	99	50	50	Pass
0.0340	92	50	54	Pass
0.0343	87	50	57	Pass
0.0346	82	50	60	Pass
0.0349	73	49	67	Pass
0.0352	62	48	77	Pass
0.0355	56	48	85	Pass
0.0358	53	48	90	Pass
0.0361	51	47	92	Pass
0.0364	48	47	97	Pass
0.0367	43	47	109	Pass