PRELIMINARY STORM DRAINAGE REPORT

FOR:

CALAVISTA – PRD/PLAT

LOCATED IN: SEC 13, TWP 26 N, RGE 1 E, W.M.
KITSAP COUNTY, WASHINGTON

Assessor's Account No.:
132601-3-065-2006
132601-3-003-2001

April 11, 2019
Revised: October 14, 2019
Revised: December 12, 2019
Revised: February 4, 2020
Revised: April 20, 2020

FOR:
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4/20/2020

"I hereby state that this Drainage Report has been prepared by me or under my supervision and meets the standard care and expertise which is usual and customary in this community of professional engineers. The analysis has been prepared utilizing procedures and practices specified by the City of Poulsbo and within the standard accepted practices of the industry. I understand that the City of Poulsbo does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me."

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I. LOCATION

The project consists of two parcels; 132601-3-065-2006 & 132601-3-003-2001.

The site is located on the east side of Caldart Ave, just south of the Cemetery and north of “NE Halden Glen Court”.

The site includes two addresses; 19700 & 19840 CALDART AVE NE, POULSBO, WA 98370. Both addresses have existing homes on them.

The site is a portion of the Southwest quarter of Section 13, Township 26 North, Range 1 East, W.M., in Kitsap County.

(Figure 1 – Vicinity Map).

II. EXISTING SITE CONDITIONS

The 9.05-acre site is composed of two parcels, both of which are underdeveloped with existing residential structures on them. Large portions of both properties remain undeveloped. The site is well vegetated and includes second growth forest of Douglas Firs, Cedars, Hemlock, Madrona, Maple, Pine and Alders with sword ferns, shrubbery and groundcover. The site slopes generally to the west, with steeper portions on the east and flatter portions to the west, abutting Caldart Ave. The steepest onsite slope approaches 36%. The entire onsite land will be considered native in the predeveloped condition for stormwater management purposes.

(Figure 2 – Predeveloped Site Conditions Map).

The parcel is bounded on all sides by Residential Low zoned properties, all of which currently are utilized as residential, except for the City of Poulsbo Cemetery on the north.

There is no evidence of existing drainage or erosion problems on-site.

There are no wetland critical areas or their buffers on the site.

Existing trees, larger than 10” dbh, have been reviewed by an ISA Certified Arborist and mapped by survey to document existing site coverage.

The soils on-site per the NRCS Soil Survey include:

22	Kapowsin gravelly ashy loam, 0 to 6 percent slopes	14%
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	46%
40	Poulsbo gravelly sandy loam, 6 to 15 percent slopes	40%

“Poulsbo” soils predominate the site and are considered Hydrologic Group “C”.

(Figure 3 – Soils Map).

A site-specific study of the soils onsite was conducted by a Licensed Geotechnical Engineer, who generated a report (ESC19-010.1), dated October 25, 2019. The report indicates infeasibility of infiltration due to proximity of till layer.

(Appendix G – Geotechnical Report).

III. UPSTREAM BASIN

Properties to the east include the following two tax parcels:

1. 132601-3-005-2009, owned by HUNTER BOBBY G
2. 132601-3-001-2003, owned by SVARDH MICHAEL L & JOAN Y

Each of these properties is developed with single family residences. Western portions of each of these parcels drains as sheet flow to the subject parcel. The contributing area is 2.53-acres. This runon will be allowed to enter the site as sheet flow and will be collected and routed through onsite stormwater treatment systems. Most of this sheet flow will be captured by a wall drainage system and routed through the onsite stormwater management facility.

Additionally, a point source discharge has been discovered onto the site in the northeast corner of the site from property in the “Fjellvue” plat.

3. 5191-000-016-0000, owned by SLADE RICHARD A & JUTHAMAS
4. 5191-000-017-0009, owned by FLEMING SANDRA L

The non-continuous flow from this point discharge appears to be from a landscaping feature and believed to be minor. We have collected survey information on this discharge and will intercept this flow and route it as appropriate through the onsite stormwater management facility.

(Figure 2 – Predeveloped Site Conditions Map).

IV. DOWNSTREAM ANALYSIS

The “Area of Study” begins at the discharge location and ends at the crossing under “Lincoln Road”, near “Caldart Cottages”.

EXISTING DOWNSTREAM

Stormwater runoff from the site currently flows westerly as sheet and shallow flow until intercepted by roadside ditches and stormwater catch basins along “Caldart Ave”. Closed conveyance from the northern portion of the site is routed under “Caldart Ave” and into “Poulsbo Gardens, Div. 1”, where it discharges to an open swale in the middle of “Mosjon Circle”. The runoff in the swale runs due south, behind several homes on either side, until it is routed via 18” CMP culvert under “Mosjon Circle” and discharged into a well-manicured recreation tract, a portion of a platted development called “Poulsbo Gardens, Div. 1”. The swale in the recreation tract is sloped to the south. Stormwater leaves “Poulsbo Gardens, Div. 1” via the sloped swale into a southerly plat named, “Caldart Heights”. Within “Caldart Heights” the stream travels southerly on the common boundary between Parcels 5498-000-003-0005 (Lot 3) & 5498-000-004-0004 (Lot 4) in a 20’ wide (10’ on each lot) “Native Vegetation Buffer”, then crosses under “NE Watland Street” in a 24” N-12 pipe (~101 LF), then through a 40’ “Native Vegetation Buffer” within an open space tract in an open channel, then crosses under “NE Odessa Way” in a 24” N-12 pipe (~81 LF), then through a 20’ “Native Vegetation Buffer” within an open space tract in an open channel, finally crossing under “NE Fontaine Way” in a 24” N-12 pipe (~35 LF) prior to leaving the plat of “Caldart Heights”. Stormwater continues southerly through privately owned parcel 142601-4-030-2005, further southerly through “Caldart Cottages”, further southerly through property owned by “St. Olafs”, before turning west in “Wilderness Park”. At some point along this route the drainage becomes the named “South Fork of Dogfish Creek”. “Dogfish Creek” discharges to “Liberty Bay”, a portion of the “Puget Sound”.

PROPOSED DOWNSTREAM

Stormwater vault discharge from the developed site, will be routed via closed conveyance from an onsite detention vault to a discharge point in the middle of an existing 24” N-12 pipe under “Watland Street” in the plat of “Caldart Heights”.

Stormwater BioPod discharge from the developed site, will be to an existing catch basin very near the SW corner of the development along, “Caldart Ave”.

(Figure 4 – Downstream Map).
(Figure 4B – Downstream Map).

Table 2-1 data for downstream

1. There is no evidence of contamination of surface waters. There is potential for contamination due to a new residential development area with vehicular traffic. It is unlikely that contaminated waters from the development will ever reach the surface waters of “Dogfish Creek”. The developed area will be constructed in a manner which will contain spills. All collected runoff will be routed to a spill-control quality treatment device which will provide oil/water separation prior to routing through a quality enhancement facility and a detention vault facility. The detention vault will have a hydraulic residence time that allows for additional settling of sediments, located in the bottom portion of the facility for deposition. The outlet control orifice will act as an additional separator.
2. No overtopping, scouring, or bank sloughing evidence is present. There is some deposition occurring in front of erosion control weirs, positioned in the bottom of the stream channel by the City in the recreation tract, located in “Poulsbo Gardens, Div.1.
3. Significant destruction for aquatic habitat or organisms (i.e. severe siltation or incision in a stream) due to the proposed discharge is not likely given the flood routing, the hydraulic residence time in the detention vault and stormwater quality enhancement provided.

4. There was no evidence found which would support or indicate a potential for contamination of ground water.

Portions of “Dogfish Creek” are listed on the Department of Ecology’s 303d list, for low dissolved oxygen, bacteria, turbidity and temperature.

(Appendix D – DOE 303d Listing for Dogfish Creek).

Known Flooding Issue

Anecdotal evidence of capacity and flooding was noted early by the City in the upper reaches of this basin. Specifically, within a recreation tract in a southern portion of the “Poulsbo Gardens” plat, where we originally considered discharging stormwater to a well-manicured and maintained recreation tract with lawns and a sculpted drainage channel. The actual stream channel appears to be maintained with hand tools and has erosion control sedimentation weirs installed, which are limiting flows. South of this tract is the plat of “Caldart Heights”. The stream channel within this plat is well defined and includes a very even gradient between 1-2% across the entire plat. Low gradient drainages can occasionally experience flooding if not well maintained. The elevation and character of the channel just south of the “Poulsbo Gardens” plat and within the “Caldart Heights” plat, appears to be less than well maintained. It is overgrown and likely contributing to the localized flooding in the “Poulsbo Gardens” recreation tract.

Due to known flooding in the channel noted above, the applicant searched for an opportunity to discharge further downstream. That opportunity was found in “Watland St”, where a culvert crosses under this road. The currently proposed discharge location provides additional elevation and distance, alleviating known flooding upstream of the new discharge location. Alleviation is also provided by removal of runoff volumes from this upper channel segment, via re-routed stormwater via closed conveyance.

With the onsite flow control proposed, runoff rates experienced offsite in the downstream will not be increased and localized flooding is not expected to be exacerbated beyond anecdotally experienced event levels. There are no other known or anticipated problems (with continued maintenance) with the downstream route to within one quarter mile of the discharge, identified as the “study area” during the Level 1 Analysis. The “study area” is limited to portions of the discharge pathway to the crossing under “Lincoln Road”. No construction in the stream channel or it’s buffers, beyond connection to an existing culvert under “Watland Street”, are currently proposed.

Habitat Biologist & WDFW Review of Downstream

Soundview Consultants was hired to review the downstream for this project. Their stream assessment concluded that the drainage channel in the “Poulsbo Gardens, Div.1” recreation tract was a man-made storm drainage channel and that the “South Fork of Dogfish Creek” begins at the culvert end on the south side of “Watland Street” within the “Caldart Heights” plat. The stream assessment also evaluated the stream channel within the Level 1 downstream

threshold area and found no other concerns. The stream assessment evaluation continued beyond the Level 1 threshold area to examine the downstream, approximately 1 mile from the proposed discharge location. Scour, associated with changing land use and localized channel characteristics was noted within "Wilderness Park", approximately one-half mile downstream. Soundview staff observed no recent signs of significant streambank erosion anywhere within the one-mile assessment. Compliance with current stormwater regulations, per the Washington State Department of Ecology and City of Poulsbo will provide the mitigation required to avoid negative impacts to the downstream.
(Attachment H – Stream Assessment Memo).

A representative from the Washington Department of Fish and Wildlife was also asked to review all subject materials and the actual stream to make a final determination of the beginning point of the "South Fork of Dogfish Creek". Based on all the evidence, including physical observation, WDFW has decided that the origin of the creek is at the southern culvert end, within the recreation tract, within "Poulsbo Gardens, Div.1".

V. SUMMARY OF PROPOSED DEVELOPMENT

The proposed 9.05-acre Planned Residential Development (PRD) will consist of 43 residential lots, associated drives, utilities and Stormwater management facilities. The home on the southern parcel will be retained on one of the proposed lots.

Per City of Poulsbo Zoning Map; The site is zoned Residential Low (RL, 4-5 DU/AC). The proposal is consistent with the current zoning and comprehensive plan.

A Geotechnical Engineer was hired to ascertain the ability to infiltrate stormwater onsite. Infiltration was determined to be infeasible due to presence of low permeable soils (till).

(Appendix G – Geotechnical Report).

The proposed development includes grading, construction of roads, utilities and Stormwater management facilities to support the new residential plat.

(Figure 5 – Developed Conditions Map).

City water and sewer will be extended into the site.

The site grading will result in 31,500 yd^3 of cut and 18,000 yd^3 of fill to accomplish the overall site grading. Excess material will be exported to an approved receiving site.

Developed site areas (acres) include:	Impervious	Pervious	Total
Proposed Lots	2.47	2.97	5.44
Tract A	0	0.02	0.02
Tract B	0	0.06	0.06

Tract C	0		0.02		0.02
Tract D	0.11		1.28		1.38
Tract E	0.06		0		0.06
Tract F	0		0.02		0.02
Tract G	0		0.06		0.06
Tract H	1.22		0.40		1.62
Tract I	0.23		0.14		0.37
Totals	4.08	+	4.97	=	9.05

New Pollution Generating Hard Surface Total = 77,053 SF (1.77-acres).
Replaced Pollution Generating Hard Surface Total = 0 SF (Assumed native in predeveloped condition.)

“PostDev” Basin areas (acres) include:	Impervious		Pervious		Total
Lot – Roof Allowance	1.74		0		1.74
Lot – Drive/Other Allowance	0.44		0		0.44
Lot – L&L	0		2.47		2.47
Tract A – L&L	0		0		0
Tract B – L&L	0		0		0
Tract C – L&L	0		0		0
Tract D – IMP	0.09		0		0.09
Tract D – Native	0		0.25		0.25
Tract D – L&L	0		0.93		0.93
Tract E – IMP	0.06		0		0.06
Tract F – L&L	0		0.02		0.02
Tract G – L&L	0		0.06		0.06
Tract H – IMP	1.17		0		1.17
Tract H – L&L	0		0.40		0.40
Tract I – IMP	0.23		0		0.23
Tract I – L&L	0		0.14		0.14
005 Hunter (existing pasture)	0		0.78		0.78
001 Svardh (existing pasture)	0		1.75		1.75
Totals	3.73	+	6.80	=	10.52

“Bypass” Basin areas (acres) include:	Impervious	Pervious	Total
Frontage Imp	0.12	0	0.12
Tract A – L&L	0	0.02	0.02
Tract B – L&L	0	0.06	0.06
Tract C – L&L	0	0.02	0.02
Tract D – IMP	0.02	0	0.02
Tract D – L&L	0	0.10	0.10
Halden – IMP	0.05	0	0.05
Lot 25 – IMP	0.06	0	0.06
Lot 25 – L&L	0	0.06	0.06

Lot 26 – IMP	0.06		0		0.06
Lot 26 – L&L	0		0.09		0.09
Lot 27 – IMP	0.06		0		0.06
Lot 27 – L&L	0		0.09		0.09
Lot 28 – IMP	0.06		0		0.06
Lot 28 – L&L	0		0.14		0.14
Lot 29 – IMP	0.06		0		0.06
Lot 29 – L&L	0		0.12		0.12
Tract H – IMP	0.05		0		0.05
Totals	0.53	+	0.70	=	1.23

(Appendix A – Basin Area Worksheet).

Applicable design standards include:

- City of Poulsbo Construction Standards.
- Stormwater Management Manual for Western Washington, amended 2014
- Low Impact Development Technical Guidance manual for Puget Sound, 2012

Additional permits required may include, but are not limited to:

- Clearing and Grading Permits from City of Poulsbo
- NPDES Construction Stormwater General Permit

VI. SUMMARY OF COMPLIANCE WITH STORMWATER REQUIREMENTS

The predeveloped basin includes some impervious surfacing. No credit for existing impervious surfacing will be utilized in the stormwater design. The existing development site includes less than 35% impervious surfacing coverage. Per Figure I-2.4.1 Flow Chart for Determining Requirements for New Development resulted in "All Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas".

(Appendix J – Figure I-2.4.1 New Development Flowchart).

MINIMUM REQUIREMENTS #1 - 9

Minimum Requirement #1: Preparation of Stormwater Site Plans
A preliminary stormwater site plan is included in the Preliminary Plat (PRD) review package. A final stormwater site plan will be submitted with the final construction plans.

Minimum requirement #2: Construction Stormwater Pollution Prevention (SWPPP)
A SWPPP will be submitted with the construction plans. A "TESC Plan" and associated details will be provided in the construction plans.

Minimum Requirement #3: Source Control of Pollution

Source control BMPs will be applied to the project. A “TESC Plan” and associated details will be provided in the construction plans.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
Stormwater discharge from the site will be to an existing drainage, somewhat south of the original discharge location in the upper reaches of the “South Fork of Dogfish Creek”. The current discharge point is near the proposed northern access connection to the plat. Due to localized flooding in this immediate downstream; This storm discharge location will be abandoned, in favor of discharge point to the south on “Watland St” to avoid an upper segment of the downstream that has some historical flooding within the “Poulsbo Gardens, Div.1” plat. Stormwater will receive quantity control and quality enhancement treatment prior to discharge, ensuring clean water is discharged into the downstream. The downstream beyond the connection point in “Watland Street” will be maintained. Relocation of the discharge location is necessary due to elevation constraints in the onsite detention system. The existing conveyance systems near the existing downstream are too shallow to maintain the existing route.

Minimum Requirement #5: On-site Stormwater Management
Compliance with List#2, as follows;
Lawn and Landscaped Areas:

- Soils will be amended.

Roofs:

- Full dispersion is infeasible because it requires retention preservation of too much land in native vegetation and would make development of the land infeasible. There is also a practical lack of downslope space for the required flow paths.
- Bioretention is infeasible for several inner-connected reasons, outlined as follows: Existing site constraints, including an existing easement in the SW corner of the site, slopes in excess of 8% covering much of the high ground on the eastside of the parcels, the existing primary discharge location being in the northern end of the parcels and the need to ensure general development feasibility; leave the SW corner of the norther access connection as the primary location to position a surface mounted Bioretention facility (or any facility for that matter). This location could house a Bioretention facility if not for the elevation constraints that make it infeasible to do so. The elevation is constrained by the need for quantity control storage and a useable discharge elevation, tied to a downstream discharge. If infiltration was selected over detention, proximity to the till layer would not provide the required 3-foot separation. Bioretention is therefore infeasible as a method for treating the overall onsite development.
- Downspout Dispersion is infeasible. Dispersion requires downstream flow paths from each downspout, where each downspout is limited to 700 SF of contributing surface area. All these flow paths have slope restriction which cannot be provided.
- Perforated Stub-out Connection is infeasible. This BMP requires native soils and relatively mild slopes, neither of which will be present across much of the developed site.

Other Hard Surfaces:

- Full dispersion is infeasible because it requires retention preservation of too much land in native vegetation and would make development of the land infeasible. There is also a practical lack of downslope space for the required flow paths.
- Permeable Pavement is infeasible. Permeable pavement must be installed at slopes under 5% and utilizes native soils for infiltration. The required infiltrative soils cannot be provided.
- Bioretention is infeasible for several inner-connected reasons, outlined as follows: Existing site constraints, including an existing easement in the SW corner of the site, slopes in excess of 8% covering much of the high ground on the eastside of the parcels, the existing primary discharge location being in the northern end of the parcels and the need to ensure general development feasibility; leave the SW corner of the norther access connection as the primary location to position a surface mounted Bioretention facility (or any facility for that matter). This location could house a Bioretention facility if not for the elevation constraints that make it infeasible to do so. The elevation is constrained by the need for quantity control storage and a useable discharge elevation, tied to a downstream discharge. If infiltration was selected over detention, proximity to the till layer would not provide the required 3-foot separation. Bioretention is therefore infeasible as a method for treating the overall onsite development.
- Sheet Flow Dispersion is infeasible due to lack of space for downstream flow pathways.

Minimum Requirement #6: Runoff Treatment

Figure V-2.1.1 Treatment Facility Selection Flow Chart from the DOE manual was utilized to determine runoff treatment needs.

Step 1: Identify Pollutants of Concern and Perform Off-site Analysis: Soundview Consultants and WDFW were both consulted to determine the location of and type of stream that stormwater will be discharged to. The stream at the discharge location is a type “N”, which is flowing through an existing 24” culvert under “Watland”. The stream is in an upper reach and tributary to the “South Fork of Dogfish Creek”, which becomes a type “F” stream, approximately 2500’ to the south of the proposed discharge connection point, in “Wilderness Park”.

Step 2: Determine if an Oil Control Facility is Required: The proposal is not a “high-use” site, nor does it include traffic volumes that would warrant an Oil Control Facility. Not required.

Step 3: Determine if Infiltration for Pollutant Removal is Practicable: Infiltration was deemed infeasible by the Geotechnical Engineering Consultant that reviewed onsite soils and found them to be too shallow to be effective. Not required.

Step 4: Determine if Phosphorus Control is Required: The downstream was reviewed on the WADOE Water Quality Atlas, which did not include any listings for phosphorus in the downstream all the way to the receiving waters of “Liberty Bay”. Not required.

Step 5: Determine if Enhanced Treatment is Required: Uses which would require “Enhanced” treatment are as follows:

- Industrial Project Sites
- Commercial Project Sites
- Multi-family Residential Project Sites
- High AADT roads.

This site does not meet any criteria requiring “Enhanced Treatment”, as outlined in the WADOE manual. Not required.

Step 6: Apply a Basic Treatment Facility: Stormwater quality mitigation will be provided by a proprietary stormwater quality enhancement facility, which has General Use Level Designation (GULD) approval by the Washington State Department of Ecology for “basic” stormwater treatment. The treatment facility will be sized to handle the peak 15-minute flow rate using WWHM 2012, as required.

(Appendix K - Figure V-2.1.1 Treatment Facility Selection Flow Chart)

Minimum Requirement #7: Flow Control
Stormwater quantity mitigation will be provided through live storage in an underground detention vault. The vault will treat approximately 7.99-acres of developed area, plus approximately 2.53-acres of upstream contributing area. Total PostDev basin is 10.53-acres. The stormwater management facilities will treat a developed basin that includes Public stormwater. The stormwater management facilities will therefore be turned over to the City upon completion of the project and will be maintained by the City.

Minimum Requirement #8: Wetlands Protection
The project will not discharge to a wetland.

Minimum Requirement #9: Operation and Maintenance
An operation and maintenance manual will be prepared and provided as required, prior to construction plan approval.

VII. HYDROLOGIC/HYDRAULIC ANALYSIS

The project was modelled utilizing the 2012 Western Washington Hydrology Model by Clear Creek Solutions.

Development coverage is outlined in Appendix A.

(Appendix A – Basin Area Worksheet)

Quantity Control Mitigation

PostDev Basin
Includes a detention vault designed to provide water quantity treatment. Furthermore, the detention vault size is based on allowable release rates as determined by WWHM 2012 modeling software that has been configured to account for the undetained release of Stormwater from the “Bypass” Basin. The resultant vault is 135’ long x 75’ wide x 11’ deep (live storage). The vault includes a system of interior walls to promote a longer hydraulic residence time for additional pollutant removal. Peak inflow to the vault will be 6.40 cfs. The vault is will include multiple access covers to ensure adequate maintenance access. The vault will also be designed to accommodate access to the access covers on the top of the facility.

Discharge from the developed site will be limited by an outlet control device on the discharge end of the vault, with the following configuration:

Interior Vault Ceiling Elevation = 303.00
Peak Stage Elevation = 302.10
2” diameter orifice (+7.00) Elevation = 299.00
2.1” diameter orifice (+5.00) Elevation = 297.00
1.813” (1-13/16”) diameter orifice (+0.00) Elevation = 292.00
Bottom of Live Storage Elevation = 292.00

Discharge Information:	Vault	Bypass	Total (all flows reported in cfs)
2-Yr Event	0.2821	0.2208	0.5029
10-Yr Event	0.5503	0.2838	0.8341
100-Yr Event	0.9893	0.3519	1.3412

(Appendix B –WWHM 2012 Report)

Quality Enhancement Mitigation

Stormwater quality enhancement facilities are designed to accommodate the peak 15-minute flow rate from the developed basin.

Calavista runoff rates for the ‘PostDev’ basin:
The ‘online’ peak 15-minute flow rate is 0.2338 cfs.
The ‘offline’ peak 15-minute flow rate is 0.1479 cfs.

Calavista runoff rates for the ‘Bypass’ basin:
The ‘online’ peak 15-minute flow rate is 0.1057 cfs.
The ‘offline’ peak 15-minute flow rate is 0.0581 cfs.

(Appendix B –WWHM 2012 Report)

Stormwater quality mitigation will be provided by a “BioPod” system sized to accommodate the applicable peak 15-minute flow rate. These units are sized based on a hydraulic loading rate of 1.6 gallons / minute (0.0036 cfs) per square foot of media surface area.

The BioPod unit required to treat the ‘PostDev’, ‘online’ flow above would be an 8’x12’ unit.
The BioPod unit required to treat the ‘PostDev’, ‘offline’ flow above would be a 6’x12’ unit.

For the ‘PostDev’ basin; The ‘offline’ 6’x12’ underground model w/internal bypass unit is being selected because it has a buried vault configuration that allows for more flexibility in placement and configuration and includes an internal bypass capable of accommodating the excess flow from the developed site.

The BioPod unit required to treat the ‘Bypass, ‘online’ flow above would be a 4’x12’ unit.
The BioPod unit required to treat the ‘Bypass’, ‘offline’ flow above would be a 4’x6’ unit.

For the ‘Bypass’ basin; The ‘offline’ 4’x6’ underground model w/internal bypass unit is being selected because it has a buried vault configuration that allows for more flexibility in placement and configuration and includes an internal bypass capable of accommodating the excess flow from the developed site.

(Appendix I – BioPod Submittal Package)

Conveyance Capacity (Onsite Mitigated Basin)

Conveyance calculations were performed to ensure that all closed conveyance pipes are sized properly to handle the design flows for the project. Several conditions have been examined for the conveyance system to ensure overall viability. All pipes in the plan set have been configured as required by the parameters identified in the conveyance capacity worksheet, so that free flow conditions are provided throughout.

(Appendix C –Conveyance Capacity Worksheet (Onsite Mitigated Basin)).

Erosion Control

The development site will include a Temporary Erosion Control Plan, to be implemented during construction. “Appendix 7 – Sediment Potential Worksheet” is included in this report to aid in the scoping, selection and sizing of appropriate BMPs. The overall score from this worksheet is 210, meaning that the site has high potential for erosion during grading activities. Care must be taken to ensure that appropriate BMPs are in place and appropriate materials are on hand to deal with erosion events as they occur. This project will require an erosion control plan and a Certified Erosion Control Lead onsite during construction, until the site is permanently stabilized.

(See Appendix E – Appendix 7 Sediment Potential Worksheet)

Conveyance Capacity (Overall Discharge Basin)

The overall discharge basin was reviewed to check the conveyance capacity from the ultimate discharge location associated with the culvert under “Watland St”. The overall basin was found to include approximately 22.5-acres. The basin was divided into uses with 3.5-acres of cemetery and the remainder of the basin given a conservative cover of 4 du/ac. The basin was analyzed two different ways.

1. WWHM 2012 Method; this method was done for comparison to the rational method. It resulted in 18.5 cfs, during the 100-yr event.
2. Rational Method; this method resulted in a 100-yr event release of ~34 cfs.

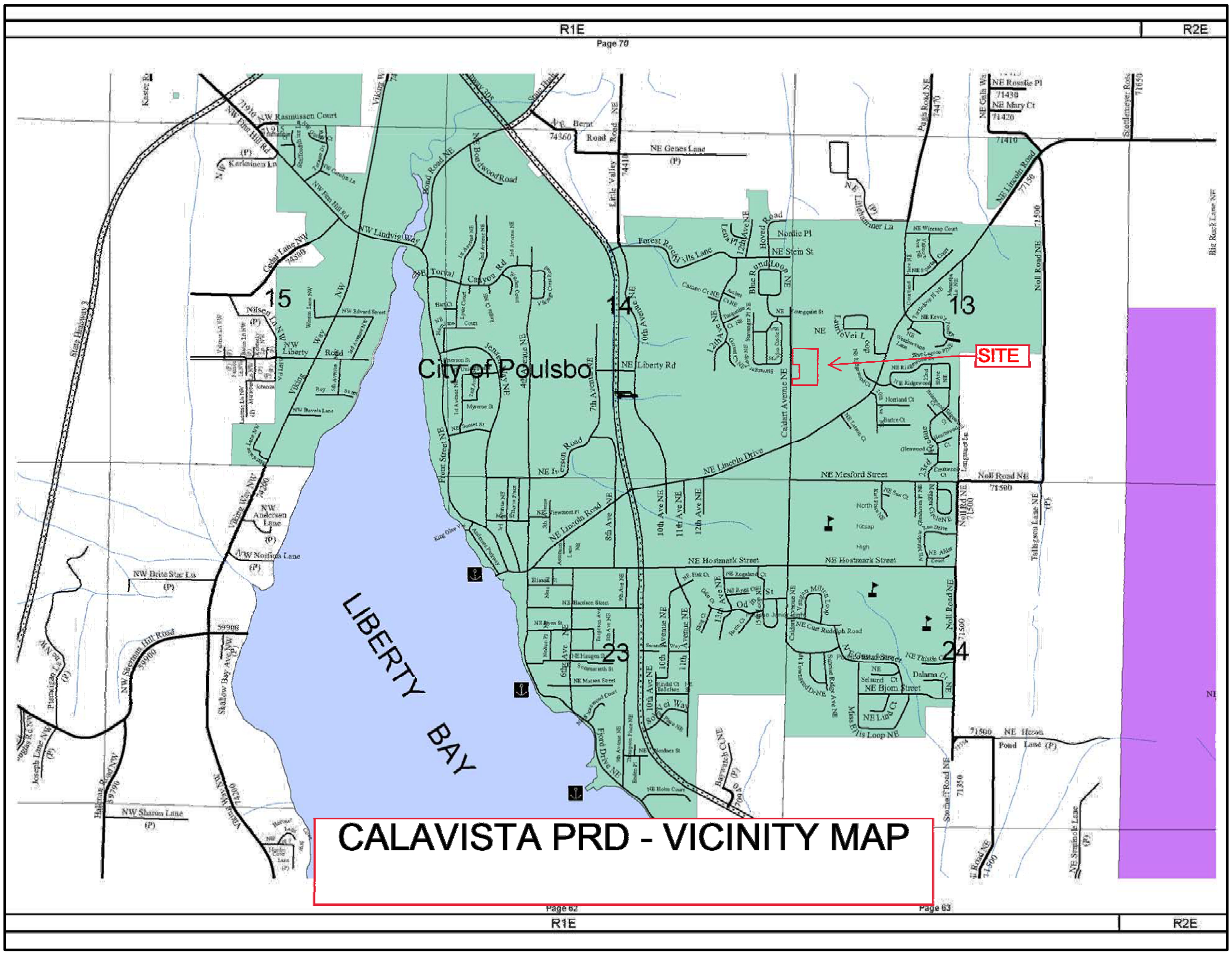
A more realistic peak flow that will be experienced at the discharge location will be much less, and more in line with the WWHM 2012 basin study. The Calavista contribution to the overall 18.5 cfs will typically be approximately 1.3 cfs or 7% of the overall flow volume during peak 100-yr events. During emergency overflow situations, this percentage would increase significantly to approximately 30%, assuming only “Calavista” was in overflow and excess runoff was not contributing flows to the downstream conveyance from elsewhere in the basin (an unlikely occurrence). Regular and routine storm events, like the 2-yr event, have lower flows of 0.5 cfs of contributed flow from the “Calavista” developed site.

(Appendix F –Conveyance Capacity Worksheet (Overall Discharge Basin)).

VIII. OPERATIONS AND MAINTENANCE

An operations and maintenance manual will be prepared and submitted, as required by the City.

CALAVISTA – PRD



19700 & 19840 CALDART AVE NE
POULSBO WA 98370

132601-3-065-2006 & 132601-3-003-2001

FIG 1 – VICINITY MAP

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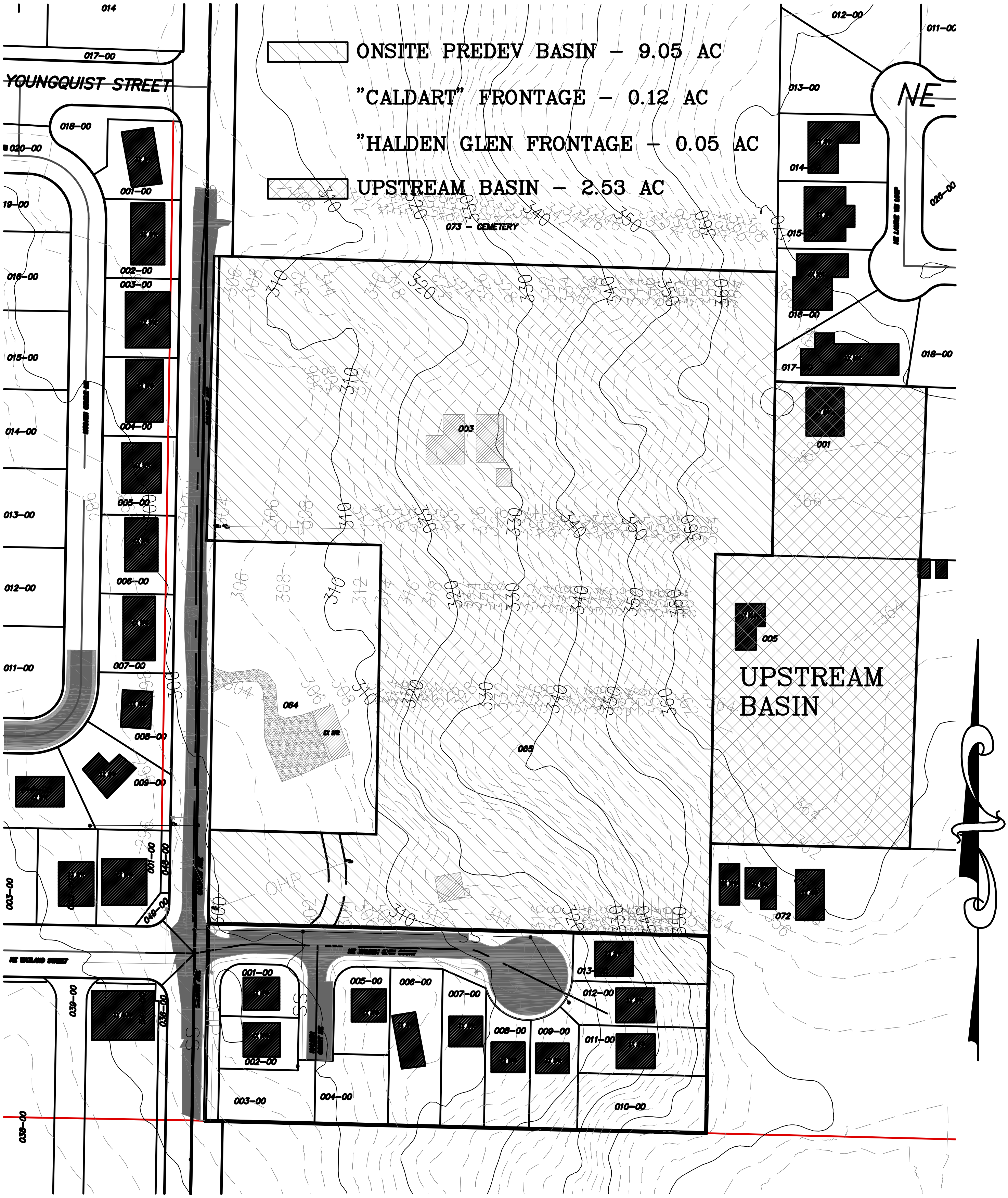
CALAVISTA – PRD



THIS MAP SHOWS BASIN AREAS.
SEE APPENDIX A FOR EXISTING
COVERAGE BREAKDOWN.

FIG 2 – PREDEVELOPED CONDITIONS MAP

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Soil Map—Kitsap County Area, Washington
(Calavista)

Map Scale: 1:1,560 if printed on A portrait (8.5" x 11") sheet.

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: Kitsap County Area, Washington
Survey Area Data: Version 14, Sep 10, 2018

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

Date(s) aerial images were photographed: Mar 29, 2016—Sep 27, 2016

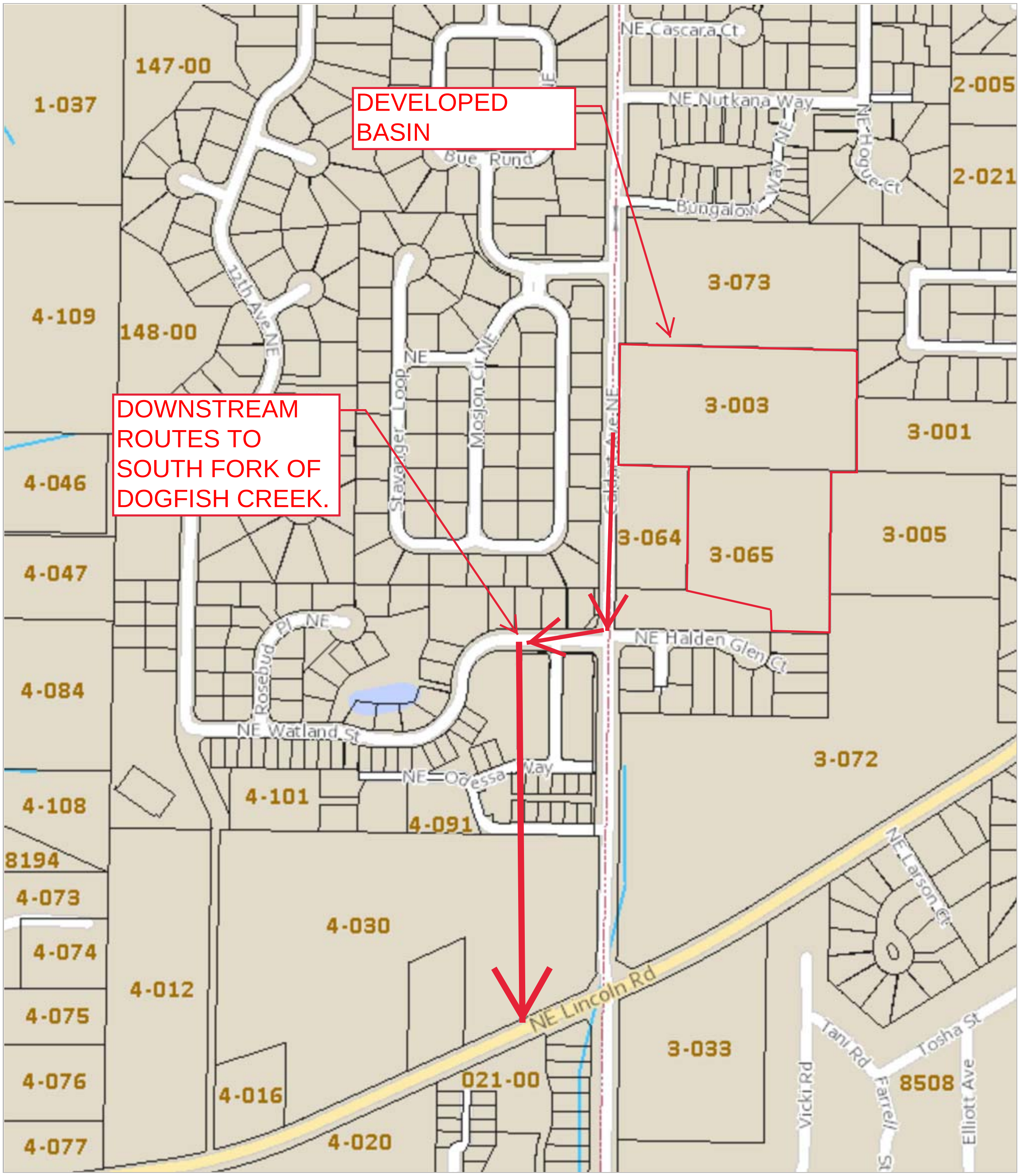
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
22	Kapowsin gravelly ashy loam, 0 to 6 percent slopes	1.7	14.1%
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	5.5	46.1%
40	Poulsbo gravelly sandy loam, 6 to 15 percent slopes	4.8	39.8%
Totals for Area of Interest		**12.0**	**100.0%**

Map Scale: 1 : 4,800

Printed: Friday. Dec 7, 2018



DEVELOPED BASIN

DOWNSTREAM ROUTES TO SOUTH FORK OF DOGFISH CREEK.

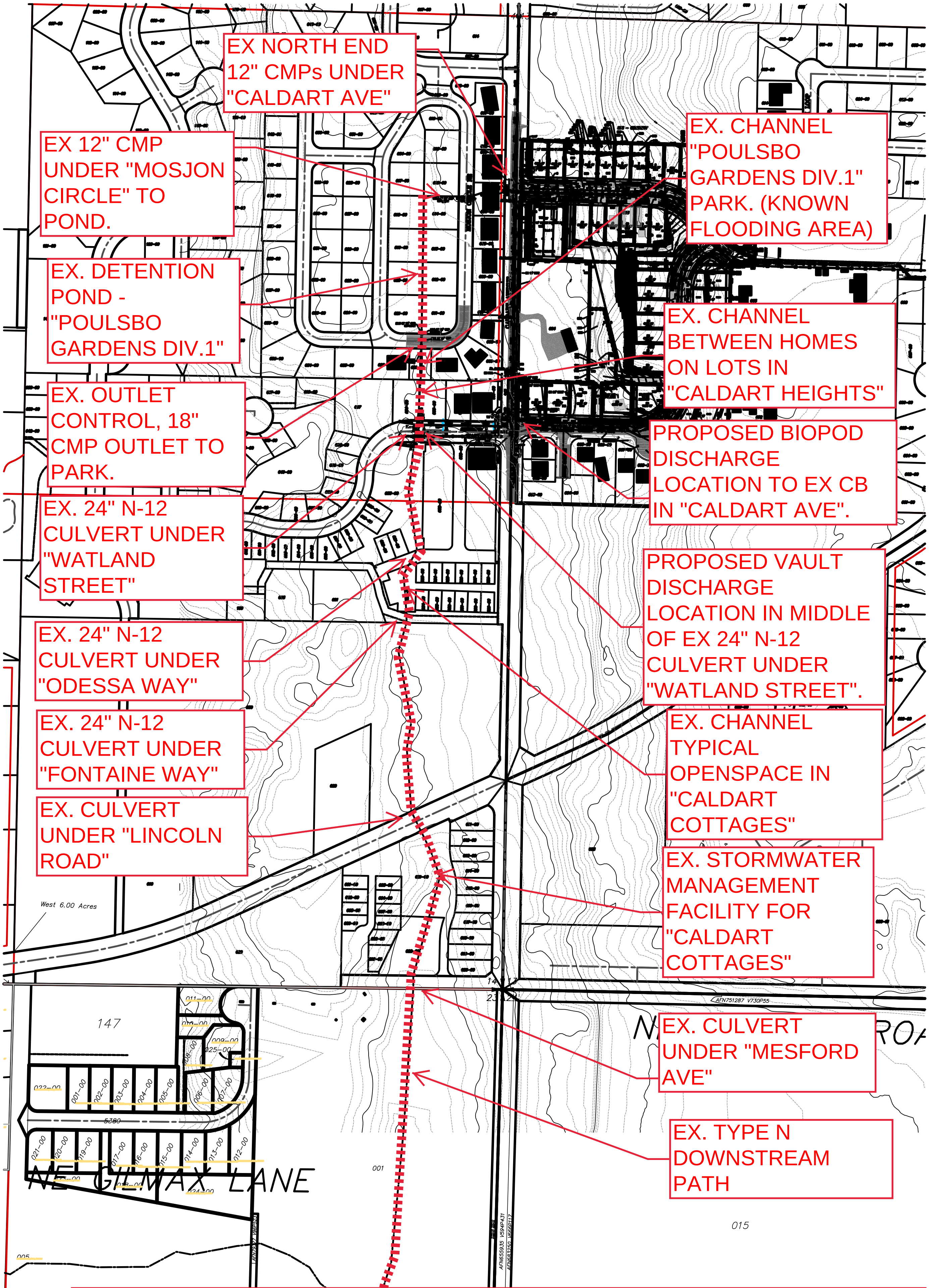
** This map is not a substitute for field survey **

0 200 400ft

Comments

FIG 4 - DOWNSTREAM MAP

N
W E
S



EX NORTH END 12" CMPs UNDER "CALDART AVE"

EX 12" CMP UNDER "MOSJON CIRCLE" TO POND.

EX. DETENTION POND - "POULSBO GARDENS DIV.1"

EX. OUTLET CONTROL, 18" CMP OUTLET TO PARK.

EX. 24" N-12 CULVERT UNDER "WATLAND STREET"

EX. 24" N-12 CULVERT UNDER "ODESSA WAY"

EX. 24" N-12 CULVERT UNDER "FONTAINE WAY"

EX. CULVERT UNDER "LINCOLN ROAD"

EX. CHANNEL "POULSBO GARDENS DIV.1" PARK. (KNOWN FLOODING AREA)

EX. CHANNEL BETWEEN HOMES ON LOTS IN "CALDART HEIGHTS"

PROPOSED BIOPOD DISCHARGE LOCATION TO EX CB IN "CALDART AVE".

PROPOSED VAULT DISCHARGE LOCATION IN MIDDLE OF EX 24" N-12 CULVERT UNDER "WATLAND STREET".

EX. CHANNEL TYPICAL OPENSPACE IN "CALDART COTTAGES"

EX. STORMWATER MANAGEMENT FACILITY FOR "CALDART COTTAGES"

EX. CULVERT UNDER "MESFORD AVE"

EX. TYPE N DOWNSTREAM PATH

FIG 4B - DOWNSTREAM MAP 1"=350'

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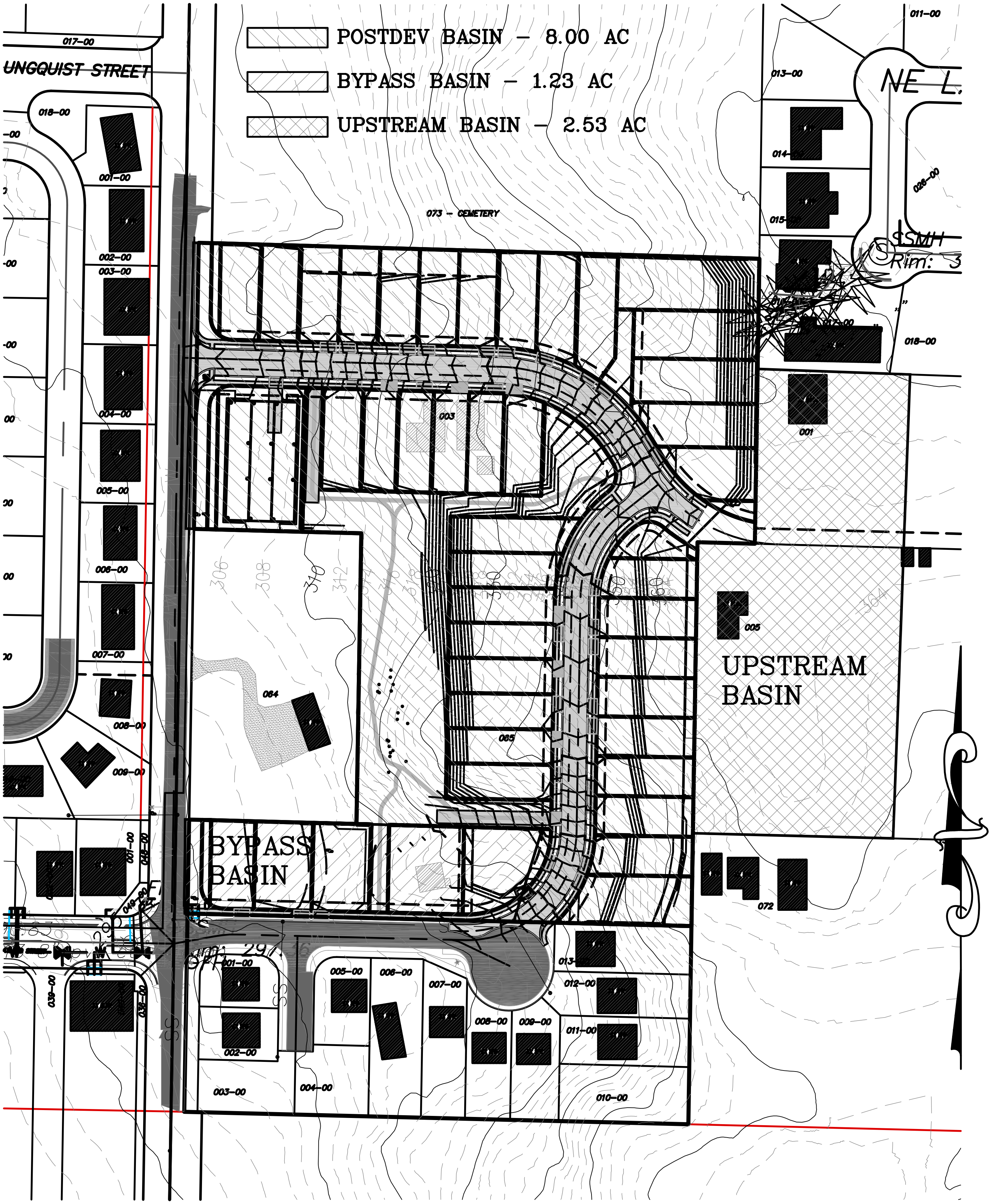
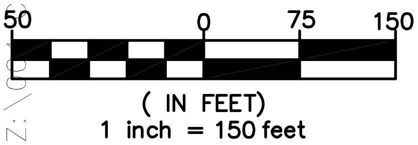
CALAVISTA – PRD



GRAPHIC SCALE



THIS MAP SHOWS BASIN AREAS.
SEE APPENDIX A FOR PROPOSED USE
COVERAGE BREAKDOWN.

FIG 5 – DEVELOPED CONDITIONS MAP

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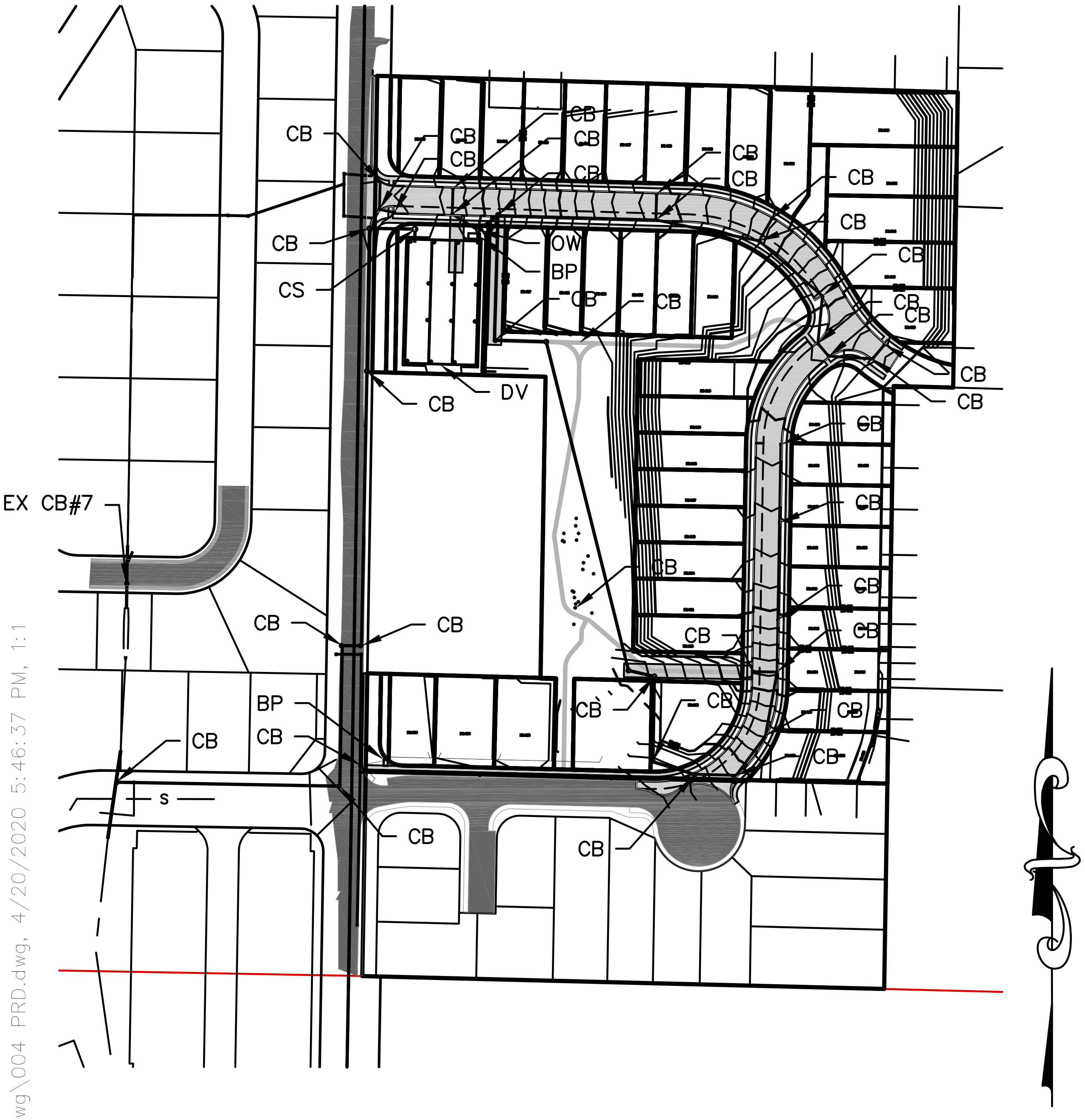
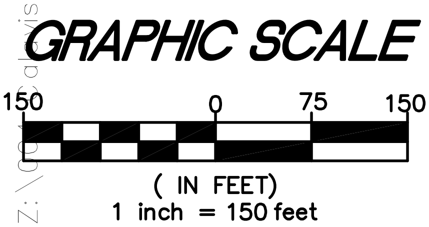
CALAVISTA – PRD



LEGEND
CB = CATCH BASIN (TYPE 1 & 2)
OW = TYPE 2 CB W/ OIL/WATER SEPARATOR
BP = BIOPOD VAULT (WATER QUALITY)
DV = DETENTION VAULT
CS = CONTROL STRUCTURE (OUTLET CONTROL)



DISCHARGE AT "WATLAND" MAP

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APPENDIX A - BASIN AREA WORKSHEET

LOT #	AREA (SF)	PREDEV NATIVE	POSTDEV NATIVE	L & L ALLOWANCE	ROOF ALLOWANCE	DRIVEWAY ALLOWANCE	OTHER IMP ALLOWANCE	Total Lot Impervious
1	4954	4954		2454	2000.0	500	0	2500.0
2	4905	4905		2405	2000.0	500	0	2500.0
3	4905	4905		2405	2000.0	500	0	2500.0
4	4905	4905		2405	2000.0	500	0	2500.0
5	4905	4905		2405	2000.0	500	0	2500.0
6	4905	4905		2405	2000.0	500	0	2500.0
7	4905	4905		2405	2000.0	500	0	2500.0
8	4959	4959		2459	2000.0	500	0	2500.0
9	5375	5375		2875	2000.0	500	0	2500.0
10	5991	5991		3491	2000.0	500	0	2500.0
11	9811	9811		7311	2000.0	500	0	2500.0
12	7783	7783		5283	2000.0	500	0	2500.0
13	7109	7109		4609	2000.0	500	0	2500.0
14	6490	6490		3990	2000.0	500	0	2500.0
15	5437	5437		2937	2000.0	500	0	2500.0
16	4830	4830		2330	2000.0	500	0	2500.0
17	4988	4988		2488	2000.0	500	0	2500.0
18	4990	4990		2490	2000.0	500	0	2500.0
19	4992	4992		2492	2000.0	500	0	2500.0
20	4994	4994		2494	2000.0	500	0	2500.0
21	4996	4996		2496	2000.0	500	0	2500.0
22	4997	4997		2497	2000.0	500	0	2500.0
23	5132	5132		2632	2000.0	500	0	2500.0
24	7457	7457		4957	2000.0	500	0	2500.0
25	5012	5012		2512	2000.0	500	0	2500.0
26	6555	6555		4055	2000.0	500	0	2500.0
27	6547	6547		4047	2000.0	500	0	2500.0
28	8479	8479		5979	2000.0	500	0	2500.0
29	7804	7804		5304	2000.0	500	0	2500.0
30	4800	4800		2300	2000.0	500	0	2500.0
31	4800	4800		2300	2000.0	500	0	2500.0
32	4800	4800		2300	2000.0	500	0	2500.0
33	4800	4800		2300	2000.0	500	0	2500.0
34	4800	4800		2300	2000.0	500	0	2500.0
35	4801	4801		2301	2000.0	500	0	2500.0
36	4933	4933		2433	2000.0	500	0	2500.0
37	5490	5490		2990	2000.0	500	0	2500.0
38	5029	5029		2529	2000.0	500	0	2500.0
39	4600	4600		2100	2000.0	500	0	2500.0
40	4600	4600		2100	2000.0	500	0	2500.0
41	4600	4600		2100	2000.0	500	0	2500.0
42	4600	4600		2100	2000.0	500	0	2500.0
43	5175	5175		2675	2000.0	500	0	2500.0
MAX	9811.0							2500.0
MIN	4600.0							2500.0
AVG	5510.2							2500.0
TOTAL (SF)	**236940.0**	**236940.0**	**0.0**	**129440.0**	**86000.0**	**21500.0**	**0.0**	**107500.0**
TOTAL (AC)	**5.44**	**5.44**	**0.00**	**2.97**	**1.97**	**0.49**	**0.00**	**2.47**

TRACT AREAS

	SF	AC	Description
TRACT A	982.0	0.02	**Openspace Tract**
TRACT B	2591.0	0.06	**Openspace Tract**
TRACT C	892.0	0.02	**Openspace Tract**
TRACT D	60211.0	1.38	**Openspace Tract**
TRACT E	2410.0	0.06	**Access Tract**
TRACT F	857.0	0.02	**Road Tract**
TRACT G	2759.0	0.06	**Road Tract**
TRACT H	70489.0	1.62	**Road Tract**
TRACT I	16143.0	0.37	**Stormwater Tract**
Total	**157334.0**	**3.61**	

SITE AREA TABLE

	SF	AC	Notes
Lots	236940.0	5.44	**Total Lot Area**
TRACT A	982.0	0.02	**Openspace Tract**
TRACT B	2591.0	0.06	**Openspace Tract**
TRACT C	892.0	0.02	**Openspace Tract**
TRACT D	60211.0	1.38	**Openspace Tract**
TRACT E	2410.0	0.06	**Access Tract**
TRACT F	857.0	0.02	**Road Tract**
TRACT G	2759.0	0.06	**Road Tract**
TRACT H	70489.0	1.62	**Road Tract**
TRACT I	16143.0	0.37	**Stormwater Tract**
Total Site	**394274.0**	**9.05**	

ONSITE AREA BREAKDOWN

	IMPERVIOUS		PERVIOUS		
	SF	AC	SF	AC	Percent Impervious Coverage
Lots	107500.0	2.47	129440.0	2.97	**45.4%**
TRACT A	0.0	0.00	982.0	0.02	**0.0%**
TRACT B	0.0	0.00	2591.0	0.06	**0.0%**
TRACT C	0.0	0.00	892.0	0.02	**0.0%**
TRACT D	4670.0	0.11	55541.0	1.28	**7.8%**
TRACT E	2410.0	0.06	0.0	0.00	**100.0%**
TRACT F	0.0	0.00	857.0	0.02	**0.0%**
TRACT G	0.0	0.00	2759.0	0.06	**0.0%**
TRACT H	53143.0	1.22	17346.0	0.40	**75.4%**
TRACT I	10125.0	0.23	6018.0	0.14	**62.7%**
Totals	**177848.0**	**4.08**	**216426.0**	**4.97**	**45.1%**

Overall Area = 9.05 AC
Percent Impervious = 45.1%

Openspace Area = 1.48 AC
Percent Openspace = 16.4%

STORM BASIN - Upstream

	IMPERVIOUS	PERVIOUS
	AC	AC
005 Hunter (Pasture)	-	0.78
001 Svardh (Pasture)	-	1.75
Frontage (Native)	-	0.12
Totals	0.00	2.65

Total Area = 2.65 AC

STORM BASIN - PreDev

	IMPERVIOUS	PERVIOUS
	AC	AC
Onsite (Native)	-	9.05
Frontage (Native)	-	0.12
Halden (L&L)	-	0.05
005 Hunter (Pasture)	-	0.78
001 Svardh (Pasture)	-	1.75
Totals	0.00	11.75

Overall Area = 11.75 AC

STORM BASIN - Bypass

	IMPERVIOUS	PERVIOUS
	AC	AC
Frontage Imp	0.12	-
Tract A - L&L	-	0.02
Tract B - L&L	-	0.06
Tract C - L&L	-	0.02
Tract D - IMP	0.02	-
Tract D - L&L	-	0.10
Halden - IMP	0.05	-
Lot 25 - IMP	0.06	-
Lot 25 - L&L	-	0.06
Lot 26 - IMP	0.06	-
Lot 26 - L&L	-	0.09
Lot 27 - IMP	0.06	-
Lot 27 - L&L	-	0.09
Lot 28 - IMP	0.06	-
Lot 28 - L&L	-	0.14
Lot 29 - IMP	0.06	-
Lot 29 - L&L	-	0.12
Tract H - IMP	0.05	-
Tract H - L&L	-	0.00
Totals	0.53	0.70

Total Area = 1.23 AC

STORM BASIN - PostDev

	IMPERVIOUS	PERVIOUS
	AC	AC
Lot - Roof Allowance	1.74	-
Lot - Drive/Other Allowance	0.44	-
Lot - Lawn & Landscaping Allowance	-	2.47
Tract A - L&L	-	0.00
Tract B - L&L	-	0.00
Tract C - L&L	-	0.00
Tract D - IMP	0.09	-
Tract D - Native	-	0.25
Tract D - L&L	-	0.93
Tract E - IMP	0.06	-
Tract F - L&L	-	0.02
Tract G - L&L	-	0.06
Tract H - IMP	1.17	-
Tract H - L&L	-	0.40
Tract I - IMP	0.23	-
Tract I - L&L	-	0.14
005 Hunter (Pasture)	-	0.78
001 Svardh (Pasture)	-	1.75
Totals	**3.73**	**6.80**

Overall Area = 10.52 AC

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	19.12.5.004
Site Name:	Calavista
Site Address:	XXX Caldart Ave
City:	Poulsbo
Report Date:	12/12/2019
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.167
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	9.17
C, Pasture, Flat	2.53
C, Lawn, Mod	0.05
Pervious Total	11.75
Impervious Land Use	acre
Impervious Total	0
Basin Total	11.75

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

PostDev

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	2.53
C, Lawn, Flat	4.02
C, Forest, Mod	0.25
Pervious Total	6.8
Impervious Land Use	acre
ROADS FLAT	0.15
ROADS MOD	1.4
ROOF TOPS FLAT	1.74
DRIVEWAYS FLAT	0.44
Impervious Total	3.73
Basin Total	10.53

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Bypass

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.7
Pervious Total	0.7
Impervious Land Use	acre
ROADS MOD	0.24
ROOF TOPS FLAT	0.23
DRIVEWAYS FLAT	0.06
Impervious Total	0.53
Basin Total	1.23

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements

Predeveloped Routing

Mitigated Routing

Vault 1

Width:	75 ft.	
Length:	135 ft.	
Depth:	12 ft.	
Discharge Structure		
Riser Height:	11 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	1.813 in.	Elevation:0 ft.
Orifice 2 Diameter:	2.1 in.	Elevation:5 ft.
Orifice 3 Diameter:	2 in.	Elevation:7 ft.
Element Flows To:		

Outlet 1 Outlet 2

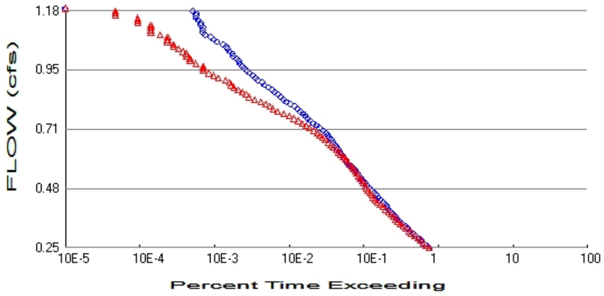
Vault Hydraulic Table

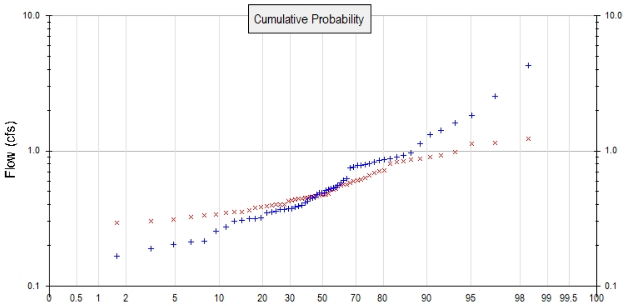
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.232	0.000	0.000	0.000
0.1333	0.232	0.031	0.032	0.000
0.2667	0.232	0.062	0.046	0.000
0.4000	0.232	0.093	0.056	0.000
0.5333	0.232	0.124	0.065	0.000
0.6667	0.232	0.155	0.072	0.000
0.8000	0.232	0.186	0.079	0.000
0.9333	0.232	0.216	0.086	0.000
1.0667	0.232	0.247	0.092	0.000
1.2000	0.232	0.278	0.097	0.000
1.3333	0.232	0.309	0.103	0.000
1.4667	0.232	0.340	0.108	0.000
1.6000	0.232	0.371	0.112	0.000
1.7333	0.232	0.402	0.117	0.000
1.8667	0.232	0.433	0.121	0.000
2.0000	0.232	0.464	0.126	0.000
2.1333	0.232	0.495	0.130	0.000
2.2667	0.232	0.526	0.134	0.000
2.4000	0.232	0.557	0.138	0.000
2.5333	0.232	0.588	0.142	0.000
2.6667	0.232	0.619	0.145	0.000
2.8000	0.232	0.650	0.149	0.000
2.9333	0.232	0.681	0.152	0.000
3.0667	0.232	0.712	0.156	0.000
3.2000	0.232	0.743	0.159	0.000
3.3333	0.232	0.774	0.162	0.000
3.4667	0.232	0.805	0.166	0.000
3.6000	0.232	0.836	0.169	0.000
3.7333	0.232	0.867	0.172	0.000
3.8667	0.232	0.898	0.175	0.000
4.0000	0.232	0.929	0.178	0.000
4.1333	0.232	0.960	0.181	0.000
4.2667	0.232	0.991	0.184	0.000
4.4000	0.232	1.022	0.187	0.000
4.5333	0.232	1.053	0.189	0.000
4.6667	0.232	1.084	0.192	0.000
4.8000	0.232	1.115	0.195	0.000
4.9333	0.232	1.146	0.198	0.000

5.0667	0.232	1.177	0.231	0.000
5.2000	0.232	1.208	0.256	0.000
5.3333	0.232	1.239	0.275	0.000
5.4667	0.232	1.270	0.290	0.000
5.6000	0.232	1.301	0.303	0.000
5.7333	0.232	1.332	0.316	0.000
5.8667	0.232	1.363	0.327	0.000
6.0000	0.232	1.394	0.338	0.000
6.1333	0.232	1.425	0.348	0.000
6.2667	0.232	1.456	0.358	0.000
6.4000	0.232	1.487	0.367	0.000
6.5333	0.232	1.518	0.376	0.000
6.6667	0.232	1.549	0.384	0.000
6.8000	0.232	1.580	0.393	0.000
6.9333	0.232	1.611	0.401	0.000
7.0667	0.232	1.642	0.437	0.000
7.2000	0.232	1.673	0.465	0.000
7.3333	0.232	1.704	0.487	0.000
7.4667	0.232	1.735	0.505	0.000
7.6000	0.232	1.766	0.522	0.000
7.7333	0.232	1.797	0.538	0.000
7.8667	0.232	1.828	0.553	0.000
8.0000	0.232	1.859	0.568	0.000
8.1333	0.232	1.890	0.581	0.000
8.2667	0.232	1.921	0.594	0.000
8.4000	0.232	1.952	0.607	0.000
8.5333	0.232	1.983	0.619	0.000
8.6667	0.232	2.014	0.631	0.000
8.8000	0.232	2.045	0.643	0.000
8.9333	0.232	2.076	0.654	0.000
9.0667	0.232	2.107	0.666	0.000
9.2000	0.232	2.138	0.676	0.000
9.3333	0.232	2.169	0.687	0.000
9.4667	0.232	2.200	0.697	0.000
9.6000	0.232	2.231	0.708	0.000
9.7333	0.232	2.262	0.718	0.000
9.8667	0.232	2.293	0.728	0.000
10.000	0.232	2.324	0.737	0.000
10.133	0.232	2.355	0.747	0.000
10.267	0.232	2.386	0.756	0.000
10.400	0.232	2.417	0.765	0.000
10.533	0.232	2.448	0.775	0.000
10.667	0.232	2.479	0.784	0.000
10.800	0.232	2.510	0.792	0.000
10.933	0.232	2.541	0.801	0.000
11.067	0.232	2.572	1.084	0.000
11.200	0.232	2.603	2.223	0.000
11.333	0.232	2.634	3.709	0.000
11.467	0.232	2.665	5.161	0.000
11.600	0.232	2.696	6.245	0.000
11.733	0.232	2.727	6.866	0.000
11.867	0.232	2.758	7.457	0.000
12.000	0.232	2.789	7.955	0.000
12.133	0.232	2.820	8.420	0.000
12.267	0.000	0.000	8.859	0.000

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 11.75
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 7.5
Total Impervious Area: 4.26

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.501074
5 year	0.900593
10 year	1.255522
25 year	1.825535
50 year	2.351006
100 year	2.974166

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.502925
5 year	0.694609
10 year	0.834089
25 year	1.025053
50 year	1.178296
100 year	1.341197

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.776	0.614
1950	0.844	0.601
1951	0.963	0.858
1952	0.321	0.323
1953	0.274	0.332
1954	0.395	0.389
1955	0.608	0.396
1956	0.580	0.566
1957	0.512	0.517
1958	0.453	0.379

1959	0.382	0.346
1960	0.800	0.825
1961	0.374	0.565
1962	0.255	0.312
1963	0.371	0.433
1964	0.517	0.402
1965	0.415	0.470
1966	0.304	0.353
1967	0.898	0.595
1968	0.475	0.582
1969	0.448	0.480
1970	0.370	0.441
1971	0.488	0.517
1972	0.760	0.632
1973	0.351	0.399
1974	0.486	0.474
1975	0.622	0.528
1976	0.448	0.427
1977	0.215	0.351
1978	0.358	0.439
1979	0.212	0.477
1980	1.412	0.721
1981	0.308	0.472
1982	0.863	0.929
1983	0.523	0.460
1984	0.316	0.336
1985	0.188	0.442
1986	0.785	0.544
1987	0.745	0.683
1988	0.313	0.300
1989	0.204	0.363
1990	2.518	1.152
1991	1.134	0.801
1992	0.422	0.382
1993	0.366	0.292
1994	0.166	0.271
1995	0.488	0.398
1996	1.322	0.974
1997	0.922	0.874
1998	0.392	0.457
1999	1.600	0.840
2000	0.347	0.454
2001	0.098	0.449
2002	0.532	0.655
2003	0.879	0.556
2004	0.825	0.897
2005	0.554	0.451
2006	0.543	0.462
2007	4.292	1.234
2008	1.825	1.131
2009	0.787	0.704

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	4.2924	1.2338
2	2.5181	1.1520
3	1.8248	1.1307

4	1.6000	0.9743
5	1.4123	0.9293
6	1.3215	0.8974
7	1.1341	0.8742
8	0.9631	0.8577
9	0.9221	0.8403
10	0.8976	0.8245
11	0.8791	0.8009
12	0.8629	0.7211
13	0.8439	0.7039
14	0.8248	0.6834
15	0.8004	0.6554
16	0.7866	0.6321
17	0.7846	0.6141
18	0.7764	0.6010
19	0.7604	0.5952
20	0.7447	0.5821
21	0.6216	0.5658
22	0.6084	0.5649
23	0.5797	0.5561
24	0.5543	0.5436
25	0.5428	0.5277
26	0.5316	0.5170
27	0.5232	0.5169
28	0.5168	0.4800
29	0.5118	0.4765
30	0.4879	0.4738
31	0.4878	0.4718
32	0.4864	0.4697
33	0.4746	0.4621
34	0.4531	0.4604
35	0.4477	0.4573
36	0.4475	0.4536
37	0.4215	0.4507
38	0.4149	0.4492
39	0.3953	0.4421
40	0.3920	0.4409
41	0.3824	0.4390
42	0.3739	0.4327
43	0.3707	0.4267
44	0.3701	0.4021
45	0.3659	0.3994
46	0.3577	0.3984
47	0.3509	0.3959
48	0.3472	0.3886
49	0.3210	0.3817
50	0.3160	0.3790
51	0.3131	0.3632
52	0.3077	0.3532
53	0.3038	0.3508
54	0.2739	0.3461
55	0.2549	0.3359
56	0.2152	0.3324
57	0.2118	0.3234
58	0.2037	0.3123
59	0.1877	0.2997
60	0.1656	0.2917
61	0.0976	0.2708

Duration Flows

The Facility PASSED

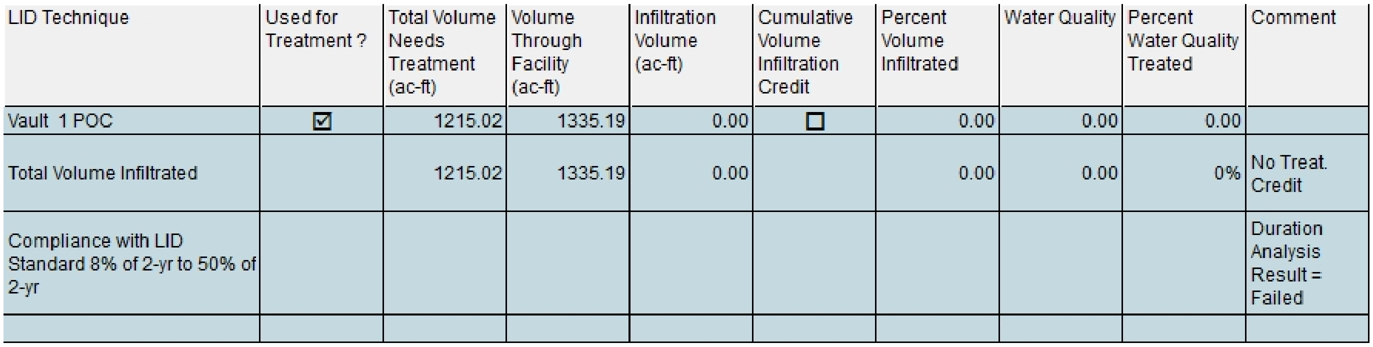
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2505	15956	15958	100	Pass
0.2718	14756	14626	99	Pass
0.2930	13569	13306	98	Pass
0.3142	12453	12256	98	Pass
0.3354	11443	11302	98	Pass
0.3566	10468	10207	97	Pass
0.3778	9668	9349	96	Pass
0.3991	8941	8622	96	Pass
0.4203	8224	7839	95	Pass
0.4415	7634	7161	93	Pass
0.4627	7035	6556	93	Pass
0.4839	6536	6102	93	Pass
0.5051	6100	5704	93	Pass
0.5264	5651	5298	93	Pass
0.5476	5304	4939	93	Pass
0.5688	4973	4594	92	Pass
0.5900	4650	4201	90	Pass
0.6112	4378	3850	87	Pass
0.6324	4132	3531	85	Pass
0.6537	3865	3238	83	Pass
0.6749	3623	3018	83	Pass
0.6961	3377	2840	84	Pass
0.7173	3144	2719	86	Pass
0.7385	2947	2571	87	Pass
0.7597	2755	2438	88	Pass
0.7810	2584	2338	90	Pass
0.8022	2404	2231	92	Pass
0.8234	2233	2105	94	Pass
0.8446	2088	2016	96	Pass
0.8658	1973	1907	96	Pass
0.8870	1847	1805	97	Pass
0.9083	1754	1720	98	Pass
0.9295	1659	1637	98	Pass
0.9507	1560	1554	99	Pass
0.9719	1454	1471	101	Pass
0.9931	1325	1367	103	Pass
1.0143	1256	1285	102	Pass
1.0356	1186	1213	102	Pass
1.0568	1133	1139	100	Pass
1.0780	1076	1057	98	Pass
1.0992	1020	983	96	Pass
1.1204	966	910	94	Pass
1.1416	921	836	90	Pass
1.1629	876	767	87	Pass
1.1841	835	708	84	Pass
1.2053	784	657	83	Pass
1.2265	737	599	81	Pass
1.2477	697	551	79	Pass
1.2689	661	505	76	Pass
1.2902	615	455	73	Pass
1.3114	543	399	73	Pass
1.3326	498	360	72	Pass
1.3538	447	320	71	Pass

1.3750	409	286	69	Pass
1.3962	378	248	65	Pass
1.4175	349	215	61	Pass
1.4387	326	180	55	Pass
1.4599	297	149	50	Pass
1.4811	274	131	47	Pass
1.5023	250	118	47	Pass
1.5235	221	103	46	Pass
1.5448	196	89	45	Pass
1.5660	179	73	40	Pass
1.5872	164	62	37	Pass
1.6084	149	56	37	Pass
1.6296	137	50	36	Pass
1.6508	126	44	34	Pass
1.6721	112	39	34	Pass
1.6933	99	36	36	Pass
1.7145	93	34	36	Pass
1.7357	81	30	37	Pass
1.7569	75	24	32	Pass
1.7782	69	21	30	Pass
1.7994	64	18	28	Pass
1.8206	57	15	26	Pass
1.8418	54	15	27	Pass
1.8630	50	15	30	Pass
1.8842	47	12	25	Pass
1.9055	45	10	22	Pass
1.9267	42	10	23	Pass
1.9479	38	9	23	Pass
1.9691	37	9	24	Pass
1.9903	34	8	23	Pass
2.0115	32	7	21	Pass
2.0328	31	6	19	Pass
2.0540	28	6	21	Pass
2.0752	23	5	21	Pass
2.0964	21	5	23	Pass
2.1176	19	5	26	Pass
2.1388	16	4	25	Pass
2.1601	15	3	20	Pass
2.1813	15	3	20	Pass
2.2025	15	3	20	Pass
2.2237	14	3	21	Pass
2.2449	14	2	14	Pass
2.2661	13	2	15	Pass
2.2874	12	2	16	Pass
2.3086	12	1	8	Pass
2.3298	12	1	8	Pass
2.3510	11	1	9	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0.4377 acre-feet
On-line facility target flow: 0.2338 cfs.
Adjusted for 15 min: 0.2338 cfs.
Off-line facility target flow: 0.1479 cfs.
Adjusted for 15 min: 0.1479 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	☑	1215.02	1335.19	0.00	☐	0.00	0.00	0.00	
Total Volume Infiltrated		1215.02	1335.19	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 = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

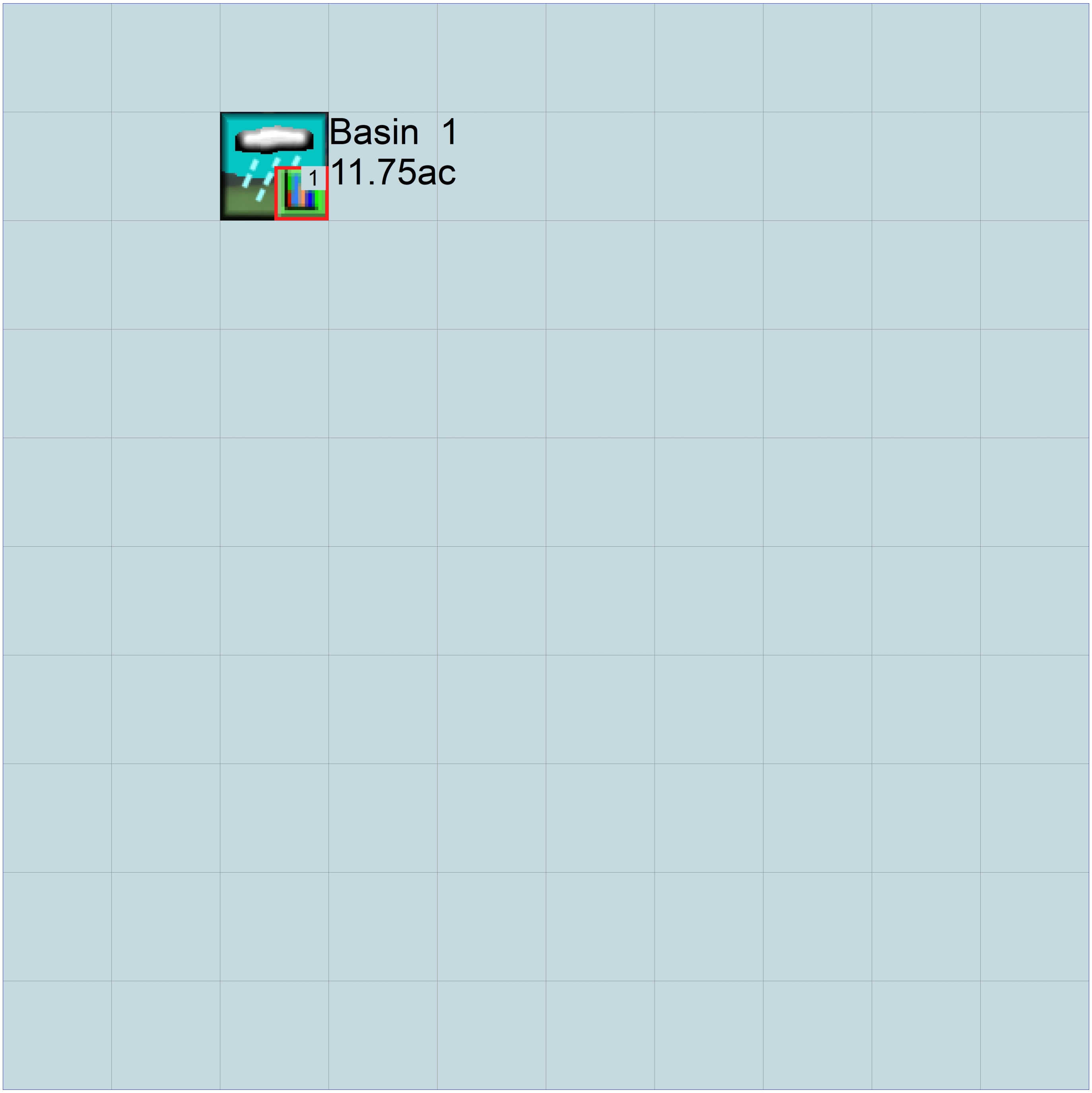
No PERLND changes have been made.

IMPLND Changes

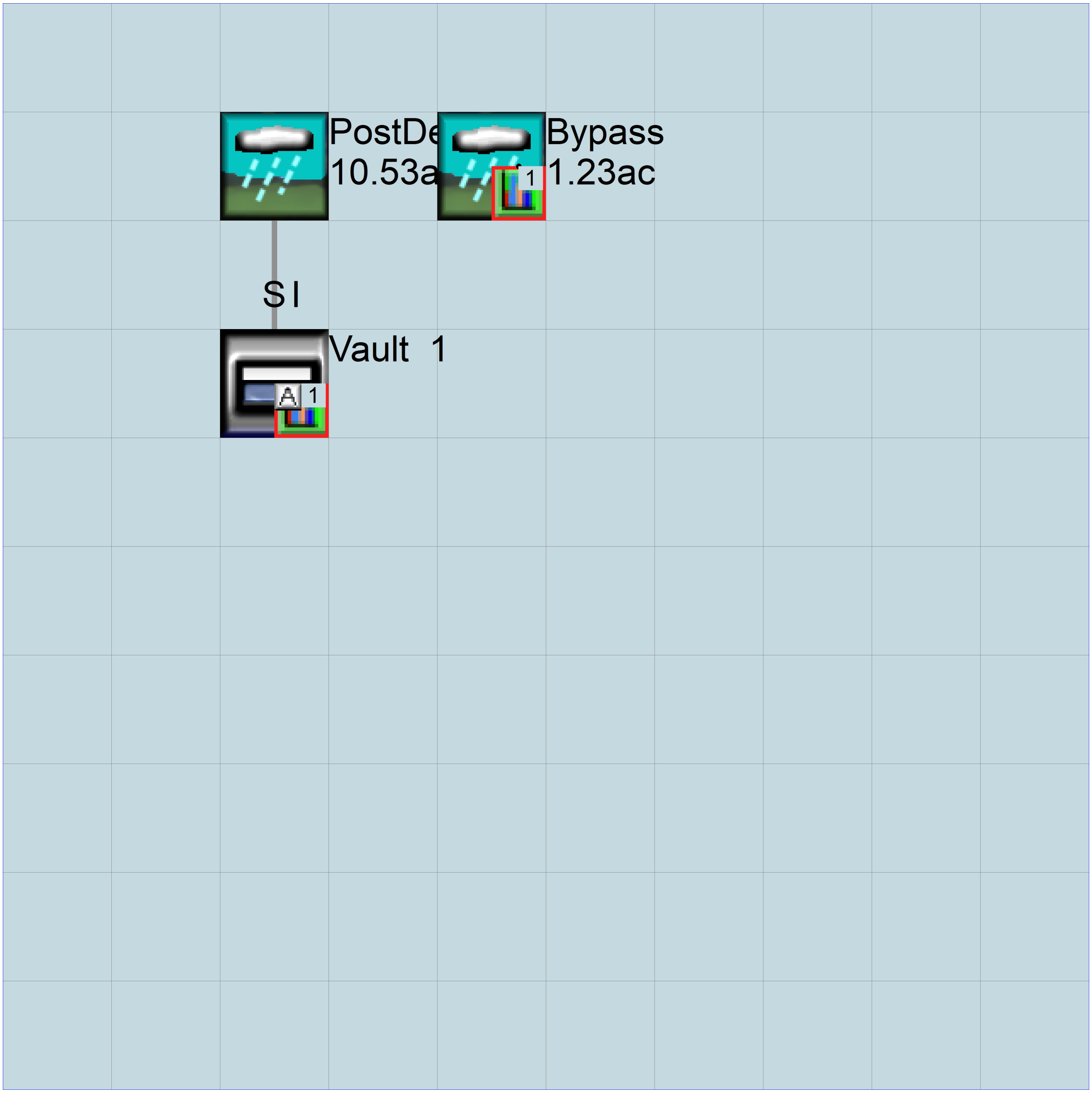
No IMPLND changes have been made.

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   19.12.5.004.wdm
MESSU      25   Pre19.12.5.004.MES
           27   Pre19.12.5.004.L61
           28   Pre19.12.5.004.L62
           30   POC19.12.5.0041.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      13
      PERLND      17
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
   11     C, Forest, Mod          1    1    1    1   27    0
   13     C, Pasture, Flat        1    1    1    1   27    0
   17     C, Lawn, Mod            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 ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   13         0    0    1    0    0    0    0    0    0    0    0    0
   17         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  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   17         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 ***
   11         0    0    0    0    0    0    0    0    0    0    0
   13         0    0    0    0    0    0    0    0    0    0    0
   17         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
   11             0       4.5      0.08       400       0.1       0.5     0.996
   13             0       4.5      0.06       400      0.05       0.5     0.996
   17             0       4.5      0.03       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11             0         0         2         2         0         0         0
   13             0         0         2         2         0         0         0
   17             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11           0.2       0.5      0.35         6       0.5       0.7
   13          0.15       0.4       0.3         6       0.5       0.4
   17           0.1      0.25      0.25         6       0.5      0.25
  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
   11             0         0         0         0       2.5         1         0
   13             0         0         0         0       2.5         1         0
   17             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

```
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

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

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  11                        9.17     COPY   501     12
PERLND  11                        9.17     COPY   501     13
PERLND  13                        2.53     COPY   501     12
PERLND  13                        2.53     COPY   501     13
PERLND  17                        0.05     COPY   501     12
PERLND  17                        0.05     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    1.167          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.167          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   19.12.5.004.wdm
MESSU      25   Mit19.12.5.004.MES
           27   Mit19.12.5.004.L61
           28   Mit19.12.5.004.L62
           30   POC19.12.5.0041.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      PERLND      16
      PERLND      11
      IMPLND       1
      IMPLND       2
      IMPLND       4
      IMPLND       5
      RCHRES       1
      COPY         1
      COPY       501
      COPY       601
      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
  601         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
   16     C, Lawn, Flat           1    1    1    1   27    0
   11     C, Forest, Mod          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
   16         0    0    1    0    0    0    0    0    0    0    0    0
   11         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
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   11         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
   16         0    0    0    0    0    0    0    0    0    0    0
   11         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
   16              0       4.5      0.03       400      0.05       0.5     0.996
   11              0       4.5      0.08       400       0.1       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
   16              0         0         2         2         0         0         0
   11              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
   16            0.1      0.25      0.25         6       0.5      0.25
   11            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
   13              0         0         0         0       2.5         1         0
   16              0         0         0         0       2.5         1         0
   11              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
    2      ROADS/MOD              1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    5      DRIVEWAYS/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
    2         0    0    1    0    0    0
    4         0    0    1    0    0    0
    5         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    0    1    9
    2         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
    5         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
    2         0    0    0    0    0
    4         0    0    0    0    0
    5         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
    2            400      0.05       0.1      0.08
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    2              0         0
    4              0         0
    5              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    2              0         0
    4              0         0
    5              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
PostDev***
PERLND  13                        2.53     RCHRES   1      2
PERLND  13                        2.53     RCHRES   1      3
PERLND  16                        4.02     RCHRES   1      2
PERLND  16                        4.02     RCHRES   1      3
PERLND  11                        0.25     RCHRES   1      2
PERLND  11                        0.25     RCHRES   1      3
IMPLND   1                        0.15     RCHRES   1      5
IMPLND   2                         1.4     RCHRES   1      5
IMPLND   4                        1.74     RCHRES   1      5
IMPLND   5                        0.44     RCHRES   1      5
```

```
Bypass***
PERLND  16                         0.7     COPY   501     12
PERLND  16                         0.7     COPY   601     12
PERLND  16                         0.7     COPY   501     13
PERLND  16                         0.7     COPY   601     13
IMPLND   2                        0.24     COPY   501     15
IMPLND   2                        0.24     COPY   601     15
IMPLND   4                        0.23     COPY   501     15
IMPLND   4                        0.23     COPY   601     15
IMPLND   5                        0.06     COPY   501     15
IMPLND   5                        0.06     COPY   601     15

******Routing******
PERLND  13                        2.53     COPY     1     12
PERLND  16                        4.02     COPY     1     12
PERLND  11                        0.25     COPY     1     12
IMPLND   1                        0.15     COPY     1     15
IMPLND   2                         1.4     COPY     1     15
IMPLND   4                        1.74     COPY     1     15
IMPLND   5                        0.44     COPY     1     15
PERLND  13                        2.53     COPY     1     13
PERLND  16                        4.02     COPY     1     13
PERLND  11                        0.25     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      0.03       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  0.232438  0.000000  0.000000
  0.133333  0.232438  0.030992  0.032570
  0.266667  0.232438  0.061983  0.046062
  0.400000  0.232438  0.092975  0.056414
  0.533333  0.232438  0.123967  0.065141
  0.666667  0.232438  0.154959  0.072830
  0.800000  0.232438  0.185950  0.079781
  0.933333  0.232438  0.216942  0.086173
  1.066667  0.232438  0.247934  0.092123
  1.200000  0.232438  0.278926  0.097711
  1.333333  0.232438  0.309917  0.102997
  1.466667  0.232438  0.340909  0.108024
  1.600000  0.232438  0.371901  0.112827
  1.733333  0.232438  0.402893  0.117434
  1.866667  0.232438  0.433884  0.121867
  2.000000  0.232438  0.464876  0.126145
  2.133333  0.232438  0.495868  0.130282
  2.266667  0.232438  0.526860  0.134291
  2.400000  0.232438  0.557851  0.138185
  2.533333  0.232438  0.588843  0.141971
  2.666667  0.232438  0.619835  0.145659
  2.800000  0.232438  0.650826  0.149257
  2.933333  0.232438  0.681818  0.152769
  3.066667  0.232438  0.712810  0.156202
  3.200000  0.232438  0.743802  0.159562
  3.333333  0.232438  0.774793  0.162852
  3.466667  0.232438  0.805785  0.166077
  3.600000  0.232438  0.836777  0.169241
  3.733333  0.232438  0.867769  0.172347
  3.866667  0.232438  0.898760  0.175397
  4.000000  0.232438  0.929752  0.178396
  4.133333  0.232438  0.960744  0.181345
  4.266667  0.232438  0.991736  0.184246
  4.400000  0.232438  1.022727  0.187103
  4.533333  0.232438  1.053719  0.189917
  4.666667  0.232438  1.084711  0.192689
  4.800000  0.232438  1.115702  0.195423
  4.933333  0.232438  1.146694  0.198118
  5.066667  0.232438  1.177686  0.231677
  5.200000  0.232438  1.208678  0.256922
  5.333333  0.232438  1.239669  0.275087
  5.466667  0.232438  1.270661  0.290305
  5.600000  0.232438  1.301653  0.303779
  5.733333  0.232438  1.332645  0.316061
  5.866667  0.232438  1.363636  0.327458
  6.000000  0.232438  1.394628  0.338163
  6.133333  0.232438  1.425620  0.348305
  6.266667  0.232438  1.456612  0.357980
  6.400000  0.232438  1.487603  0.367254
  6.533333  0.232438  1.518595  0.376182
  6.666667  0.232438  1.549587  0.384805
  6.800000  0.232438  1.580579  0.393158
  6.933333  0.232438  1.611570  0.401268
```

```
  7.066667  0.232438  1.642562  0.437184
  7.200000  0.232438  1.673554  0.465391
  7.333333  0.232438  1.704545  0.487023
  7.466667  0.232438  1.735537  0.505841
  7.600000  0.232438  1.766529  0.522949
  7.733333  0.232438  1.797521  0.538857
  7.866667  0.232438  1.828512  0.553852
  8.000000  0.232438  1.859504  0.568117
  8.133333  0.232438  1.890496  0.581777
  8.266667  0.232438  1.921488  0.594922
  8.400000  0.232438  1.952479  0.607621
  8.533333  0.232438  1.983471  0.619927
  8.666667  0.232438  2.014463  0.631882
  8.800000  0.232438  2.045455  0.643521
  8.933333  0.232438  2.076446  0.654873
  9.066667  0.232438  2.107438  0.665962
  9.200000  0.232438  2.138430  0.676809
  9.333333  0.232438  2.169421  0.687432
  9.466667  0.232438  2.200413  0.697847
  9.600000  0.232438  2.231405  0.708067
  9.733333  0.232438  2.262397  0.718105
  9.866667  0.232438  2.293388  0.727971
  10.00000  0.232438  2.324380  0.737675
  10.13333  0.232438  2.355372  0.747227
  10.26667  0.232438  2.386364  0.756633
  10.40000  0.232438  2.417355  0.765901
  10.53333  0.232438  2.448347  0.775038
  10.66667  0.232438  2.479339  0.784050
  10.80000  0.232438  2.510331  0.792943
  10.93333  0.232438  2.541322  0.801721
  11.06667  0.232438  2.572314  1.084085
  11.20000  0.232438  2.603306  2.223417
  11.33333  0.232438  2.634298  3.709934
  11.46667  0.232438  2.665289  5.161806
  11.60000  0.232438  2.696281  6.245272
  11.73333  0.232438  2.727273  6.866221
  11.86667  0.232438  2.758264  7.457654
  12.00000  0.232438  2.789256  7.955003
  12.13333  0.232438  2.820248  8.420597
  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    1.167          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.167          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     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
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     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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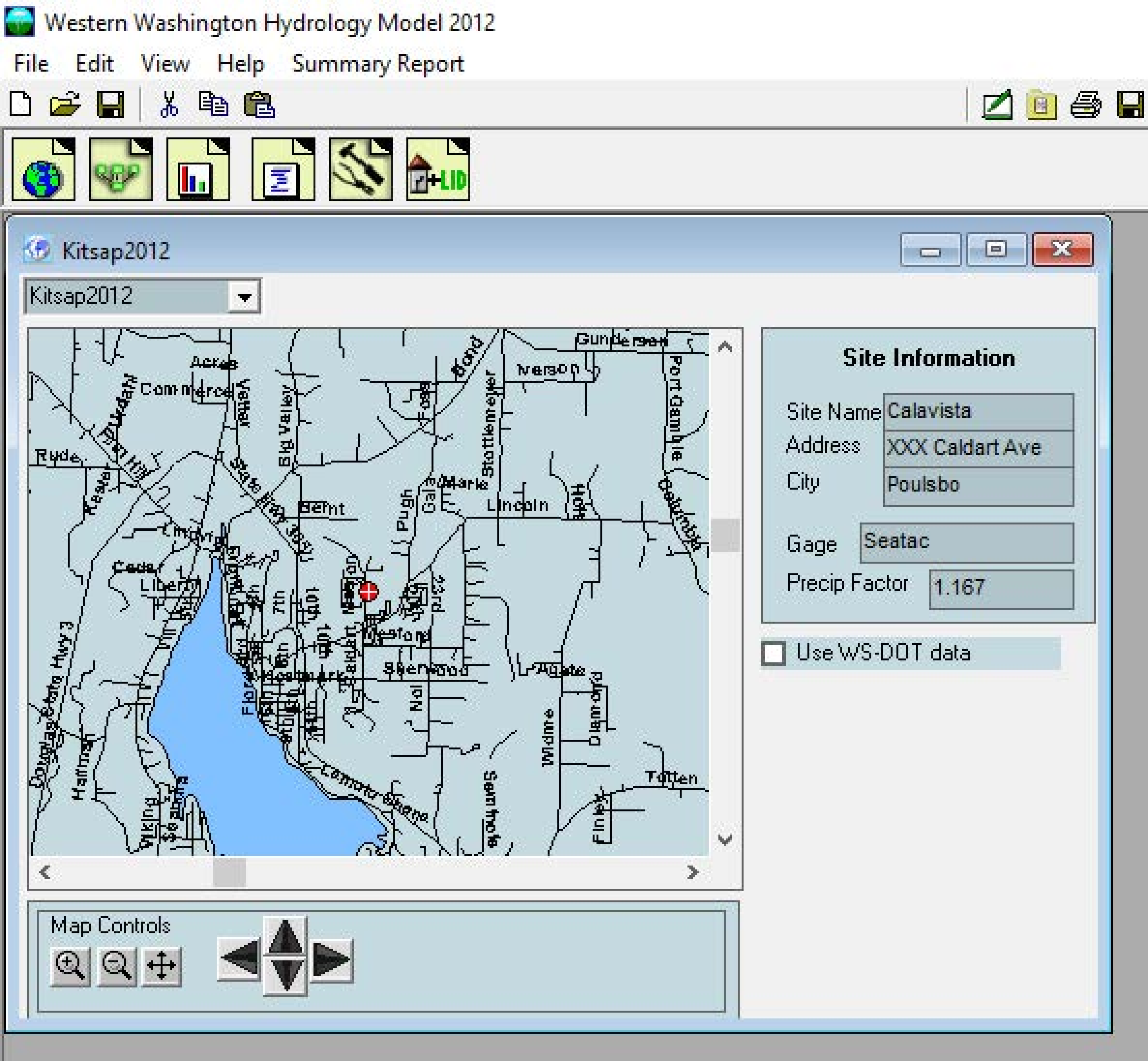


Kitsap2012

Site Name Calavista

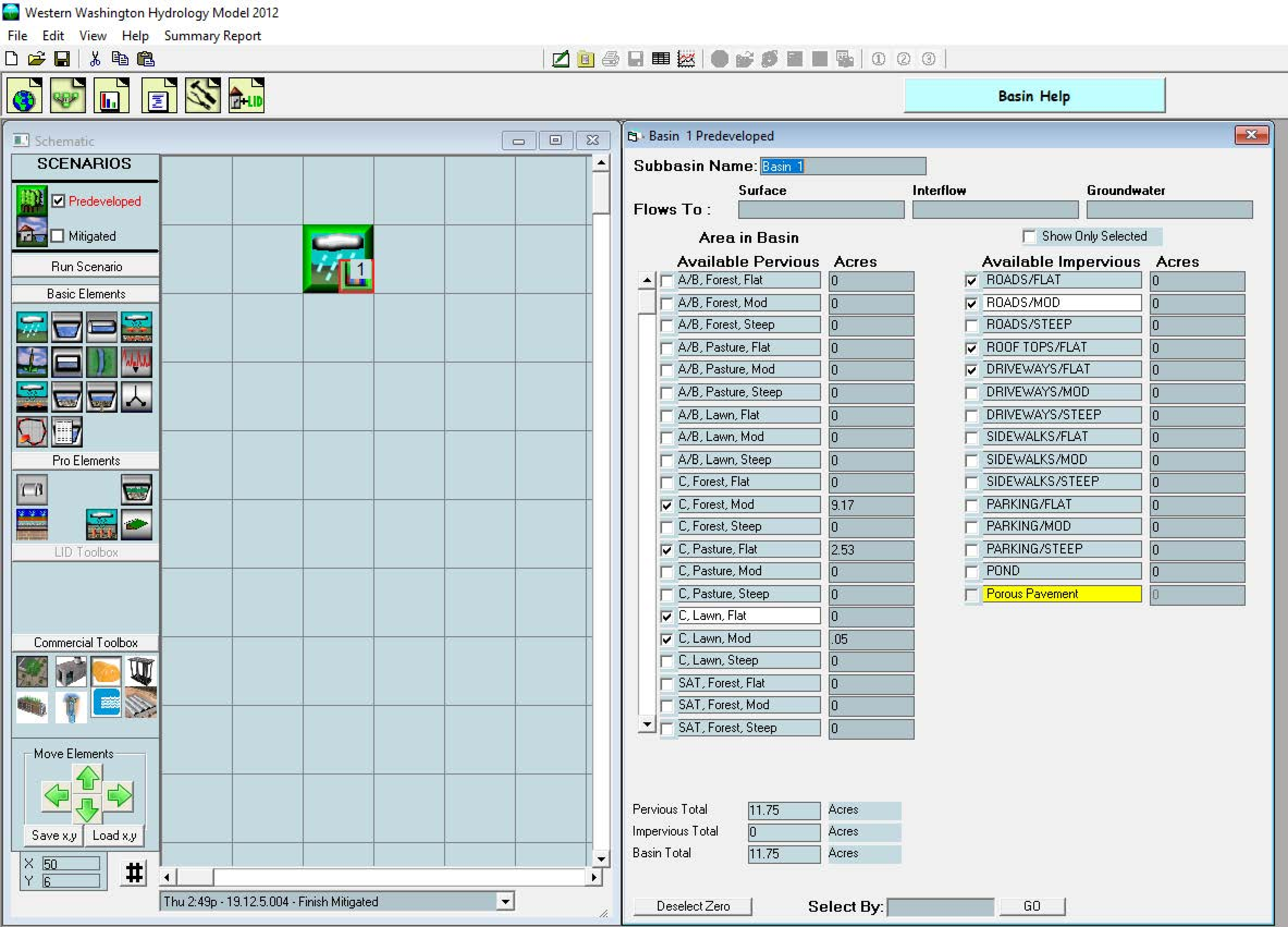
Address XXX Caldart Ave

City Poulsbo

Gage Seatac

Precip Factor 1.167

☐ Use WS-DOT data



☑ Predeveloped
☐ Mitigated

X 50
Y 6

Thu 2:49p - 19.12.5.004 - Finish Mitigated

Basin 1 Predeveloped

Subbasin Name: Basin 1

Flows To : Surface Interflow Groundwater

Area in Basin

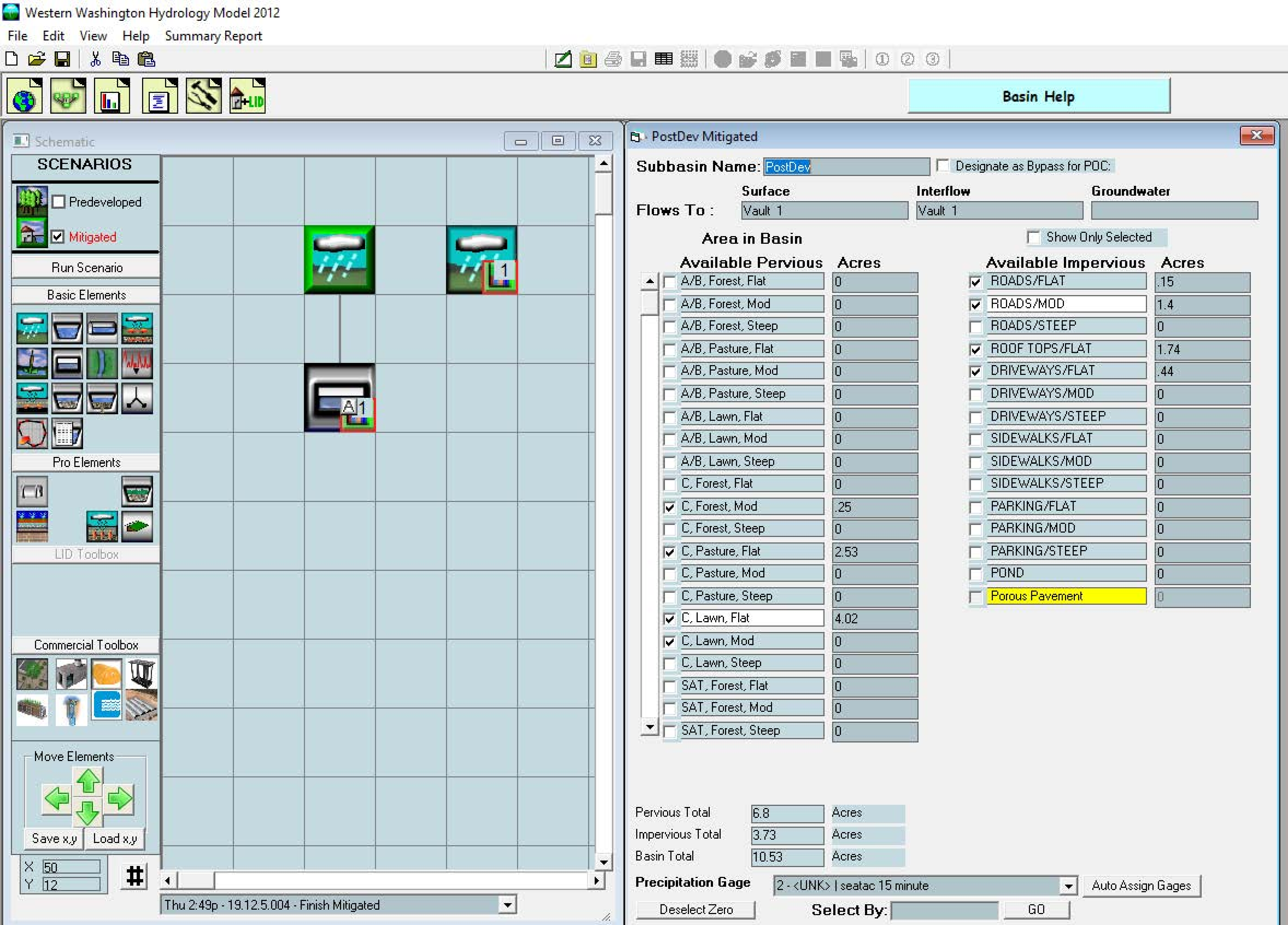
☐ Show Only Selected

	Available Pervious	Acres
☐	A/B, Forest, Flat	0
☐	A/B, Forest, Mod	0
☐	A/B, Forest, Steep	0
☐	A/B, Pasture, Flat	0
☐	A/B, Pasture, Mod	0
☐	A/B, Pasture, Steep	0
☐	A/B, Lawn, Flat	0
☐	A/B, Lawn, Mod	0
☐	A/B, Lawn, Steep	0
☐	C, Forest, Flat	0
☑	C, Forest, Mod	9.17
☐	C, Forest, Steep	0
☑	C, Pasture, Flat	2.53
☐	C, Pasture, Mod	0
☐	C, Pasture, Steep	0
☑	C, Lawn, Flat	0
☑	C, Lawn, Mod	.05
☐	C, Lawn, Steep	0
☐	SAT, Forest, Flat	0
☐	SAT, Forest, Mod	0
☐	SAT, Forest, Steep	0

	Available Impervious	Acres
☑	ROADS/FLAT	0
☑	ROADS/MOD	0
☐	ROADS/STEEP	0
☑	ROOF TOPS/FLAT	0
☑	DRIVEWAYS/FLAT	0
☐	DRIVEWAYS/MOD	0
☐	DRIVEWAYS/STEEP	0
☐	SIDEWALKS/FLAT	0
☐	SIDEWALKS/MOD	0
☐	SIDEWALKS/STEEP	0
☐	PARKING/FLAT	0
☐	PARKING/MOD	0
☐	PARKING/STEEP	0
☐	POND	0
☐	Porous Pavement	0

Pervious Total	11.75	Acres
Impervious Total	0	Acres
Basin Total	11.75	Acres

Select By:



☐ Predeveloped
☑ Mitigated

X 50
Y 12

Thu 2:49p - 19.12.5.004 - Finish Mitigated

Subbasin Name: PostDev ☐ Designate as Bypass for POC:

	Surface	Interflow	Groundwater
Flows To :	Vault 1	Vault 1	

Area in Basin ☐ Show Only Selected

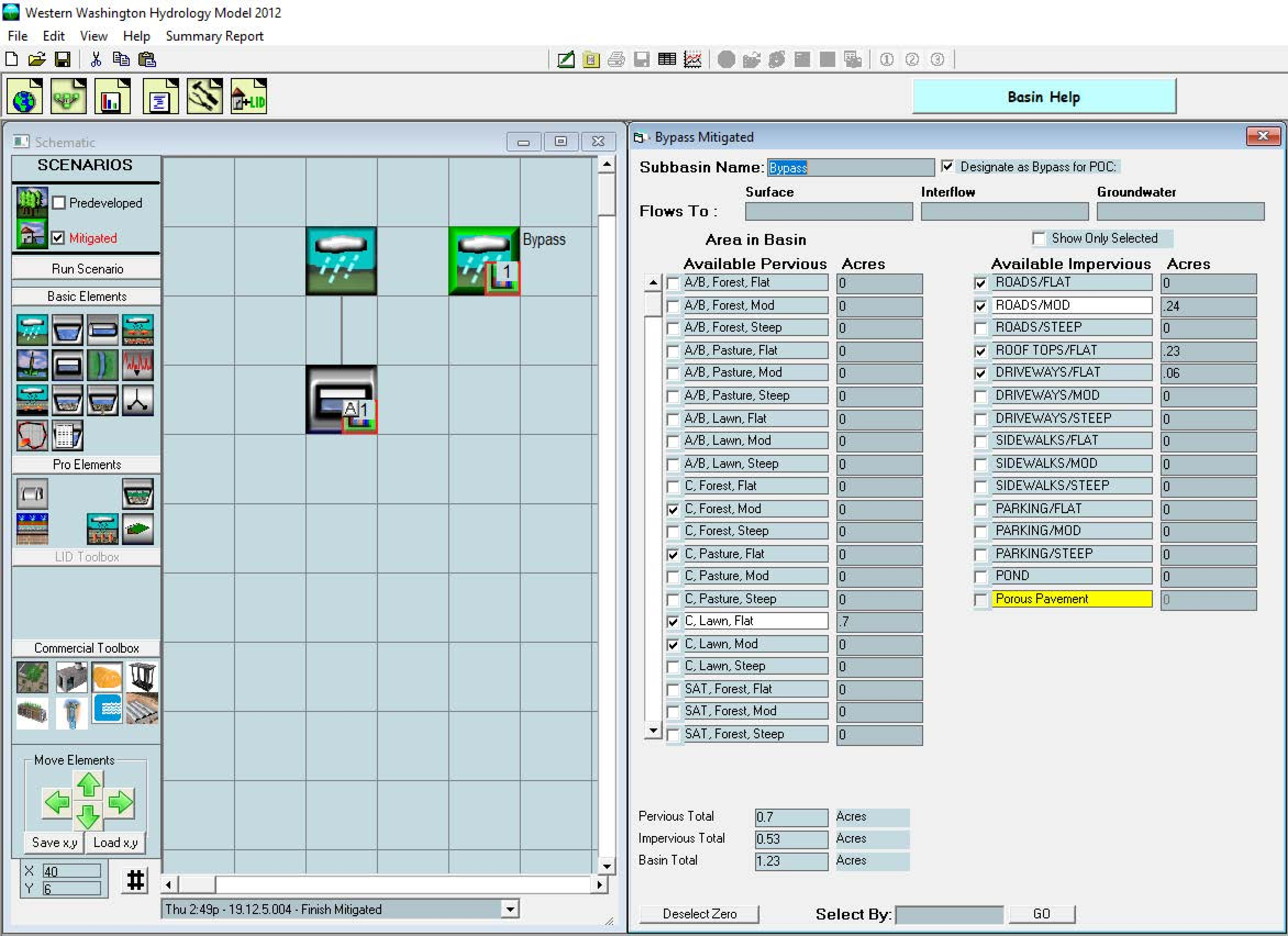
	Available Pervious	Acres
☐	A/B, Forest, Flat	0
☐	A/B, Forest, Mod	0
☐	A/B, Forest, Steep	0
☐	A/B, Pasture, Flat	0
☐	A/B, Pasture, Mod	0
☐	A/B, Pasture, Steep	0
☐	A/B, Lawn, Flat	0
☐	A/B, Lawn, Mod	0
☐	A/B, Lawn, Steep	0
☐	C, Forest, Flat	0
☑	C, Forest, Mod	.25
☐	C, Forest, Steep	0
☑	C, Pasture, Flat	2.53
☐	C, Pasture, Mod	0
☐	C, Pasture, Steep	0
☑	C, Lawn, Flat	4.02
☑	C, Lawn, Mod	0
☐	C, Lawn, Steep	0
☐	SAT, Forest, Flat	0
☐	SAT, Forest, Mod	0
☐	SAT, Forest, Steep	0

	Available Impervious	Acres
☑	ROADS/FLAT	.15
☑	ROADS/MOD	1.4
☐	ROADS/STEEP	0
☑	ROOF TOPS/FLAT	1.74
☑	DRIVEWAYS/FLAT	.44
☐	DRIVEWAYS/MOD	0
☐	DRIVEWAYS/STEEP	0
☐	SIDEWALKS/FLAT	0
☐	SIDEWALKS/MOD	0
☐	SIDEWALKS/STEEP	0
☐	PARKING/FLAT	0
☐	PARKING/MOD	0
☐	PARKING/STEEP	0
☐	POND	0
☐	Porous Pavement	0

Pervious Total	6.8	Acres
Impervious Total	3.73	Acres
Basin Total	10.53	Acres

Precipitation Gage 2 - <UNK> | seatac 15 minute
Auto Assign Gages

Deselect Zero **Select By:** GO



☐ Predeveloped

☑ Mitigated

X 40

Y 6

Thu 2:49p - 19.12.5.004 - Finish Mitigated

Subbasin Name: Bypass ☑ Designate as Bypass for POC:

Flows To :

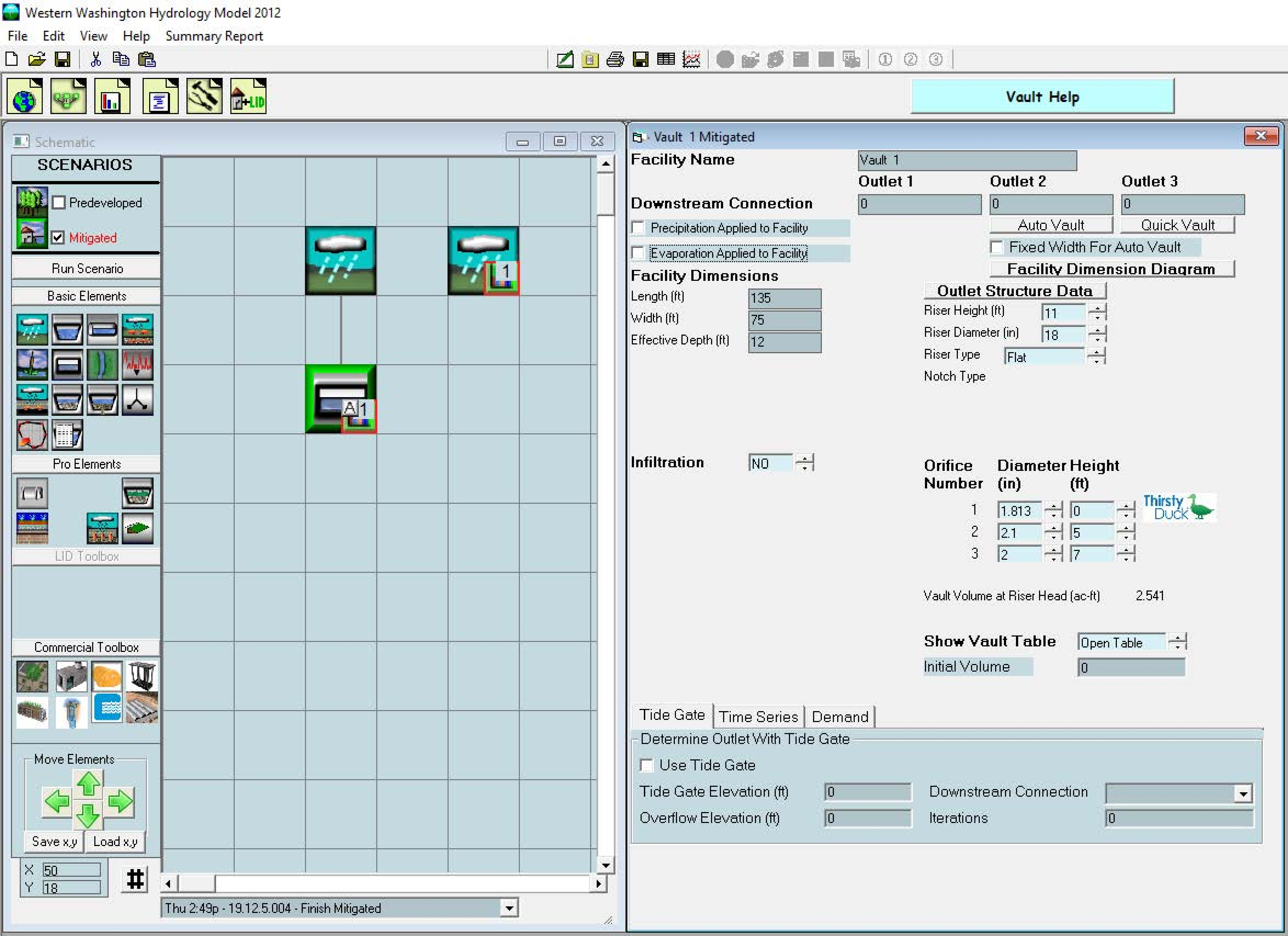
Surface	Interflow	Groundwater

Area in Basin ☐ Show Only Selected

	Available Pervious	Acres
☐	A/B, Forest, Flat	0
☐	A/B, Forest, Mod	0
☐	A/B, Forest, Steep	0
☐	A/B, Pasture, Flat	0
☐	A/B, Pasture, Mod	0
☐	A/B, Pasture, Steep	0
☐	A/B, Lawn, Flat	0
☐	A/B, Lawn, Mod	0
☐	A/B, Lawn, Steep	0
☐	C, Forest, Flat	0
☑	C, Forest, Mod	0
☐	C, Forest, Steep	0
☑	C, Pasture, Flat	0
☐	C, Pasture, Mod	0
☐	C, Pasture, Steep	0
☑	C, Lawn, Flat	.7
☑	C, Lawn, Mod	0
☐	C, Lawn, Steep	0
☐	SAT, Forest, Flat	0
☐	SAT, Forest, Mod	0
☐	SAT, Forest, Steep	0

	Available Impervious	Acres
☑	ROADS/FLAT	0
☑	ROADS/MOD	.24
☐	ROADS/STEEP	0
☑	ROOF TOPS/FLAT	.23
☑	DRIVEWAYS/FLAT	.06
☐	DRIVEWAYS/MOD	0
☐	DRIVEWAYS/STEEP	0
☐	SIDEWALKS/FLAT	0
☐	SIDEWALKS/MOD	0
☐	SIDEWALKS/STEEP	0
☐	PARKING/FLAT	0
☐	PARKING/MOD	0
☐	PARKING/STEEP	0
☐	POND	0
☐	Porous Pavement	0

Pervious Total	0.7	Acres
Impervious Total	0.53	Acres
Basin Total	1.23	Acres



☐ Predeveloped
☑ Mitigated

X 50
Y 18

Thu 2:49p - 19.12.5.004 - Finish Mitigated

Vault 1 Mitigated

Facility Name Vault 1

	Outlet 1	Outlet 2	Outlet 3
Downstream Connection	0	0	0

☐ Precipitation Applied to Facility

☐ Evaporation Applied to Facility

☐ Fixed Width For Auto Vault

Facility Dimensions

Length (ft) 135
Width (ft) 75
Effective Depth (ft) 12

Outlet Structure Data

Riser Height (ft) 11
Riser Diameter (in) 18
Riser Type Flat
Notch Type

Infiltration NO

Orifice Number	Diameter (in)	Height (ft)
1	1.813	0
2	2.1	5
3	2	7

Vault Volume at Riser Head (ac-ft) 2.541

Show Vault Table Open Table

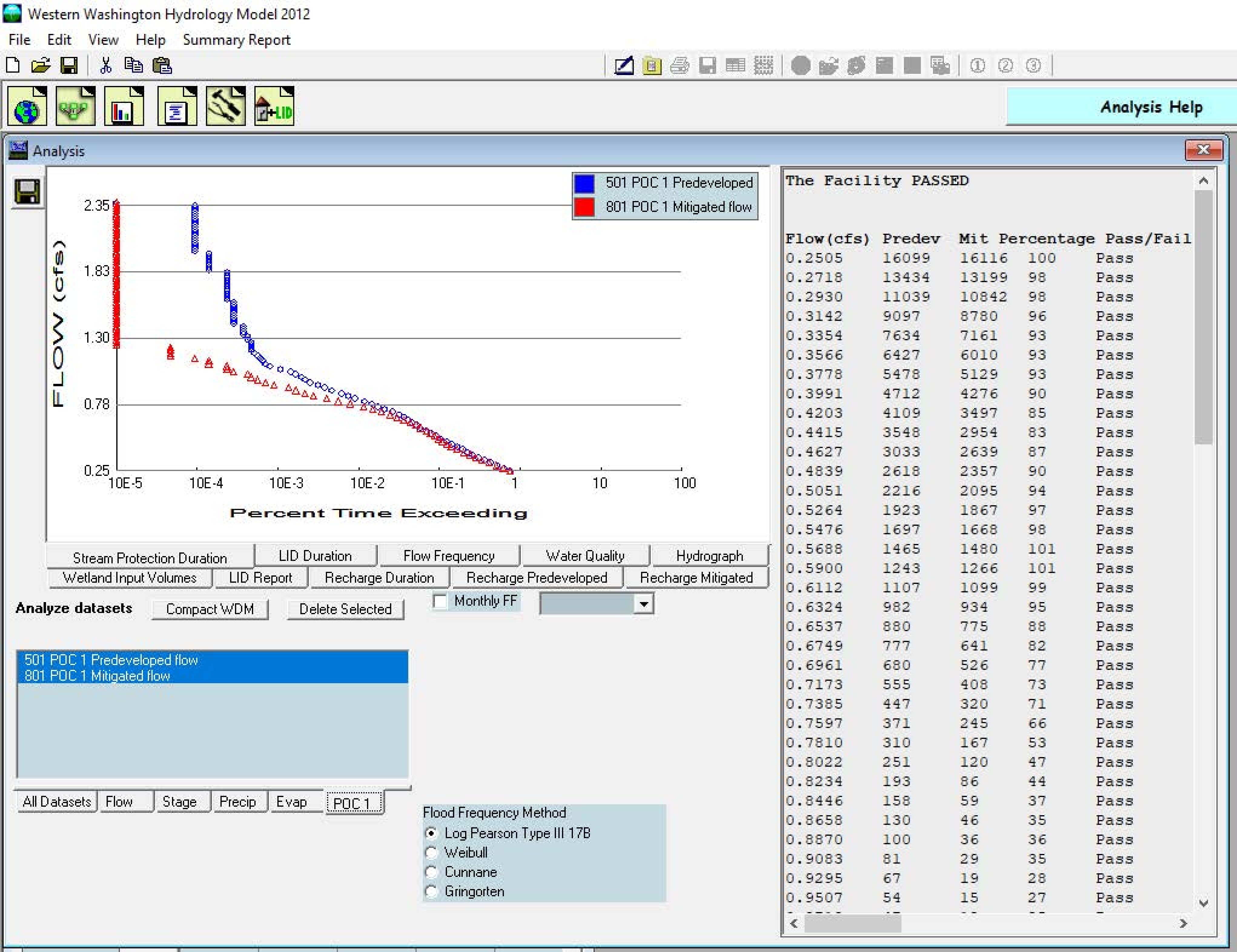
Initial Volume 0

Tide Gate

Determine Outlet With Tide Gate

☐ Use Tide Gate

Tide Gate Elevation (ft) 0
Overflow Elevation (ft) 0
Downstream Connection
Iterations 0



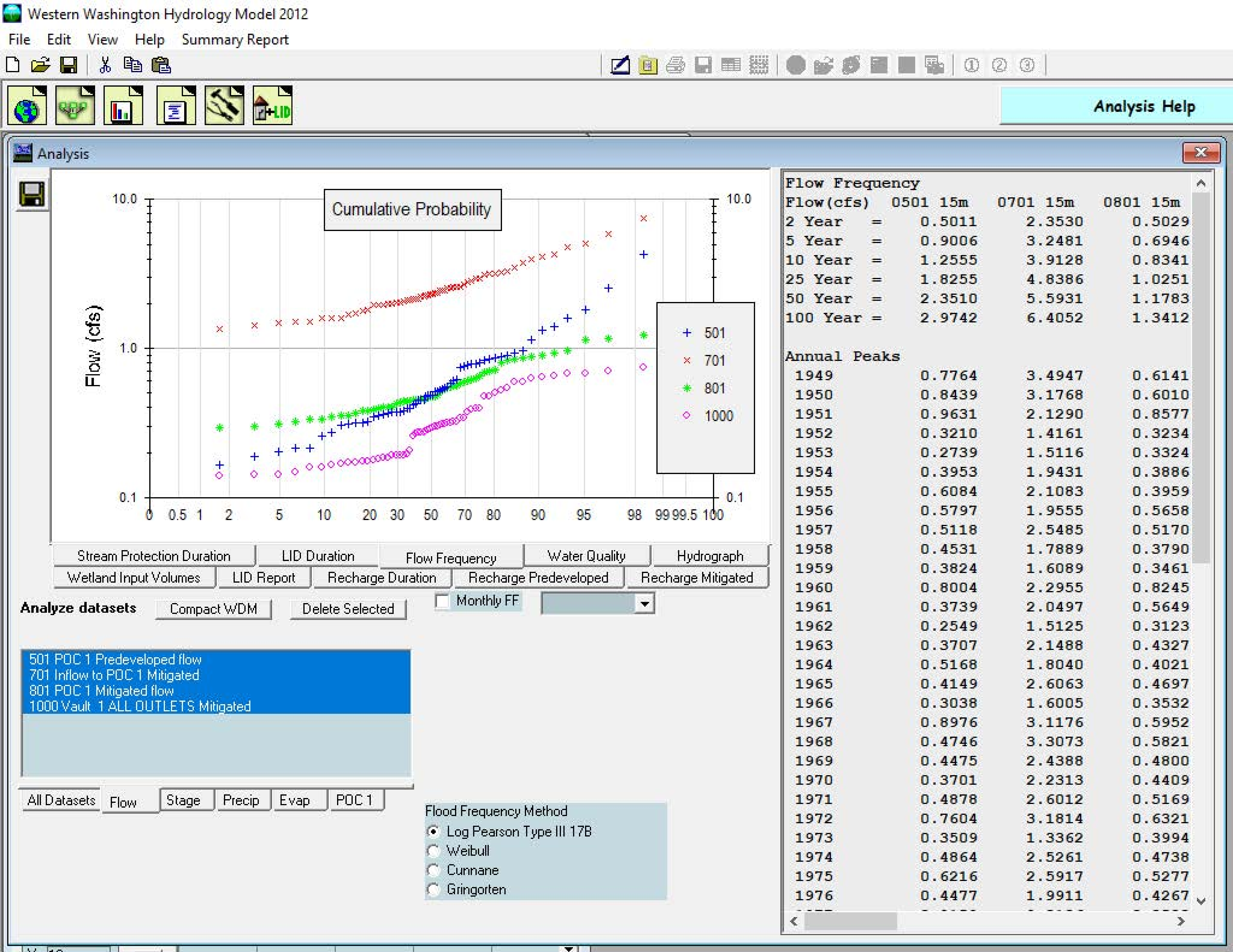
☐ Monthly FF

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

```
The Facility PASSED


Flow(cfs)  Predev  Mit Percentage Pass/Fail
0.2505     16099   16116  100      Pass
0.2718     13434   13199  98       Pass
0.2930     11039   10842  98       Pass
0.3142     9097    8780   96       Pass
0.3354     7634    7161   93       Pass
0.3566     6427    6010   93       Pass
0.3778     5478    5129   93       Pass
0.3991     4712    4276   90       Pass
0.4203     4109    3497   85       Pass
0.4415     3548    2954   83       Pass
0.4627     3033    2639   87       Pass
0.4839     2618    2357   90       Pass
0.5051     2216    2095   94       Pass
0.5264     1923    1867   97       Pass
0.5476     1697    1668   98       Pass
0.5688     1465    1480   101      Pass
0.5900     1243    1266   101      Pass
0.6112     1107    1099   99       Pass
0.6324     982     934    95       Pass
0.6537     880     775    88       Pass
0.6749     777     641    82       Pass
0.6961     680     526    77       Pass
0.7173     555     408    73       Pass
0.7385     447     320    71       Pass
0.7597     371     245    66       Pass
0.7810     310     167    53       Pass
0.8022     251     120    47       Pass
0.8234     193     86     44       Pass
0.8446     158     59     37       Pass
0.8658     130     46     35       Pass
0.8870     100     36     36       Pass
0.9083     81      29     35       Pass
0.9295     67      19     28       Pass
0.9507     54      15     27       Pass
```



Analyze datasets

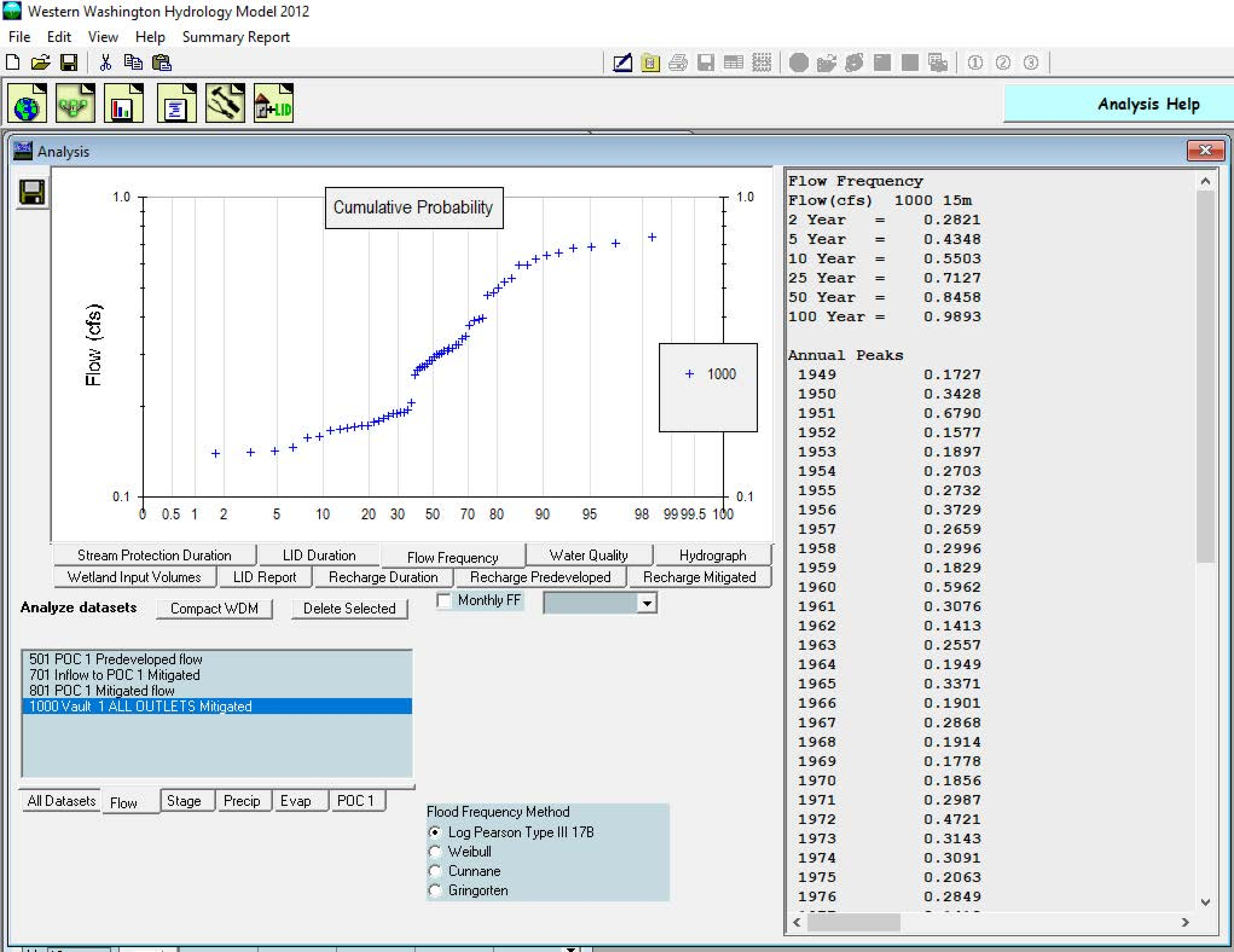
☐ Monthly FF

501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Vault 1 ALL OUTLETS Mitigated

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

```
Flow Frequency
Flow(cfs)  0501 15m   0701 15m   0801 15m
2 Year   =    0.5011     2.3530     0.5029
5 Year   =    0.9006     3.2481     0.6946
10 Year  =    1.2555     3.9128     0.8341
25 Year  =    1.8255     4.8386     1.0251
50 Year  =    2.3510     5.5931     1.1783
100 Year =    2.9742     6.4052     1.3412

Annual Peaks
 1949         0.7764     3.4947     0.6141
 1950         0.8439     3.1768     0.6010
 1951         0.9631     2.1290     0.8577
 1952         0.3210     1.4161     0.3234
 1953         0.2739     1.5116     0.3324
 1954         0.3953     1.9431     0.3886
 1955         0.6084     2.1083     0.3959
 1956         0.5797     1.9555     0.5658
 1957         0.5118     2.5485     0.5170
 1958         0.4531     1.7889     0.3790
 1959         0.3824     1.6089     0.3461
 1960         0.8004     2.2955     0.8245
 1961         0.3739     2.0497     0.5649
 1962         0.2549     1.5125     0.3123
 1963         0.3707     2.1488     0.4327
 1964         0.5168     1.8040     0.4021
 1965         0.4149     2.6063     0.4697
 1966         0.3038     1.6005     0.3532
 1967         0.8976     3.1176     0.5952
 1968         0.4746     3.3073     0.5821
 1969         0.4475     2.4388     0.4800
 1970         0.3701     2.2313     0.4409
 1971         0.4878     2.6012     0.5169
 1972         0.7604     3.1814     0.6321
 1973         0.3509     1.3362     0.3994
 1974         0.4864     2.5261     0.4738
 1975         0.6216     2.5917     0.5277
 1976         0.4477     1.9911     0.4267
```



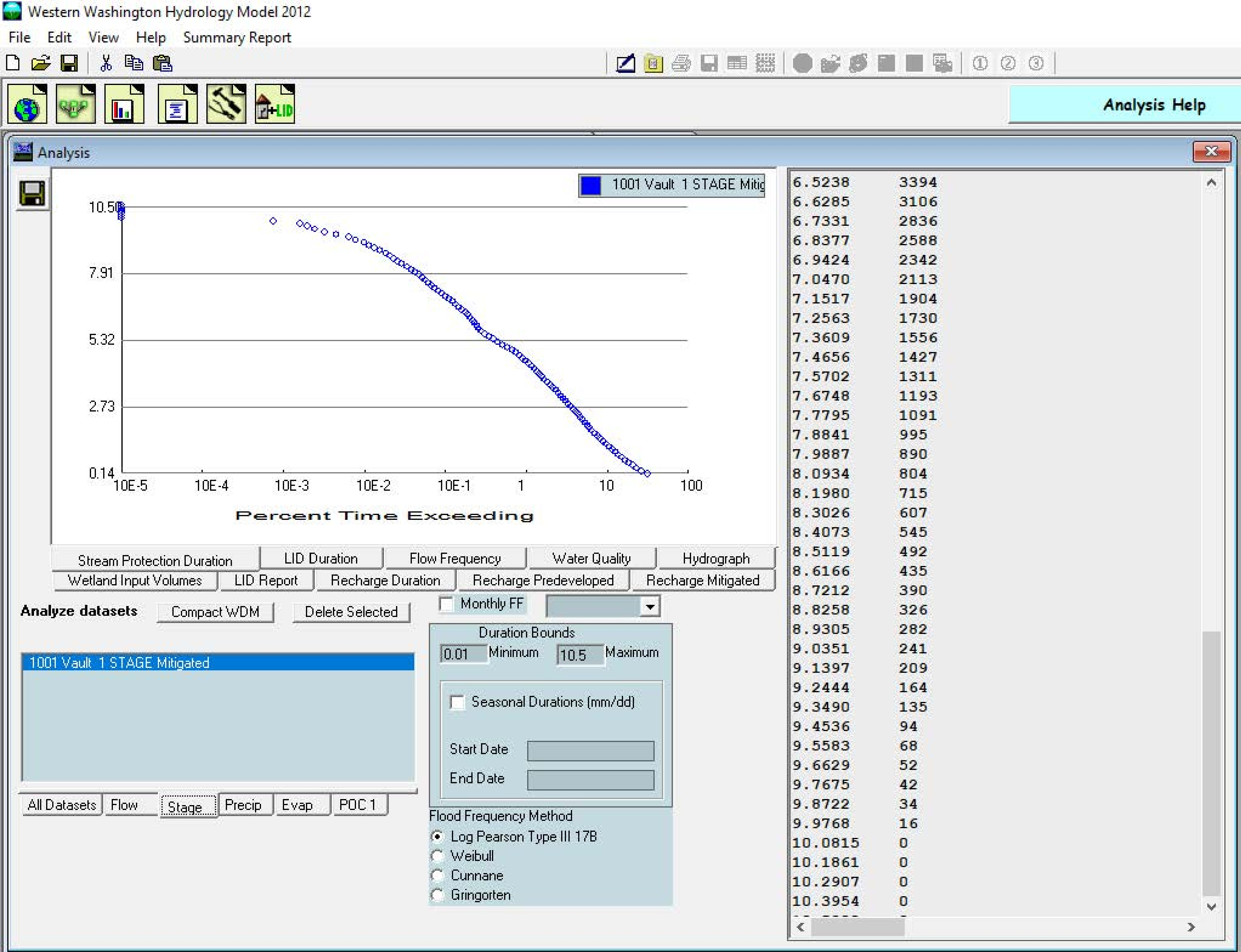
☐ Monthly FF

501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Vault 1 ALL OUTLETS Mitigated

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

```
Flow Frequency
Flow(cfs)  1000 15m
2 Year   =     0.2821
5 Year   =     0.4348
10 Year  =     0.5503
25 Year  =     0.7127
50 Year  =     0.8458
100 Year =     0.9893

Annual Peaks
 1949          0.1727
 1950          0.3428
 1951          0.6790
 1952          0.1577
 1953          0.1897
 1954          0.2703
 1955          0.2732
 1956          0.3729
 1957          0.2659
 1958          0.2996
 1959          0.1829
 1960          0.5962
 1961          0.3076
 1962          0.1413
 1963          0.2557
 1964          0.1949
 1965          0.3371
 1966          0.1901
 1967          0.2868
 1968          0.1914
 1969          0.1778
 1970          0.1856
 1971          0.2987
 1972          0.4721
 1973          0.3143
 1974          0.3091
 1975          0.2063
 1976          0.2849
```



1001 Vault 1 STAGE Mitigated

☐ Monthly FF

Duration Bounds

0.01 Minimum

10.5 Maximum

☐ Seasonal Durations (mm/dd)

Start Date

End Date

Flood Frequency Method

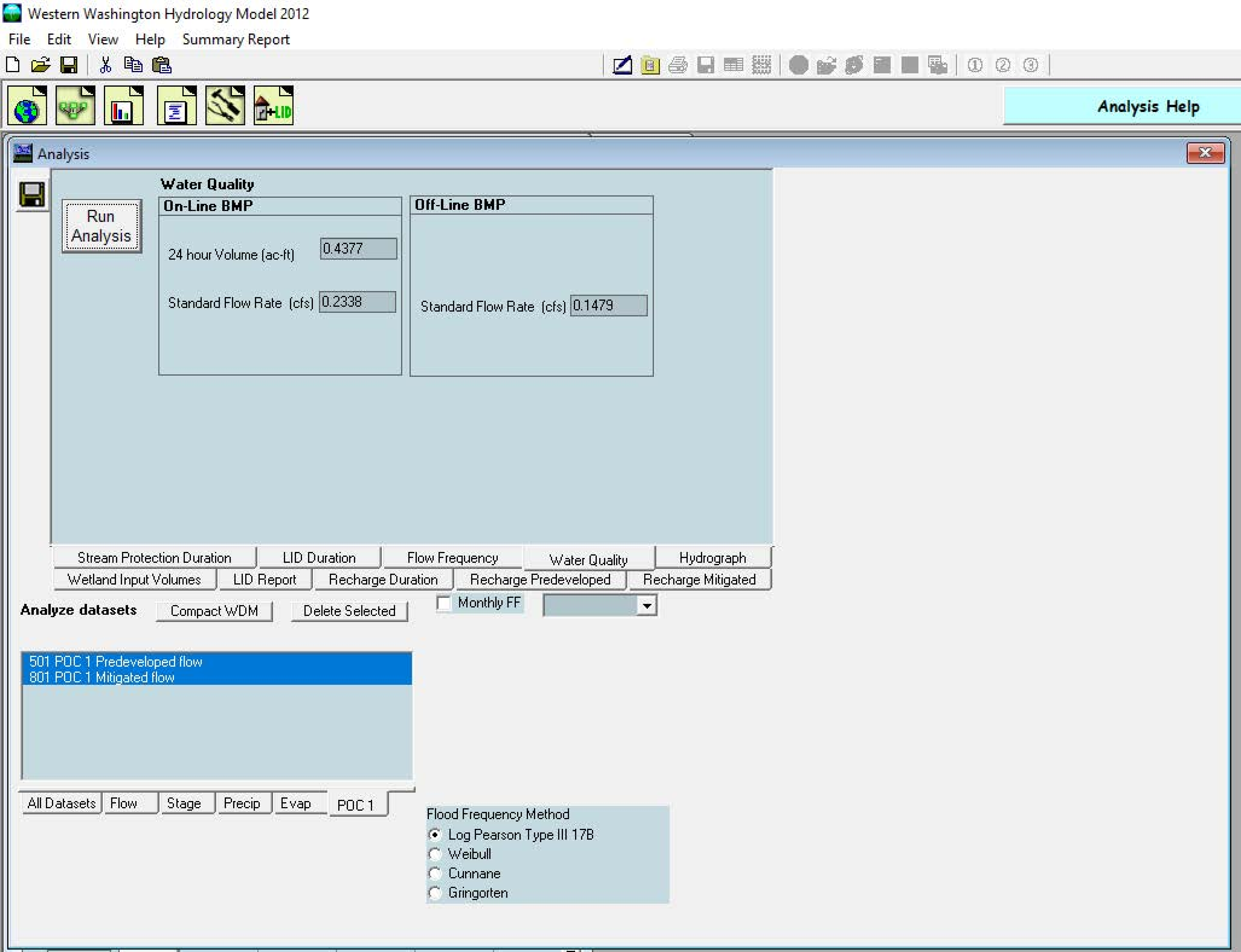
● Log Pearson Type III 17B

○ Weibull

○ Cunnane

○ Gringorten

```
6.5238      3394
6.6285      3106
6.7331      2836
6.8377      2588
6.9424      2342
7.0470      2113
7.1517      1904
7.2563      1730
7.3609      1556
7.4656      1427
7.5702      1311
7.6748      1193
7.7795      1091
7.8841      995
7.9887      890
8.0934      804
8.1980      715
8.3026      607
8.4073      545
8.5119      492
8.6166      435
8.7212      390
8.8258      326
8.9305      282
9.0351      241
9.1397      209
9.2444      164
9.3490      135
9.4536      94
9.5583      68
9.6629      52
9.7675      42
9.8722      34
9.9768      16
10.0815     0
10.1861     0
10.2907     0
10.3954     0
```



Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.4377

Standard Flow Rate (cfs) 0.2338

Off-Line BMP

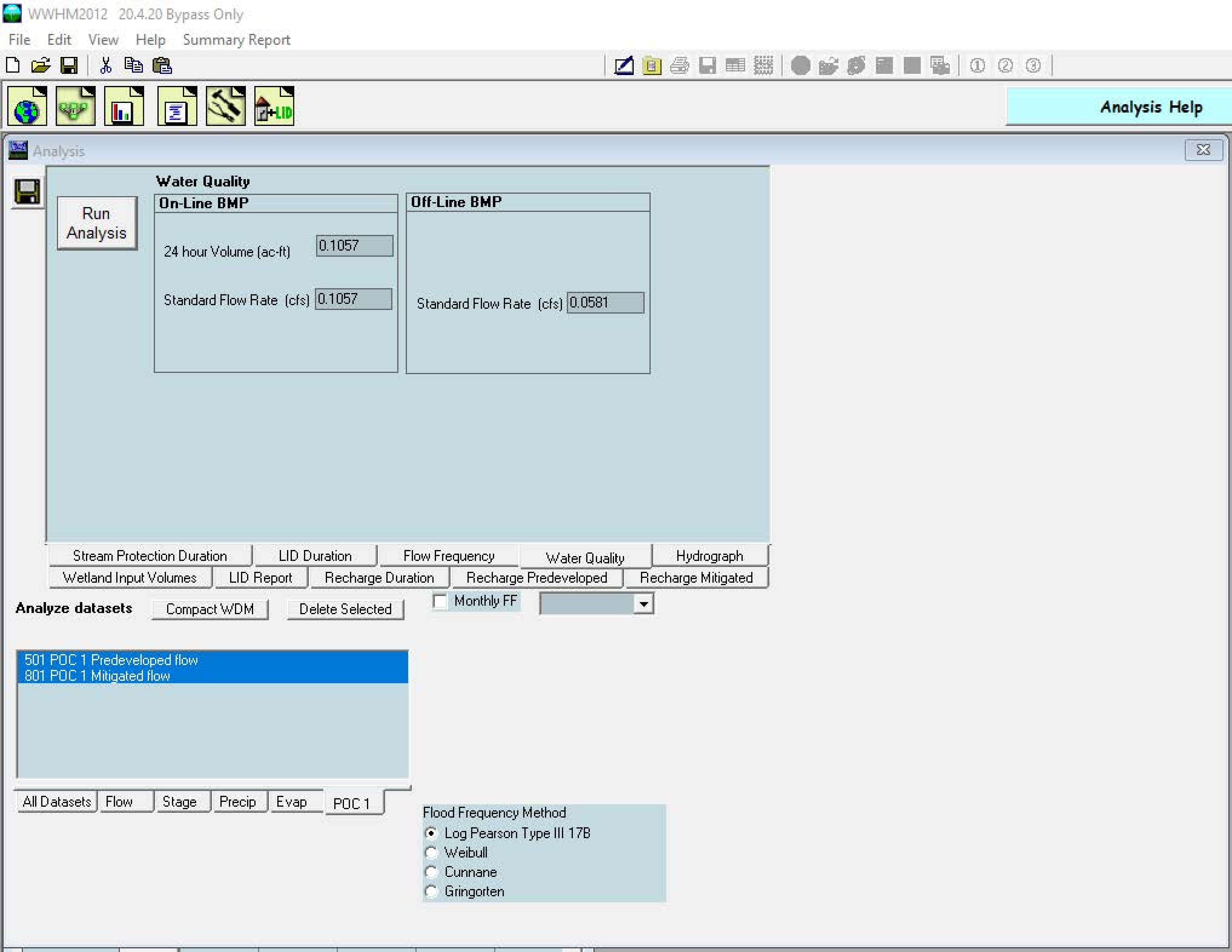
Standard Flow Rate (cfs) 0.1479

☐ Monthly FF

Analyze datasets

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten



Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.1057

Standard Flow Rate (cfs) 0.1057

Off-Line BMP

Standard Flow Rate (cfs) 0.0581

☐ Monthly FF

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

Flood Frequency Method
- ● Log Pearson Type III 17B
- ○ Weibull
- ○ Cunnane
- ○ Gringorten

APPENDIX C - CONVEYANCE WORKSHEET

Job # 1222

Calavista PRD

11-Apr-19

WWHM2012
19.4.11.1222

701 Inflow to POC 1 Mitigated
(See Appendix C - WWHM 2012 Report)

Flows	(cfs)
2 Year	2.35
5 Year	3.25
10 Year	3.91
25 Year	4.84
50 Year	5.59
100 Year	**6.41**

Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.00	0.7854		
Hyd Rad	☒	0.2500	Q (cfs) =	**2.73**
Slope (Ft/Ft)	0.005		V (fps)	**3.47**

Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.00	0.7854		
Hyd Rad	☒	0.2500	Q (cfs) =	**3.86**
Slope (Ft/Ft)	0.01		V (fps)	**4.91**

Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.00	0.7854		
Hyd Rad	☒	0.2500	Q (cfs) =	**5.46**
Slope (Ft/Ft)	0.02		V (fps)	**6.95**

Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.00	0.7854		
Hyd Rad		0.2500	Q (cfs) =	**6.68**
Slope (Ft/Ft)	0.03		V (fps)	**8.51**

Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.25	1.2272		
Hyd Rad		0.3125	Q (cfs) =	**7.00**
Slope (Ft/Ft)	0.01		V (fps)	**5.70**

Mannings Flow Calculator

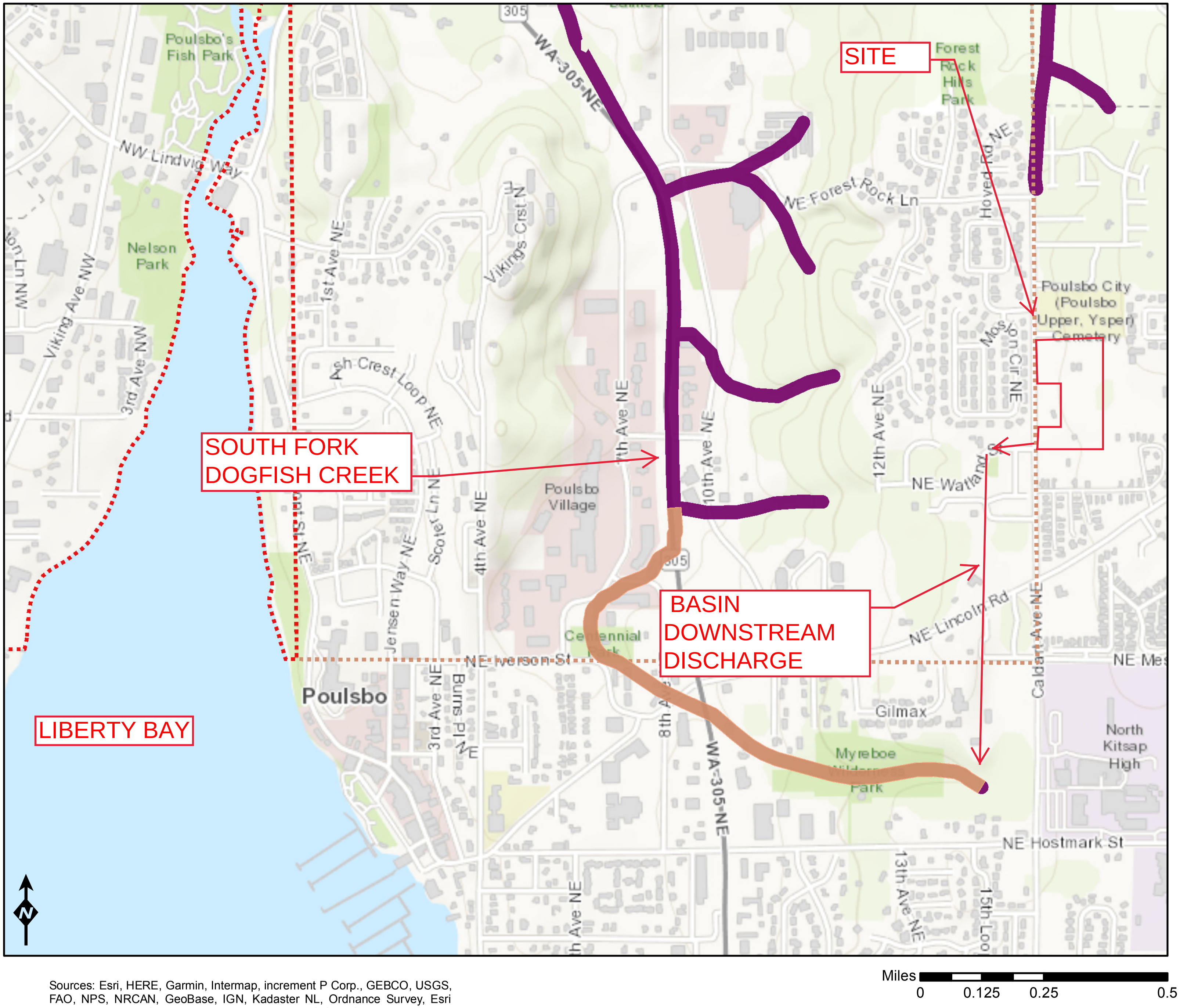
(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	1.50	1.7671		
Hyd Rad		0.3750	Q (cfs) =	**8.05**
Slope (Ft/Ft)	0.005		V (fps)	**4.55**

APPENDIX D - DOE 303d LISTING FOR DOGFISH CREEK

Water Quality Atlas Map

December 7, 2018



Assessed Waters/Sediment

Water
- 🟥 Category 5 - 303d
- 🟪 Category 4C
- 🟫 Category 4B
- 🟧 Category 4A
- 🟨 Category 2
- 🟩 Category 1

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

● WQ Standards

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap

DEPARTMENT OF ECOLOGY State of Washington

Listing ID: 8729

Main Listing Information

Listing ID:	8729	**2014 Category:**	2
Waterbody Name:	DOGFISH CREEK	**2012 Category:**	2
Medium:	Water	**2008 Category:**	2
Parameter:	Turbidity	**2004 Category:**	2
WQI Project:	None Assigned	**On 1998 303(d) List?:**	Y
Designated Use:	None Assigned	**On 1996 303(d) List?:**	Y

Assessment Unit

Assessment Unit ID: 17110019002769

Location Identification

Counties:	Kitsap	**WRIA:**	15 - Kitsap
Waterbody ID (WBID):	WA-15-2030	**Waterbody Class:**	RAA
Town/Range/Section (Legacy):	26N-1E-14		

Basis

Forsyth, 1995. 2 excursions beyond the criterion out of 4 samples collected at the mouth during 1994-1995.

Remarks

Remark	Modified By	Modified On	Visibility
This waterbody segment was listed on the 1998 303(d) list based on two exceedances. This information is insufficient to determine impairment for purposes of the 303(d) list and does not meet Category 5 listing requirements in WQ Policy 1-11. This waterbody segment will be placed in Category 2 as a priority for monitoring so that adequate information can be obtained to determine if the waterbody is impaired.	Imported	6/11/2007	Public

EIM

No EIM Records Entered

Listing ID: 23529

Main Listing Information

Listing ID: 23529
Waterbody Name: DOGFISH CREEK
Medium: Water
Parameter: Dissolved Oxygen
WQI Project: None Assigned
Designated Use: None Assigned

2014 Category: 5
2012 Category: 5
2008 Category: 5
2004 Category: 1
On 1998 303(d) List?: N
On 1996 303(d) List?: N

Assessment Unit

Assessment Unit ID: 17110019002769

Location Identification

Counties: Kitsap
WRIA: 15 - Kitsap
Waterbody ID (WBID): None Assigned
Waterbody Class: RAA
Town/Range/Section (Legacy): 26N-1E-14

Basis

Location ID: [12070000] -- In 2007, 0 of 4 sample values (0%) showed an excursion of the criterion (9.5 mg/L) for this waterbody; (External Data Source: [USGS NWIS database)

Location ID:KCHD-SF01], [KCHD-DF01] -- In 2006, 1 of 9 sample values (11%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;

Location ID: [KCHD-SF01], [KCHD-DF01] -- In 2005, 6 of 12 sample values (50%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;

Location ID: [KCHD-SF01], [KCHD-DF01] -- In 2004, 2 of 7 sample values (29%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;

Location ID: [KCHD-SF01], [KCHD-DF01] -- In 2003, 1 of 11 sample values (9%) showed an excursion of the criterion (9.5 mg/L) for this waterbody;

Location ID [KCHD-SF01] -- In 2002, 1 of 3 sample values (33.3%) showed an excursion of the criterion for this waterbody, (criterion = 9.5 mg/L).
Location ID [KCHD-DF01] -- In 2002, none of the 3 sample values (0.0%) showed an excursion of the criterion for this waterbody, (criterion = 9.5 mg/L).

Liberty Bay Foundation unpublished data (submitted by Luis Barrantes on 12 Decemeber 2002) from station LBNS-1 (Mouth of Dogfish Creek behind Liberty Bay Auto Center (@ culvert outlet)) show no excursions beyond the criterion from measurements collected in 2001-2002 .

Remarks

Remark	Modified By	Modified On	Visibility
Ten percent or more of the samples collected in a single year were excursions of the criterion, and at least 3 excursions exist from all data considered.	Jessica Archer	10/3/2014	Public

EIM

User Study ID:	User Location ID:
KITSAPWQ	KCHD-SF01
KITSAPWQ	KCHD-DF01

Listing ID: 23695

Main Listing Information

Listing ID:	23695	**2014 Category:**	4B
Waterbody Name:	DOGFISH CREEK	**2012 Category:**	4B
Medium:	Water	**2008 Category:**	4B
Parameter:	Bacteria	**2004 Category:**	4B
WQI Project:	Dogfish Creek 4b Project	**On 1998 303(d) List?:**	N
Designated Use:	None Assigned	**On 1996 303(d) List?:**	N

Assessment Unit

Assessment Unit ID: 17110019002769

Location Identification

Counties:	Kitsap	**WRIA:**	15 - Kitsap
Waterbody ID (WBID):	None Assigned	**Waterbody Class:**	RAA
Town/Range/Section (Legacy):	26N-1E-14		

Basis

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2009, 6 of 22 sample values (27%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 53.4 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2008, 1 of 4 sample values (25%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). Fewer than five samples were available, therefore a geometric mean was not calculated for this period.

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2006, 6 of 12 sample values (50%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 70.8 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2005, 4 of 12 sample values (33%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 47.6 does not exceed the geometric mean criterion (50 cfu/100mL).

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2004, 4 of 11 sample values (36%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 114.2 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID: [15-DOG-0.6], [KCHD-DF01], [KCHD-SF01] -- In water year 2003, 5 of 12 sample values (42%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 69.2 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID [KCHD-SF01] -- Fewer than five samples were available in 2002, therefore a geometric mean was not calculated for this period.
Location ID [KCHD-SF01] -- 1 of 3 samples (33.3%) collected in 2002 exceed the percent criterion (100 col/100mL).
Location ID [KCHD-DF01] -- Fewer than five samples were available in 2002, therefore a geometric mean was not calculated for this period.
Location ID [KCHD-DF01] -- 2 of 3 samples (66.7%) collected in 2002 exceed the percent criterion (100 col/100mL).

Liberty Bay Foundation unpublished data (submitted by Luis Barrantes on 12 Decemeber 2002) from station LBNS-1 (Mouth of Dogfish Creek behind Liberty Bay Auto Center (@ culvert outlet)) show a geometric mean of 128 cfu/100mL from samples collected in 2001-2002.

Remarks

Remark	Modified By	Modified On	Visibility
Combined Listing: Listing ID 53092 was rolled into this listing	Chad Brown	9/24/2015	Public
This listing is part of one of four Kitsap County Health's Pollution Identification and Control (PIC) projects that meet Category 4B requirements. The four plans, although issued at separate times, show on-the ground improvements to addressing fecal coliform problems. The PIC plans are closely tied to the county's annual Water Quality Monitoring Report. Changed from Cat 5 to 4B 04/25/05.	Susan Braley	10/27/2014	Public
Policy 1-11 was revised in July 2012 to specify that bacteria is assessed according to water year (Oct 1-Sept 30) from the previous assessment period of calendar year. The water year assessment is only applied to newly assessed data. Therefore, this listing contains data assessed by both water year and calendar year.	Jessica Archer	10/2/2014	Public
Impairment was determined by exceedance of the geometric mean criterion in water year(s) 2009, 2006, 2004 and 2003 and the percent criterion in water year(s) 2009, 2008, 2006, 2005, 2004, 2003 and calendar year 2002.	Jessica Archer	10/2/2014	Public

EIM

User Study ID:	User Location ID:
KITSAPWQ	KCHD-SF01
KITSAPWQ	KCHD-DF01
TSWA0002	15-DOG-0.6

Listing ID: 73436

Main Listing Information

Listing ID:	73436	**2014 Category:**	2
Waterbody Name:	UNNAMED CREEK (TRIB TO DOGFISH CREEK)	**2012 Category:**	3
Medium:	Water	**2008 Category:**	3
Parameter:	Temperature	**2004 Category:**	3
WQI Project:	None Assigned	**On 1998 303(d) List?:**	N
Designated Use:	None Assigned	**On 1996 303(d) List?:**	N

Assessment Unit

Assessment Unit ID: Unmappable - UNNAMED CREEK (TRIB TO DOGFISH CREEK)-26N-1E-14

Location Identification

Counties:	Kitsap	**WRIA:**	15 - Kitsap
Waterbody ID (WBID):	None Assigned	**Waterbody Class:**	None Assigned
Town/Range/Section (Legacy):	26N-1E-14		

Basis

Location ID: 15-SFD-0.0 -- In 2009, 1 of 16 sample values (6%) showed an excursion of the criteria (16°C) for this waterbody;

Location ID: 15-SFD-0.0 -- In 2008, 0 of 10 sample values (0%) showed an excursion of the criteria (16°C) for this waterbody;

Remarks

No Remarks Entered

EIM

User Study ID:	User Location ID:
TSWA0002	15-SFD-0.0

Listing ID: 74656

Main Listing Information

Listing ID:	74656	**2014 Category:**	4B
Waterbody Name:	DOGFISH CREEK, S.F.	**2012 Category:**	3
Medium:	Water	**2008 Category:**	3
Parameter:	Bacteria	**2004 Category:**	3
WQI Project:	Kitsap County Bacteria 4B	**On 1998 303(d) List?:**	N
Designated Use:	None Assigned	**On 1996 303(d) List?:**	N

Assessment Unit

Assessment Unit ID: 17110019002844

Location Identification

Counties:	Kitsap	**WRIA:**	15 - Kitsap
Waterbody ID (WBID):	None Assigned	**Waterbody Class:**	None Assigned
Town/Range/Section (Legacy):	26N-1E-23		

Basis

Location ID: [15-SFD-1.3] -- In water year 2009, 11 of 22 sample values (50%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 64.9 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID: [15-SFD-1.3] -- In water year 2008, 1 of 4 sample values (25%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). Fewer than five samples were available, therefore a geometric mean was not calculated for this period.

Remarks

Remark	Modified By	Modified On	Visibility
Impairment is being addressed by the Kitsap County Pollution Identification and Correction Program	Patrick Lizon	2/10/2015	Public
Impairment was determined by exceedance of the geometric mean criterion in water year(s) 2009 and the percent criterion in water year(s) 2009, and 2008.	Jessica Archer	10/2/2014	Public

EIM

User Study ID:	User Location ID:
TSWA0002	15-SFD-1.3

Listing ID: 74746

Main Listing Information

Listing ID:	74746	**2014 Category:**	4B
Waterbody Name:	UNNAMED CREEK (TRIB TO DOGFISH CREEK)	**2012 Category:**	3
Medium:	Water	**2008 Category:**	3
Parameter:	Bacteria	**2004 Category:**	3
WQI Project:	Kitsap County Bacteria 4B	**On 1998 303(d) List?:**	N
Designated Use:	None Assigned	**On 1996 303(d) List?:**	N

Assessment Unit

Assessment Unit ID: Unmappable - UNNAMED CREEK (TRIB TO DOGFISH CREEK)-26N-1E-14

Location Identification

Counties:	Kitsap	**WRIA:**	15 - Kitsap
Waterbody ID (WBID):	None Assigned	**Waterbody Class:**	None Assigned
Town/Range/Section (Legacy):	26N-1E-14		

Basis

Location ID: [15-SFD-0.0] -- In water year 2009, 10 of 22 sample values (45%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). The geometric mean of 86.6 exceeds the geometric mean criterion (50 cfu/100mL).

Location ID: [15-SFD-0.0] -- In water year 2008, 2 of 4 sample values (50%) showed an excursion of the % criterion for this waterbody (100 cfu/100mL). Fewer than five samples were available, therefore a geometric mean was not calculated for this period.

Remarks

Remark	Modified By	Modified On	Visibility
Impairment is being addressed by the Kitsap County Pollution Identification and Correction Program	Patrick Lizon	2/10/2015	Public
Impairment was determined by exceedance of the geometric mean criterion in water year(s) 2009 and the percent criterion in water year(s) 2009, and 2008.	Jessica Archer	10/2/2014	Public

EIM

User Study ID:	User Location ID:
TSWA0002	15-SFD-0.0

APPENDIX 7 – Determining Construction Site Sediment Damage Potential

The following rating system allows objective evaluation of a particular development site's potential to discharge sediment. Permittees may use the rating system below or develop alternative process designed to identify site-specific features which indicate that the site must be inspected prior to clearing and construction. Any alternative evaluation process must be documented and provide for equivalent environmental review.

Step one is to determine if there is a sediment/erosion sensitive feature downstream of the development site. If there is such a site downstream complete step two, assessment of hydraulic nearness. If there is a sediment/erosion sensitive feature and it is hydraulically near the site then go to step three to determine the construction site sediment transport potential.

STEP 1 – Sediment/Erosion Sensitive Feature Identification

Sediment/erosion sensitive features are areas subject to significant degradation due to the effect of sediment deposition or erosion. Special protection must be provided to protect them. Sediment/erosion sensitive features include but are not limited to:

i. Salmonid bearing fresh water streams and their tributaries or freshwater streams that would be Salmonid bearing if not for anthropogenic barriers;
ii. Lakes;
iii. Category I, II, and III wetlands;
iv. Marine near-shore habitat;
v. Sites containing contaminated soils where erosion could cause dispersal of contaminants; and
vi. Steep slopes (25% or greater) associated with one of the above features.

Identify any sediment/erosion sensitive features, and proceed to step two. If there are none the assessment is complete.

STEP 2 – Hydraulic Nearness Assessment

Sites are hydraulically near a feature if the pollutant load and peak quantity of runoff from the site will not be naturally attenuated before entering the feature. The conditions that render a site hydraulically near to a feature include, but are not limited to, the following:

i. The feature or a buffer to protect the feature is within 200 feed downstream of the site.
ii. Runoff from the site is tight-lined to the feature or flows to the feature through a channel or ditch.

A site is not hydraulically near a feature if one of the following takes place to provide attenuation before runoff from the site enters the feature:

i. Sheet flow through a vegetated area with dense ground cover
ii. Flow through a wetland not included as a sensitive feature
iii. Flow through a significant shallow or adverse slope, not in a conveyance channel, between the site and the sensitive feature.

Identify any of the sediment/erosion sensitive features from step one that are hydraulically near the site, and proceed to step three. If none of the sediment/erosion sensitive features are hydraulically near the site the assessment is complete.

STEP 3 – Construction Site Sediment Transport Potential

Using the worksheet below, determine the total points for each development site. Assign points based on the most critical condition that affects 10% or more of the site.

If soil testing has been performed on site, the results should be used to determine the predominant soil type on the site. Otherwise, soil information should be obtained from the county soil survey to determine Hydrologic Soil Group (Table of Engineering Index Properties for step 1.D) and Erosion Potential (Table of Water Features for step 1.E)

When using the county soil survey, the dominant soil type may be in question, particularly when the site falls on a boundary between two soil types or when one of two soil types may be present on a site. In this case, the soil type resulting in the most points on the rating system will be assumed unless site soil tests indicate that another soil type dominates the site.

Use the point score from Step 3 to determine whether the development site has a high potential for sediment transport off of the site.

Total Score	Transport Rating
<100	Low
≥100	High

A high transport rating indicates a higher risk that the site will generate sediment contaminated runoff.

Construction Site Sediment Transport Potential Worksheet

A. Existing slope of site (average, weighted by aerial extent): Points
- 2% or less 0
- >2-5% 5
- >5-10% 15
- >10-15% .... [✓ 30]
- >15% 50

B. Site Area to be cleared and/or graded:
- <5,000 sq. ft. 0
- 5,000 sq. ft. – 1 acre .... [✓ 30]
- >1 acres 50

C. Quantity of cut and/or fill on site:
- <500 cubic yards 0
- 500 – 5,000 cubic yards .... [✓ 5]
- >5,000 – 10,000 cubic yards 10
- >10,000 – 20,000 cubic yards 25
- >20,000 cubic yards 40

D. Runoff potential of predominant soils (Natural Resources Conservation Service):
- Hydrologic soil group A 0
- Hydrologic soil group B 10
- Hydrologic soil group C .... [✓ 20]
- Hydrologic soil group D 40

E. Erosion Potential of predominant soils (Unified Classification System):
- GW, GP, SW, SP soils 0
- Dual classifications (GW-GM, GP-GM, GW-GC, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) 10
- GM, GC, SM, SC soils .... [✓ 20]
- ML, CL, MH, CH soils 40

F. Surface or Groundwater entering site identified and intercepted[1]:
- Yes .... [✓ 0]
- No 25

G. Depth of cut or height of fill >10 feet:
- Yes .... [✓ 25]
- No 0

H. Clearing and grading will occur in the wet season (October 1 – May 1):
- Yes 50
- No .... [✓ 0]

TOTAL POINTS.......... 130

---

[1] If no surface or groundwater enters site, give 0 points.

APPENDIX F - CONVEYANCE CAPACITY WORKSHEET (OVERALL DISCHARGE BASIN)

Poulsbo Gardens CB#7 - Outlet Culvert Conveyance Check

Job #1222
Calavista

Emergency Overflow Basin Calculation Using Rational Method
Q= CiA

		4 DU/AC	Cemetery	
(Roof, paved areas)	C=	0.48	0.15	
(100-Yr, Bremerton)	I=	3.5	3.5	(100-Year Bremerton)
(Input area-acres)	A=	19.0	3.5	(Area, Acres)
	Q=CIA	**31.92**	**1.84**	

Total Q **33.76** CFS

Existing Capacity Mannings Flow Calculator

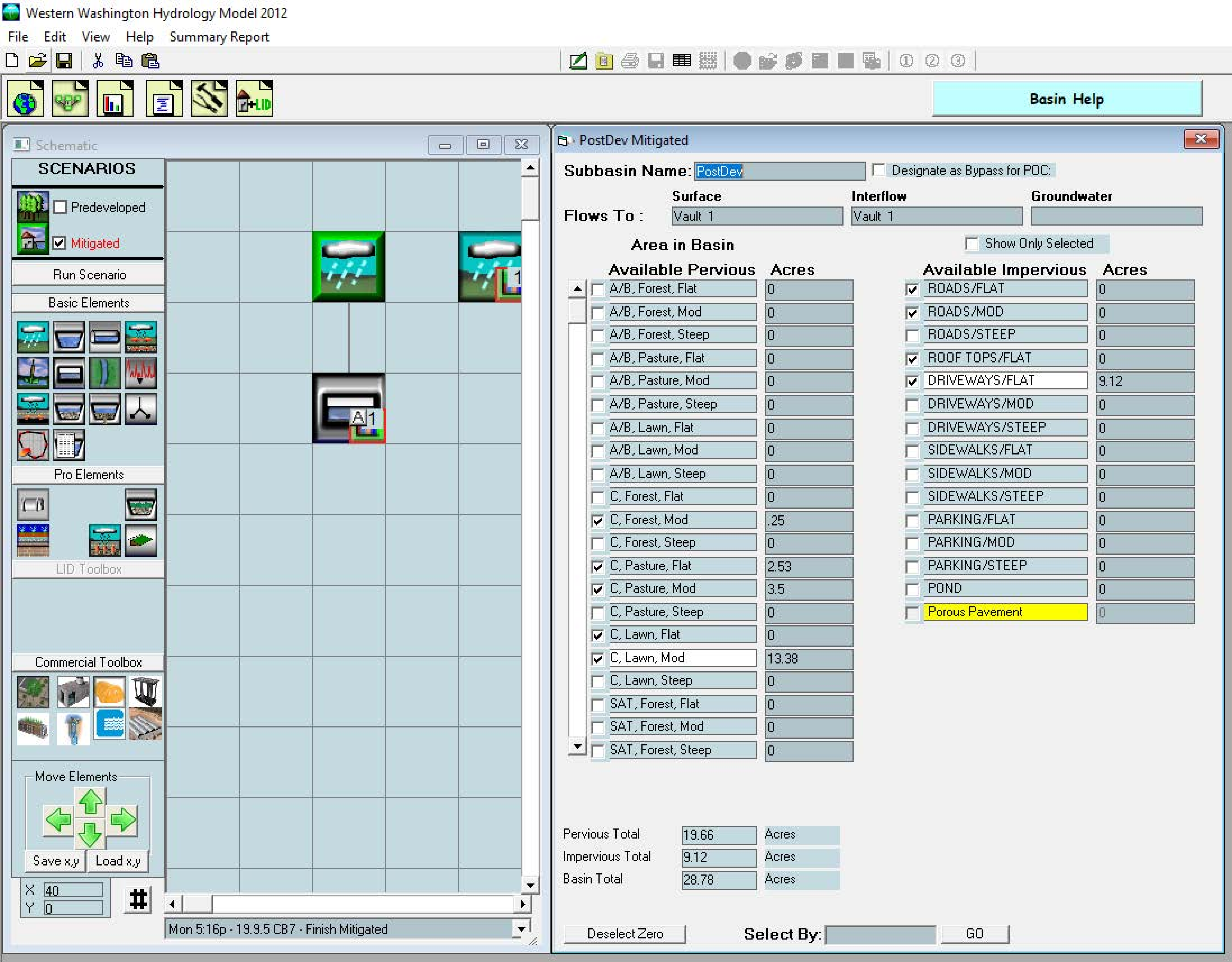
(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.024			
Pipe Diam (Ft)	1.50	1.7671		
Hyd Rad	☒	0.3750	Q (cfs) =	**4.02**
Slope (Ft/Ft)	0.005		V (fps)	**2.28**

Proposed Capacity Mannings Flow Calculator

(Q = 1.486/n * A * R^.6667 * s^.5)

Mannings n	0.012			
Pipe Diam (Ft)	2.00	3.1416		
Hyd Rad	☒	0.5000	Q (cfs) =	**34.66**
Slope (Ft/Ft)	0.02		V (fps)	**11.03**



☐ Predeveloped
☑ Mitigated

X 40
Y 0

Mon 5:16p - 19.9.5 CB7 - Finish Mitigated

Subbasin Name: PostDev ☐ Designate as Bypass for POC:

	Surface	Interflow	Groundwater
Flows To :	Vault 1	Vault 1	

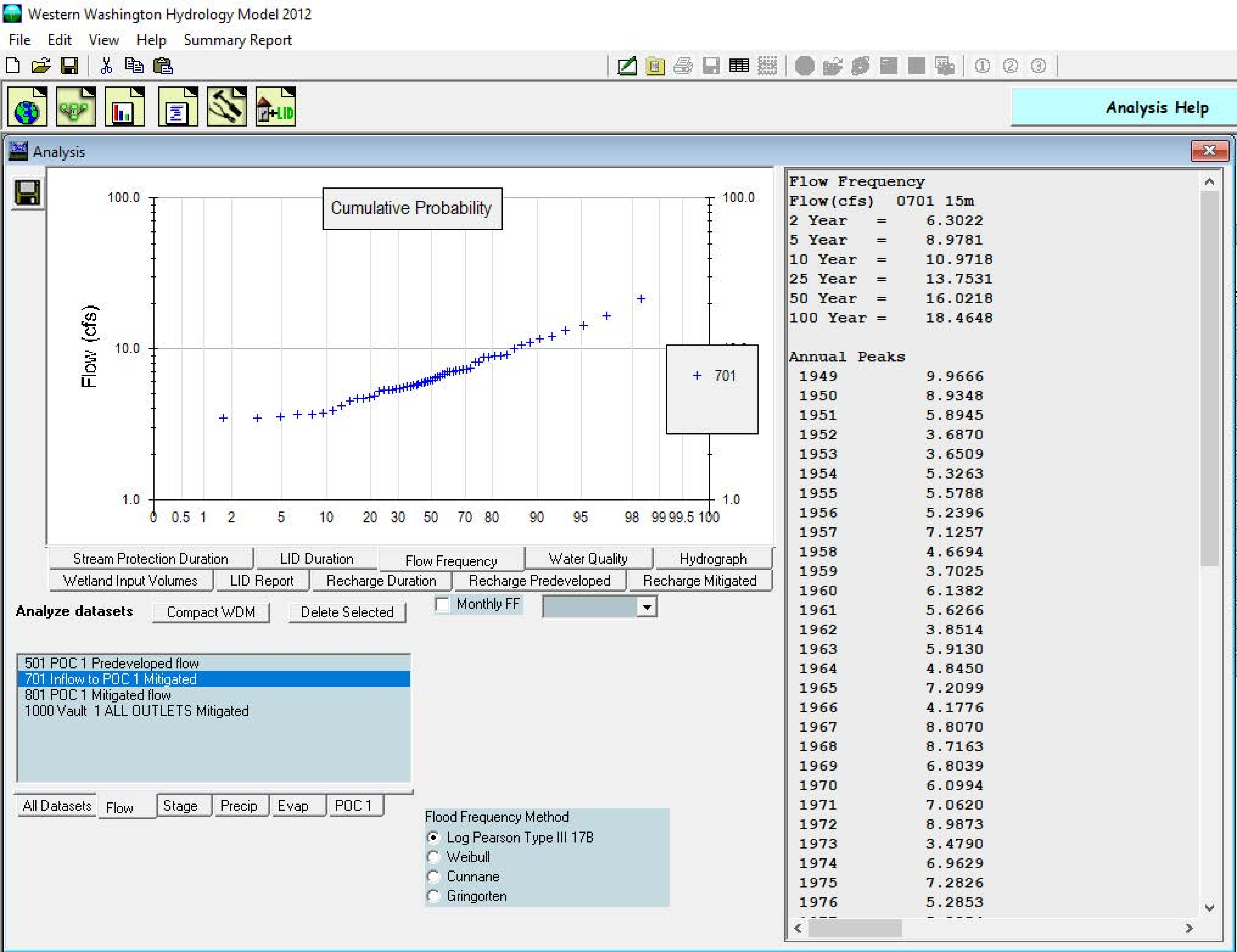
Area in Basin ☐ Show Only Selected

	Available Pervious	Acres
☐	A/B, Forest, Flat	0
☐	A/B, Forest, Mod	0
☐	A/B, Forest, Steep	0
☐	A/B, Pasture, Flat	0
☐	A/B, Pasture, Mod	0
☐	A/B, Pasture, Steep	0
☐	A/B, Lawn, Flat	0
☐	A/B, Lawn, Mod	0
☐	A/B, Lawn, Steep	0
☐	C, Forest, Flat	0
☑	C, Forest, Mod	.25
☐	C, Forest, Steep	0
☑	C, Pasture, Flat	2.53
☑	C, Pasture, Mod	3.5
☐	C, Pasture, Steep	0
☑	C, Lawn, Flat	0
☑	C, Lawn, Mod	13.38
☐	C, Lawn, Steep	0
☐	SAT, Forest, Flat	0
☐	SAT, Forest, Mod	0
☐	SAT, Forest, Steep	0

	Available Impervious	Acres
☑	ROADS/FLAT	0
☑	ROADS/MOD	0
☐	ROADS/STEEP	0
☑	ROOF TOPS/FLAT	0
☑	DRIVEWAYS/FLAT	9.12
☐	DRIVEWAYS/MOD	0
☐	DRIVEWAYS/STEEP	0
☐	SIDEWALKS/FLAT	0
☐	SIDEWALKS/MOD	0
☐	SIDEWALKS/STEEP	0
☐	PARKING/FLAT	0
☐	PARKING/MOD	0
☐	PARKING/STEEP	0
☐	POND	0
☐	Porous Pavement	0

Pervious Total	19.66	Acres
Impervious Total	9.12	Acres
Basin Total	28.78	Acres

Deselect Zero **Select By:** GO



☐ Monthly FF

501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Vault 1 ALL OUTLETS Mitigated

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

```
Flow Frequency
Flow(cfs)   0701 15m
2 Year    =     6.3022
5 Year    =     8.9781
10 Year   =     10.9718
25 Year   =     13.7531
50 Year   =     16.0218
100 Year  =     18.4648

Annual Peaks
 1949           9.9666
 1950           8.9348
 1951           5.8945
 1952           3.6870
 1953           3.6509
 1954           5.3263
 1955           5.5788
 1956           5.2396
 1957           7.1257
 1958           4.6694
 1959           3.7025
 1960           6.1382
 1961           5.6266
 1962           3.8514
 1963           5.9130
 1964           4.8450
 1965           7.2099
 1966           4.1776
 1967           8.8070
 1968           8.7163
 1969           6.8039
 1970           6.0994
 1971           7.0620
 1972           8.9873
 1973           3.4790
 1974           6.9629
 1975           7.2826
 1976           5.2853
```

Provided for comparison only.
WWHM2012
1222.19.9.5 CB7

701 Inflow to POC 1 Mitigated

Flows	(cfs)
2 Year	6.3
25 Year	13.75
100 Year	**18.5**

RATIONAL METHOD RUNOFF CALCULATOR

	1-5% c "flat"	>5% c"rolling"
Undeveloped		
Wood and Forest	0.05	0.10
Sparse Trees and Ground Cover	0.10	0.15
Light grass to Bare Gorund	0.15	0.20
Developed Areas		
Pavement and Roofs	0.90	0.90
Gravel Roads and Parking Lots	0.75	0.80
City Business	0.85	0.90
Apartment Dwelling Areas	0.80	0.85
Industrial Areas (heavy)	0.70	0.80
Industrial Areas (light)	0.60	0.70
Earth Shoulder	0.50	0.50
Playgrounds	0.25	0.30
Lawns, Meadows, Pasture	0.20	0.25
Parks and Cemetary	0.15	0.20
Single Family Residential Areas		
1 DU/GA		0.30
2 DU/GA		0.36
3 DU/GA		0.42
4 DU/GA		0.48
6 DU/GA		0.60
9-15 DU/GA		0.70

EnviroSound Consulting Inc.

Geotechnical &
Environmental
Consulting

Revised Limited Geotechnical Engineering Report

Project Information

Project Name: Calavista Development
Location: Poulsbo, Washington
Client: Caldart Poulsbo, LLC
Project #: ESC19-G010.1
Date: December 19, 2019

Company Information

P.O. Box 776
Tracyton, Washington 98393
Phone: 360-698-5950
Fax: 360-698-5929

REVISED LIMITED GEOTECHNICAL ENGINEERING REPORT

CALAVISTA DEVELOPMENT
19700 AND 19840 CALDART AVENUE NE
POULSBO, WASHINGTON 98370

Prepared for:
CALDART POULSBO LLC
105 S. MAIN STREET, STE 230
SEATTLE, WASHINGTON 98104

Prepared by:
ENVIROSOUND CONSULTING, INC.
P.O. BOX 776
TRACYTON, WASHINGTON 98393

Project No. ESC19-G010.1
December 19, 2019

EnviroSound Consulting Geotechnical & Environmental Consulting

December 19, 2019

Project: ESC19-G010.1

Caldart Poulsbo LLC
105 S. Main Street, Ste 230
Seattle, Washington 98104

Attention: Mr. Barry Margolese

Revised Limited Geotechnical Engineering Report
Proposed Calavista Residential Development
19700 and 19840 Caldart Ave NE
Poulsbo, Washington
Tax Parcels #132601-3-003-2001 and 132601-3-065-2006

Dear Mr. Margolese

Submitted herewith is our revised report for EnviroSound Consulting's original geotechnical engineering investigation for the subject project. The original report was dated April 25, 2019 and was conducted in accordance with our proposal (Proposal Number ESC19-PG004, dated January 16, 2019. This revised report incorporates comments from the City of Poulsbo dated June 24, 2019 and comments from a peer review completed by Aspect Consulting, LLC dated December 12, 2019. The report presents findings from our geotechnical engineering investigation and provides recommendations for geotechnical engineering aspects of project design.

We appreciate the opportunity to work with you on this project. If we can be of further assistance, or if you have any questions regarding this project, please contact our office.

Sincerely,

Shawn E. Williams, L.E.G.
Senior Engineering Geologist

Engineering Geologist
2203

12-19-19

Michael J. Wolczko, P.E.
Senior Geotechnical Engineer

Michael John Wolczko
31276

12/19/19

Enclosures

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LIST OF FIGURES

1.0 INTRODUCTION

EnviroSound Consulting (EnviroSound) was retained by Caldart Poulsbo LLC to conduct a geotechnical engineering investigation for the proposed Calavista residential development in Poulsbo, Washington. The geotechnical report was done in general compliance with our proposal ESC19-PG004 dated January 16, 2019.

1.1 Scope of Work

The purpose of this investigation was to evaluate the subsurface soils and groundwater conditions at the site in order to assess the suitability of stormwater infiltration at the site, and to provide preliminary geotechnical engineering recommendations suitable for project design. The scope of work consisted of a site investigation, excavating geotechnical test pits, and the preparation of a limited geotechnical engineering report. This report provides recommendations for foundations, earthwork, pavements, temporary excavations and shoring that are based on preliminary plans provided by RDCJR Civil Engineering. EnviroSound recommended in the original report that we review final plans, once these details were established, so that we could provide additional recommendations for finalizing earthwork and foundation construction specifications. In addition, we recommended that EnviroSound be involved in the process of developing the plan details, so that we could assist with developing the most suitable and cost-effective building configurations.

1.2 Project Description

EnviroSound has been provided with electronic copies of Sheets 1 through 21 of the Calavista – PRD plans prepared by RDCJR Civil Engineering, dated October 21, 2019. Based on our discussions and review of the provided plans, we understand that the proposed development will consist of the construction of 43 lots for residential housing. Site development work will include site grading to establish roadways and building pads, utility installation, constructing a stormwater detention facility, and constructing retaining walls. Site grading work will consist of excavations up to about 8.0 feet and placing up to approximately 16 feet of fill. Retaining walls up to 8.0 feet high will be used at the site to establish grades. A stormwater detention facility is proposed in a low-lying area in the northwestern part of the site. Based on our review of these documents, it is our opinion that the information presented in these documents is in concurrence with the recommendations presented in our original report.

1.3 Site Description

The subject property consists of two parcels, a northern lot located at 19840 Caldart Avenue NE, and a southern lot located at 19700 Caldart Avenue NE, in Poulsbo Washington (see Figure 1, Site Vicinity). The northern lot consists of a rectangular-shaped, approximately 4.74 acre parcel, and the southern lot consists of a “C”-shaped, approximately 4.29 acre parcel. According to data provided by the Kitsap County Parcel Viewer, the properties are located in Section 13, Township 26 North, Range 1 East, W.M. The northern parcel is located at Longitude -122.62664291 degrees and Latitude 47.74310681 degrees, and the southern parcel is located at Longitude -122.62650317 degrees and Latitude 47.74201540 degrees.

The subject properties are bordered along the west side by Caldart Avenue NE, with residential housing beyond. The Poulsbo City Cemetery is located north of the northern lot. Open fields and residential housing is present along the east side of the properties. NE Halden Glen Court with residential housing beyond is located south of the southern lot.

At the time of our visit, a double-wide mobile home and out buildings were located on the northern lot, and a two-story, single family residence was located on the southern lot. Access to the northern parcel was by a gravel road that extended east from Caldart Avenue NE. Access to the southern parcel was by a gravel road that extended northeast from NE Halden Glen Court.

Vegetation on the northern parcel consisted of generally grass lawns and open areas covered with blackberry bushes and scotch broom, with scattered larger coniferous and deciduous trees. The majority of the eastern portion of the southern parcel was covered with a young forest of alder trees and a thick underbrush of blackberry bushes. Large coniferous and deciduous trees were located in the south-central and southwestern portions of the southern parcel. A review of historical aerial photographs indicates that logging occurred on the northern parcel in 1994, and logging occurred on the southern lot prior to 2001.

A review of a topographic site plan provided by Team 4 Engineering indicates that the subject property consists of a generally west-facing slope. The northern lot descends from a high point of approximately elevation 370 feet along the east property line to about elevation 306 feet along the west property line. The southern lot descends from a high point of approximately elevation 365 feet along the east property line to about elevation 300 at the southwestern corner of the lot.

The subject property generally consists of relatively flat-lying to gently sloping ground in the western portion of the site that slopes up to a generally flatter upland area along the east side of the site. The flat-lying area in the western portion of the site had inclinations measured at less than 3 degrees (5 percent slope). The slope across the site had inclinations measured at between about 8 and 20 degrees (14 to 36 percent slope). Local man-made slopes were at between about 25 degrees and near-vertical.

At the time of our visit, we did not observe any groundwater springs or standing surface water on the site. The native slopes at the site appeared to be relatively stable with no significant sloughing noted at the time of the site visit.

2.0 SITE INVESTIGATION

2.1 Geologic Setting

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

A review of the available geologic mapping indicates that the site is located in an area mapped at the contact between Vashon age glacial till (Qvt) and Vashon age glacial advance outwash (Qva).

Glacial till typically consists of an unsorted heterogeneous mixture of clay, silt, sand, and gravel with occasional boulders and cobbles deposited directly by glacial ice. Till that is deposited in front of and is overridden by an advancing glacial ice sheet is referred to as lodgment till and is compacted to a very dense or hard state because of the weight of the overriding ice. Till that was deposited as the ice sheet receded is normally consolidated and is referred to as ablation till.

Locally, till can contain lenses of stratified material. Glacial till has relatively low permeability and is often responsible for a perched water table in gentle-to flat-lying topography.

Glacial outwash typically consists of moderately sorted sand, gravel and cobbles that was deposited by glacial meltwater streams and rivers either ahead of and overridden by the advancing ice sheet (advance outwash), or during ablation and retreat of the glacier (recessional outwash).

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, information indicates the following soil type exists on the project site:

- 22 – Kapowsin gravelly ashy loam, 0 to 6 percent slopes
- 39 – Poulsbo gravelly sandy loam, 0 to 6 percent slopes
- 40 – Poulsbo gravelly sandy loam, 6 to 15 percent slopes

The soil survey descriptions of these soil types are summarized in the following table.

USDA Soil Survey Name	**22- Kapowsin gravelly ashy loam, 0 to 6 percent slopes**	**39 – Poulsbo gravelly sandy loam, 0 to 6 percent slopes**	**40 – Poulsbo gravelly sandy loam, 6 to 15 percent slopes**
Typical Profile	0-15 inches, gravelly ashy loam 15-29 inches, loam 29-59 inches, gravelly loam	0 to 24 inches: gravelly ashy sandy loam 24 to 60 inches: very gravelly sandy loam	0 to 24 inches: gravelly ashy sandy loam 24 to 60 inches: very gravelly sandy loam
Origination	Volcanic ash mixed with glacial drift over dense glaciomarine deposits	Glacial till with volcanic ash in the upper part	Glacial till with volcanic ash in the upper part
Drainage	Moderately well drained.	Moderately well drained	Moderately well drained
Permeability	Moderately rapid above the hardpan and very slow in the pan.	Moderately rapid above the hardpan and very slow in the pan	Moderately rapid above the hardpan and very slow in the pan
Surface Runoff	Slow	Slow	Slow
Erosion Hazard	Slight	Slight	Slight

2.2 Subsurface Exploration

Six (6) test pits, identified as test pits TP-1 through TP-6, were excavated at the site on February 27, 2019. The test pits were excavated with a John Deere 50G track-mounted mini-excavator, provided and operated by Bulls Eye Excavation, under subcontract to EnviroSound. The test pits were excavated to depths of between about 8 and 11 feet deep below the existing ground surface (bgs). We estimated the locations of the test pits by pacing and measuring relative to landmarks at the site. These locations are shown in Figure 2, Site Plan, and should be considered approximate.

A senior geologist with our firm observed the test pit excavations and visually identified the exposed soils, estimated the relative density of the soils, obtained representative soil samples, and compiled a field log of each exploration. The relative density of the exposed soils in the upper 4 feet of the pit was estimated based on probing the sides and bottoms of the pits with a ½-inch-diameter steel bar and by observing the ease or difficulty of the excavation. The relative density of the exposed soils below 4 feet was estimated based on the ease or difficulty of the excavation. Representative soil samples were collected in bags and returned to our laboratory. Where observed, groundwater was noted during excavation. The groundwater-level observations are noted in the test pit logs. The groundwater levels noted on the logs may not be representative of the highest potential groundwater levels at the site. Summary logs of the explorations are presented in Appendix A.

2.3 Laboratory Testing

To aid in classifying the soils and to evaluate the strength characteristics, laboratory tests were performed on selected samples. Test method references are shown in the following table. Phoenix Soil Research of Kingston, Washington was retained to provide geotechnical laboratory analysis.

Parameter	*Testing Method Reference*
Moisture Content	ASTM D2216
Gradation Analysis	ASTM D422

The results of the laboratory testing are provided in Appendix B.

2.4 Soil Conditions

The subsurface conditions encountered in the explorations generally consisted of topsoil and forest duff overlying glacial till or till-like deposits and advance outwash deposits. The till and outwash deposits were generally interlayered in all of the explorations except test pit TP-3. Outwash deposits were more prevalent in the western portion of the subject property. Topsoil and forest duff at the site was between about 0.5 and 0.8 feet thick.

The till and till-like deposits consisted of loose to very dense, slightly gravelly to gravelly, silty sand. The till-like deposits were interlayered with sand seams.

The outwash deposits consisted of medium dense to dense, trace to slightly silty sand, slightly gravelly to gravelly sand and sandy gravel, with scattered seams of dense silty sand. Test pit TP-1 was terminated in the outwash deposits and the remainder of the test pits terminated in till or till-like deposits.

Underlying the topsoil/forest duff in test pit TP-3 was weathered and unweathered glacial till consisting of medium dense to very dense, slightly gravelly to gravelly, silty sand. Test pit TP-3 was terminated in glacial till.

2.4.1 Groundwater

Groundwater seepage was encountered in test pit TP-2 at a depth of about 7.5 bgs. The groundwater appeared to be perched on an underlying dense to very dense till layer. Groundwater seepage was not encountered in any of the other explorations. Water table elevations can fluctuate with time. Groundwater levels are typically influenced by seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Groundwater level observations at the time of the field investigation may vary from those encountered during the construction phase of the project.

2.5 Geologic Hazards

<u>General</u>

A review of “Slope Stability, Kitsap County, Washington”, Jerry Deeter, 1979 and current geologic hazard and critical aquifer mapping presented by the City of Poulsbo were performed in conjunction with the preparation of this report.

The maps provided by the City of Poulsbo indicate that the subject property is mapped in an area as having no potential geologic hazards. A more detailed review of potential geologic hazards is provided below.

Critical Aquifers

Critical aquifer mapping provided by City of Poulsbo maps the subject property in an area of Aquifer Recharge Area of Concern (Shallow Aquifer). Development standards provided in the City of Poulsbo Critical Areas Ordinance, Section 16.20.515-B explains that a hydrogeological report is required for operations proposed in aquifer recharge areas of concern that pose a potential threat to groundwater according to Table 16.20.515 – Activities with Potential Threat to Groundwater. The proposed development is not listed in this table and therefore does not require a hydrogeological report. In addition, areas mapped as an aquifer recharge area of concern require stormwater treatment and infiltration where soils permit and are determined feasible. However, due to the presence of glacial till on the subject property, stormwater infiltration is not feasible.

Erosion Hazard

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, mapping indicates that the native glacial till soil at the site has a slight erosion hazard. In our opinion, if the soils are disturbed in the sloping areas, there will be a serious erosion hazard and erosion control measures should be implemented immediately.

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

Seismic Hazard

A review of Kitsap County Critical Areas mapping shows the site as having a small area through the middle of the site of moderate seismic hazard. However, this should not have significant impact on the development and overall stability of the slopes due to the dense nature of the soils encountered in our test pits.

The 2015 International Building Code (IBC), Section 1613.3.2, refers to Chapter 20 of ASCE-7 for Site Class Definitions. The seismic site class rating is based on the average Standard Penetration Resistance or N-value of a soil profile extending to a depth of 100 feet. The soil explorations on this site extended to a maximum depth of approximately 11 feet bgs. Since the majority of the native site soils at the site are glacially consolidated and are estimated to be dense to very dense, we estimate that the average Standard Penetration Resistance for the top 100 feet of site soils is greater than 50. Therefore, for seismic design of structures the site should be considered class C, “very dense soil and soft rock”, as defined by Table 20.3-1 “Site Class Definitions,” according to the 2010 ASCE-7 Standard.

We referred to the U.S. Seismic Design Maps Website and 2012/2015 IBC to obtain values for S_S, S_{MS}, S_{DS}, S_1, S_{M1}, S_{D1}, F_a, and F_v. The U.S. Seismic Design Maps Website includes the most updated published data on seismic conditions. The latitude/longitude method was used to obtain the ground motions with a Latitude of 47.74237075 degrees and a Longitude of -122.62666687 degrees. The seismic design parameters for this site are as follows:

Table 1: Seismic Design Parameters
(Reference: 2015 IBC Section 1613.3.2, and ASCE)

Seismic Item	Value
Site Class	C
Site Coefficient F_a	1.000
S_s	1.305 g
S_{MS}	1.305 g
S_{DS}	0.87 g
Site Coefficient F_v	1.500
S_1	0.522 g
S_{M1}	0.679 g
S_{D1}	0.452 g

The damage from fault surface rupture to a site can include displacement damage to structures and offset of roads and underground utilities. Based on our review of the U.S. Geological Survey and Washington State Department of Natural Resources fault mapping, the subject property lies within the delineated area of the Seattle Fault Zone. Although fault surface ruptures have not been mapped or observed in the Poulsbo area, surface ruptures of Seattle Fault strands have been observed and mapped on south Bainbridge Island approximately 10.0 miles away.

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The native soils on the subject property, primarily consisting of medium dense to very dense sand and silty sand interpreted to underlie the site are considered to have a low potential for liquefaction and amplification of ground motion. Loose and/or saturated materials on the slopes have the potential for sloughing failures during seismic events.

Landslide Hazard

The subject property is located on a west-facing slope with no known history of landsliding. A review of the “Slope Stability, Kitsap County, Washington”, Jerry Deeter, 1979 indicates that the subject property has been mapped as Stable slopes (S). Stable slopes generally rise less than 15 percent in grade, except in local areas of low groundwater concentration or competent bedrock. Stable slopes include rolling uplands and lowlands underlain by stable material such as unweathered till and/or peat deposits which, although inherently weak, have no significant slope. It should be noted that the mapping was performed in the 1970’s and does not reflect more recent activity.

3.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

3.1 General

The subject property is shown in an area mapped as having no potential geologic hazards by the City of Poulsbo and native slopes at the site do not exceed 40 percent. The native slopes at the site appeared to be relatively stable with no significant sloughing noted at the time of the site visit. Medium dense to dense soils were encountered at the site at depths of between about 2 and 4 feet bgs. It is our opinion that the minimum required buffer of 25 feet from geologically hazardous areas established in the City of Poulsbo Critical Area Ordinance section 16.20.420 Development standards can be waived due to the presence of dense soils at shallow depth and the relatively stable nature of the slopes. Based on the findings of this investigation, it is our opinion that the proposed site development is feasible provided that recommendations in this report are incorporated in final design plans.

Critical elements of the site development should be observed and tested by a qualified representative of EnviroSound. These include but are not limited to installation of any retaining wall construction, structural fill placement, foundation subgrade verification, slab on grade verification and subsurface drainage. We recommend that EnviroSound be involved in the process of planning the construction, configurations and elevations for the proposed structures. We also recommend that EnviroSound review updated plans, as these documents become available; to verify that geotechnical recommendations are being incorporated.

3.2 Site Drainage

The control of surface and near-surface water is very important for the long-term stability of slopes. An effective drainage mitigation plan must address several aspects of the project. These include areas of slope protection, vegetation management, erosion control, and drainage control. We recommend that temporary and final site grading be designed to direct surface water away from slopes.

3.3 Foundations

We recommend that building foundation loads be supported on spread footings bearing on undisturbed, medium dense to dense native soils or on compacted structural fill established on the suitable native soils. We recommend that the structural fill be placed in accordance with the structural fill recommendations presented in this report.

Foundation elements located near existing slopes, rockery walls, or retaining walls should be embedded to a depth in order to create a 2H:1V (horizontal to vertical) envelope from the outside face of the footing down to the toe of any slope or wall. These footings should also be supported as recommended above.

Footings founded on the medium dense or denser native soil or properly placed structural fill could be designed for an allowable bearing load pressure of 2,500 pounds per square foot (psf). The allowable bearing capacities may be increased by one-third when used with alternative basic load combinations that include wind or earthquake loads. This recommendation is in accordance with the International Building Code (IBC) 2012 Section 1806.

The allowable bearing pressures require that the footings bear at least 18 inches bgs and have a minimum width of 24 inches for isolated footings and 18 inches for continuous wall footings. The elevation difference of adjacent footing should not be greater than one-half the clear distance between them. Where adjoining continuous wall footings are designed at different elevations, the upper footing should be stepped down to the lower footing.

Footings should have adequate embedment for local frost penetration requirements. In the area of this project, the minimum depths are typically 18 inches for exterior footings and 12 inches for interior footings. If footings are supported by structural fill, the fill should extend beyond the outer edges of footings a minimum distance equal to the thickness of the fill beneath the footing.

Lateral footing displacement can be resisted by friction along the base of the foundation and passive pressure acting against the appropriate footing faces. We recommend an allowable friction factor of 0.35 and an allowable equivalent fluid passive pressure of 275 psf/ft of depth.

Footing excavations should be cleaned of all loose soil, leveled, and protected from water. Footing excavations should be kept free of water at all times. If the soils in the footing become wet it is recommended that the wet/soft soils be excavated to suitable soil and replaced with crushed rock.

A representative with our firm should evaluate all foundation subgrades prior to installation of formwork or reinforcing steel. If unsuitable soils are detected at the footing subgrade, further excavation to suitable soils should take place. EnviroSound should be provided with the final grading and structural plans to verify the intent of these recommendations have been implemented.

3.4 Foundation Drainage

We recommend that continuous footing drains with cleanouts be installed at the base of the footings along the outside perimeter of the proposed SFR's constructed at the site to prevent pooling of water underneath the SFR's. These drains should consist of a minimum 4-inch diameter perforated rigid pipe (with perforations placed at 4 and 8 o'clock) with a minimum thickness of 6 inches of washed pea gravel around the pipe. Drainage socks should not be used around the pipe. The backfill soils within 1 foot of the foundation walls should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the structure and discharge into an appropriate area.

Roof drains should not be connected to the footing subdrains. The discharge from footing drains, roof drains, or other drains should be routed by means of a tightline to a suitable discharge point that assume excessive stormwater flows do not back-up into the footing drain system assuming the suitable discharge point is a storm sewer.

3.5 Floor Slabs

Based on our explorations, we anticipate that building floor slabs can be supported on densely compacted structural fill placed over native bearing soil subgrades, or supported on undisturbed, medium dense to dense native soil. A modulus of subgrade reaction of 200 pounds per cubic inch should be used to design the slab.

As a capillary break between native soil and the floor slab, we recommend that a minimum 4-inch-thick layer of washed rounded or angular gravel be placed beneath floor slabs. The gravel should have a maximum size of ¾ inch and less than 3 percent fines passing the No. 200 sieve. The gravel should be compacted with at least two passes of a vibrating plate compactor or smooth-drum roller. Angular gravel can provide a firmer working surface than rounded gravel on which to place the slab reinforcement and concrete. The floor slab subgrade should be evaluated by proof rolling and/or probing to confirm that it is in a firm and unyielding condition. Prior to placing the gravel, the exposed subgrade surface should be compacted as needed to achieve a dense, unyielding condition and should be evaluated by a representative of our firm to confirm that it is suitable for floor slab support. Any loose soil encountered beneath slab areas should be removed and replaced with structural fill.

A vapor retarder consisting of plastic sheeting should be placed on top of the capillary break materials to help prevent migration of moisture through the concrete slab, especially in areas with moisture sensitive floor coverings. The moisture barrier system should be installed in accordance with ASTM guidelines. A layer of sand may be placed above the vapor barrier as an option to aid in curing the concrete.

3.6 Lateral Earth Pressures & Retaining Walls

Lateral pressures will be exerted on below grade (basement) and retaining walls by backfill soils, surcharge loads, and hydrostatic pressures caused by groundwater. Lateral earth pressures on walls depend upon the type of wall, type of backfill material and allowable wall movements. For walls that are restrained at the top, lateral earth pressures should be estimated for an "at rest" condition. For walls that are free to rotate away from the retained soil, lateral earth pressures should be estimated for an "active" earth pressure. For walls that are compressing the retained soil, lateral earth pressures should be estimated for a "passive" earth pressure. Recommended lateral earth pressures coefficients are provided in the following table along with equivalent fluid pressures. These pressures are calculated assuming a moist unit weight for the backfill soil of 125 pounds per cubic foot (pcf) and an angle of internal friction of 35 degrees. These values are representative of the onsite materials behind retaining walls backfilled using structural fill.

Lateral Earth Pressures, no slope above or below the wall					
"Active" Condition		"At Rest" Condition		"Passive" Condition	
Coefficient (Ka)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Ko)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Kp)	Equivalent Fluid Unit Weight (pcf)
0.27	34	0.43	54	1.77	231

The recommended equivalent fluid unit weights do not include hydrostatic pressure due to groundwater accumulated behind walls. The recommended fluid pressures assume a horizontal ground surface above and below the wall and do not include seismic loading, or any surcharge due to nearby loading from structures, equipment or traffic. The passive pressure has been reduced by a factor of 2 to limit wall translation. Traffic loading of 250 psf should be included in all calculations on walls adjacent to roadways or parking areas.

The potential seismic force on the wall can be modeled as a uniform pressure on the back of the wall equal to 7H (H is the height of the wall (in feet)), for active conditions, with no slope above the wall. For walls designed for at rest conditions, with no slope above the wall, the uniform pressure for the seismic increase should be increased to 23H. The units for this pressure are pounds per square foot (psf).

Continuous drains with cleanouts should be installed at the base of retaining walls to prevent the buildup of hydrostatic pressure behind the structure as discussed in Foundation Drainage of this report.

3.7 Asphalt Pavement

Asphalt Pavement Preliminary recommendations for asphalt pavement thicknesses are based on the AASHTO Guide for Design of Pavement Structures. We presume that the primary traffic on the site will be passenger cars. We used the section on Low-Volume Road Design for Flexible Pavement with a 50 percent inherent reliability level, as recommended in the Guide for local roads. We further assumed that the traffic level would be low, corresponding to 50,000 to 100,000 Equivalent Single Axle Load (ESAL) applications over the lifetime of the pavement. Note that one ESAL is for an 18-kip axle load. One passenger car is approximately 0.008 ESALs. Therefore, the low traffic level corresponds to at least 6,250,000 passenger car trips over the pavement. In the borings, we encountered loose to medium dense, gravelly Sand and Silt. We assigned these soils a relative quality of "Fair".

Based on the previous assumptions, we preliminarily recommend 2 inches of surface course Asphaltic Concrete (AC) over 6 inches of granular base course. Surface course AC can be substituted for base course and vice versa at a rate of 1 inch of AC per 3 inches of base course. We recommend that the AC thickness not be reduced below 2 inches. The final pavement section can be adjusted based on estimated vehicle loading and desired design life. In consideration of heavier traffic such as garbage trucks or maintenance trucks 3 inches of AC over 8 inches of base course should be considered.

In preparing the preceding recommendations, we assumed that the Elastic Modulus of the Asphaltic Concrete would be at least 400,000 psi, and that the Base Course would be a well graded crushed rock with a California Bearing Ratio (CBR) of 100. If materials with different strengths than presented will be used, we should be contacted to adjust the pavement section recommendations accordingly.

Concrete pavement design recommendations are based on methods provided by the American Concrete Pavement Association for residential-type streets on fine grained soils. A minimum concrete thickness of 6.0 inches is recommended for the parking areas with a base course of 2.0 inches. Pervious concrete typically achieves similar strength characteristics as standard concrete, by increasing the cement ratio; therefore no increase in the depth of concrete pavement is required for porous concrete.

Prior to the placement of standard pavements we recommend that the subgrade be proof rolled with heavy construction equipment such as a loaded dump truck or water truck to ensure that the subgrade is relatively dense and unyielding. Subgrade conditions for porous pavement shall be per the design engineers recommendations and details.

3.8 Earthwork Considerations

During wet weather conditions, which are typically present from October through April, subgrade stability problems and grading difficulties may develop due to high moisture content in the soil, disturbance of sensitive soils and/or the presence of perched groundwater. Therefore, we recommend that earthwork activity be performed during the dry season. If work must proceed in wet weather, we recommend following the guidelines presented in the wet weather section of this report.

3.8.1 Site Preparation

General site clearing should include removal of vegetation, topsoil and debris. Site stripping should extend to a minimum depth of 6 inches, or until all organics in excess of 3 percent by volume or other unsuitable soils are removed. These materials will not be suitable for use as fill for parking or building areas. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Any buried structures encountered during construction should be properly removed and backfilled. Excavation, depressions, or soft and pliant areas extending below planned finish subgrade level should be cleaned to firm, undisturbed soil and backfilled with structural fill to planned finish subgrade.

3.8.2 Groundwater Concerns

Groundwater seepage was observed in test pit TP-2 at a depth of about 7.5 feet bgs. Groundwater is not expected to impact foundation excavations of the building. However, water table elevations fluctuate with time, being dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors.

3.8.3 Excavations

Excavations at the project site can be accomplished with conventional excavating equipment, such as a dozer or backhoe. We recommend a flat-bladed bucket be used for foundation excavation to minimize the disturbance of the native, silty soils.

It is our opinion that the soils encountered in the explorations are a Type C material as defined by the Washington Industrial Safety and Health Act’s (WISHA) regulations on excavation, trenching and shoring. In the absence of water, temporary slopes excavated in Type C material should be inclined no steeper than 1.5H:1V (horizontal: vertical).

Note that these recommended slopes are for temporary slopes excavated under dry conditions. Flatter slopes should be used as necessary to maintain stability. For example, if water flows or seeps into the excavation, it could cause an unstable local condition on the side slopes. The slopes should be protected with a waterproof covering such as plastic sheeting during periods of wet weather to reduce sloughing and erosion. A representative of our firm should evaluate temporary and permanent slopes to ensure that they are appropriate for the soils encountered during construction. Recommendations to reduce temporary slopes to 2H:1V or flatter may be provided, depending on the observed conditions during construction.

In areas where it is not possible to maintain the recommended slopes due to space constraints, temporary shoring would be required. Such shoring would need to be properly designed by an engineer.

Consistent with conventional construction practice, temporary excavation slopes should not be shown on the plans but should instead be made the responsibility of the Contractor. The Contractor is continually at the site and is able to observe the nature and conditions of the subsurface materials encountered, including groundwater, and also has responsibility for methods, sequence, and schedule of construction. If instability is detected, slopes should be flattened or shored. The Contractor should be familiar with applicable local, state, and federal safety regulations, including the current WISHA regulations on excavation, trenching and shoring. Regardless of the construction method used, all excavation work (and all project work) should be accomplished in compliance with applicable local, state, and federal safety codes.

Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. EnviroSound is providing this information solely as a service to our client. Under no circumstances should the information provided above be interpreted to mean that EnviroSound is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

The soils to be penetrated by the proposed excavations may vary significantly across the site. EnviroSound's preliminary soil classification is based solely on the materials encountered in the borings. The Contractor should continually classify the soils that are encountered as excavation progresses with respect to the WISHA system.

Stockpiles of materials or heavy equipment should not be placed closer to the top of the excavation slope than the depth of the excavation. In addition, the Contractor shall be made responsible for controlling any ground or surface water wherever encountered on the project. In this regard, sloping, slope protection, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work. Discharges from de-watering systems must be included in the project Surface Water Pollution Prevention Plan (SWPPP).

3.8.4 Permanent Slopes

We recommend that permanent cut-and-fill slopes be no steeper than 2H:1V for stability purposes and maintenance considerations. We recommend that all slopes be covered with 6 inches of topsoil and seeded and/or planted with relatively fast-growing vegetation to limit surface sloughing and erosion. Additionally, low growth, shrubs can be planted to enhance the stability of the slopes and limit surface sloughing and erosion. Unless vegetation is well established or slopes are covered with plastic, some erosion can be expected.

3.8.5 Structural Fill

The glacial till soils present at the site are moisture sensitive due to their high fines content and will not likely be suitable for use as structural fill during wet weather conditions. Soils with a high fines content may be difficult to compact if the moisture content is not at or below the optimum moisture content. The onsite granular outwash soils may be suitable for use as structural fill, provided they are free of organic or deleterious material, and are placed in accordance with the recommendations presented in this report.

If the earthwork is to take place during the normally wet period of the year, provisions should be in place for export of wet, moisture sensitive soil and import of granular structural fill material. Imported structural fill should consist of well-graded gravel and/or sand with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). If construction occurs during dry periods the fines content can be increased to 10 percent. All material proposed for use as structural fill should be approved by a representative of the geotechnical engineer.

Structural fill should be placed in loose lifts no more than 12 inches thick, moisture conditioned as necessary (moisture content of soil should be within 2 percent of optimum moisture) and compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D-1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Note that, although in place density testing of fill is frequently used as the primary criterion for acceptance of fill, it should not be the only criterion. If, in the judgment of the geotechnical engineer or his representative, placed fill is not suitable it should be rejected regardless of in place density test results. As an example, fill that is compacted wet of the optimum moisture content may exhibit "pumping" behavior even if in place density test results indicate greater than 95 percent compaction has been achieved. In such a situation, the fill should be removed and replaced with drier material.

3.8.6 Utility Trench Fill

Excavations for utilities should be completed and maintained during utility installation and backfilling, in accordance with Occupational Safety and Health Administration (OSHA) requirements. The utility contractor should be responsible for maintaining safety within open trenches. Care should be taken to reduce surcharge loads and vibrations adjacent to utility excavations. Groundwater seepage and sloughing of the test pit sidewalls was encountered at about 7.5 feet bgs during excavation of test pit TP-2. Due to groundwater seepage being encountered during excavation, the contractor should allow for shoring in the event that the groundwater destabilizes the trench sidewalls.

The subsurface soils in the upper 4 feet at this site generally included loose to medium dense silty sand with varying amounts of gravel. We expect that the potential for significant caving within open excavations will be moderate in the loose to medium dense soil so the utility contractor should exercise caution and be prepared to slope excavation sidewalls at gentler angles or install temporary shoring, if conditions indicate that caving may occur. We expect that the potential for significant caving within open excavations will be relatively low in areas of medium dense or denser soil. The factors that may influence the potential for caving could include the depth and length of trench that is opened at any one time, along with the length of time the trench is to remain open and surface and groundwater conditions. The utility contractor should be aware of these factors and observe the excavation for signs of possible caving, such as heavy seepage and tension cracks within and above the excavation sidewalls.

Backfill for utility trenches should consist of suitable material, as described in the **Structural Fill** section of this report. Utility trench backfill placed beneath building and pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D-1557. The utility trench backfill placed beneath pavement areas, at depths greater than 2 feet below the final grade may be compacted to a minimum of 90 percent of the maximum dry density, as defined by ASTM Test Method D-1557. The bedding material for utility pipes should be in accordance with the manufacturer’s specifications. The utility contractor should use equipment and backfill placement methods, which will reduce the possibility of damage to utilities or structures during placement and compaction.

3.8.7 Wet Weather Earthwork

The soils encountered during explorations that are likely to be encountered during grading activities are granular but contain sufficient amounts of silt and fine sand to make them moisture sensitive. The soils would likely provide a suitable working surface under dry conditions; however, after exposure to rain and continual vehicle traffic, the native soils will degrade rapidly and require overexcavation.

Wet weather generally begins about October and continues through about May, although rainy periods may occur at any time of the year. Therefore, we recommend scheduling earthwork during the normal dry weather months of June through September. In our opinion, earthwork performed during the dry weather months would be less costly than wet weather earthwork.

The following recommendations are applicable if earthwork is to be accomplished in wet weather or in wet conditions:

- Fill material should consist of clean, well-graded sand, or sand and gravel, with not more than 5 percent passing the No. 200 sieve, based on wet-sieving the minus-¾-inch fraction. Any fines should be nonplastic.
- A geotextile separator should be placed between native soils and structural fill.

- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Covering work areas or slopes with plastic, sloping, ditching, use of sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work. Bales of straw and/or geotextile silt fences should be used to control surface soil movement and erosion.
- Earthwork should be accomplished in small sections to reduce exposure to wet conditions. Excavation or the removal of unsuitable soil should be followed immediately by the placement of concrete or a layer of compacted, clean, structural fill or lean-mix concrete.
- No soil should be left uncompacted and exposed to moisture. A smooth drum vibratory roller, or equivalent, should be used to seal the surface if wet weather is anticipated. Wet surface soils should be removed prior to filling each day. Stockpiles of structural fill should be protected from wet weather with waterproof sheeting.
- In-place soils or fill soils that become wet and unstable, and/or too wet to suitably compact, should be removed and replaced with clean granular soil (see above).
- Excavation and fill placement activities should be observed on a full-time basis by an experienced geotechnical engineer if these activities are to be completed during wet weather or under wet conditions.

The above recommendations for wet weather earthwork should be incorporated into the contract specifications.

3.8.8 Erosion Control

A Storm Water Pollution Prevention Plan (SWPPP) is required for all projects that disturb greater than 7,000 square feet. The SWPPP will be prepared by RDCJR Civil Engineering. The native glacial till soils at the site contain a moderate amount of silt. Basic erosion control measures should be adequate to trap sediments within the project limits.

We recommend that exposed soils be covered and protected from erosion. The soils on the slopes may erode in the disturbed state or under conditions of channelized water flow. Therefore, best management practices for erosion control including silt fences, hay bales, etc. should be used to prevent sediment from leaving the site and entering storm water sewer systems or surface waters. Water should not be allowed to free flow over the slopes. Stripping of vegetation on steep slopes should not be performed and stripping in other areas should be limited to the greatest extent possible for proposed future construction. We further recommend that vegetation be replanted on the slopes as soon as practical following completion of any grading. Stripped slope areas should be protected from weather with a plastic visqueen cover when construction will not be occurring on them for more than one to two days.

The Washington State Department of Ecology (DOE) has three publications, which may be helpful in developing long-term slope vegetation maintenance/protection and landscape plans:

- “Slope Stabilization and Erosion Control Using Vegetation: A Manual of Practice for Coastal Property Owners", May 1993, Publication 93-30.
- "Vegetation Management: A Guide for Puget Sound Bluff Property Owners", May 1993, Publication 93-31.
- "Surface Water and Ground Water on Coastal Bluffs: A Guide for Puget Sound Property Owners", June 1995, Publication 95-107.

3.8.9 Stormwater

Runoff from building and impervious surfaces should be directed into a stormwater disposal system designed by a State of Washington registered engineer experienced with stormwater system design. Stormwater infiltration as required by City of Poulsbo Critical Areas Ordinance 16.20.515 – Development Standards for Critical Aquifer Recharge Areas is not feasible on the site due to the presence of glacial till. Ground surfaces should be sloped a minimum of 5 percent for a minimum distance of 10 feet away from structures and paved surfaces 2 percent for 10 feet in accordance with Section 1804.3 in the 2012 International Building Code (IBC). Stormwater drainage and/or mitigation shall be in accordance with local codes and regulations.

4.0 LIMITATIONS

This report has been prepared for Caldart Poulsbo LLC regarding the subject project. Information presented in this report has been collected and interpreted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions, and in accordance with sound and generally accepted principles consistent with normal consulting practice. No other warranty, expressed or implied, including (but not limited to) any warranty or merchantability or fitness for a particular use has been made.

Caldart Poulsbo LLC and EnviroSound discussed the risks and rewards associated with this project, as well as EnviroSound's fee for services. Caldart Poulsbo LLC and EnviroSound agreed to allocate certain of the risks so that, to the fullest extent permitted by law, EnviroSound's total aggregate liability to Caldart Poulsbo LLC is limited to $50,000 or the fee, whichever is greater, for any and all injuries, claims (including any claims for costs of defense or other incurred costs), losses, expenses, or damages whatsoever arising out of or in any way related to EnviroSound's services for this project, from any cause or causes whatsoever, including but not limited to, negligence, errors, omissions, strict liability, breach of contract, breach of warranty, negligent misrepresentation, or other acts giving rise to liability based upon contract tort, or statute.

In the event that change in the nature, design, or location of the proposed construction is made, or any physical changes to the site occur, recommendations are not to be considered valid unless the changes are reviewed by EnviroSound and conclusions of this report are modified or verified in writing.

The subsurface exploration logs and related information depicts conditions only at the specific locations and at the particular time designated on the logs. The passage of time may result in a change of subsurface conditions at these exploration locations. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. The nature and extent of variations of subsurface conditions between explorations are not known. If variations appear during additional explorations or construction, reevaluation of recommendations in this report may be necessary.

Stratification lines designating the interface between soil types in subsurface exploration logs represent approximate boundaries. The transition between materials may be gradual.

Analyses and recommendations provided in this report are based in part upon the data obtained from the subsurface explorations.

The scope of EnviroSound services did not include an environmental assessment for the presence or absence of hazardous and/or toxic materials, in the soil, groundwater, surface water, or atmosphere. Any statements or absence of statements in this report on any subsurface exploration log regarding staining or odor of soil, groundwater, or surface water, unusual or suspicious items, or conditions observed are strictly descriptive information for Caldart Poulsbo LLC.

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- "Geologic Map of Surficial Deposits in the Seattle 30’ x 60’ Quadrangle Washington," Young and others, 1993.
- “Geologic Map of the Lofall 7.5-minute Quadrangle, Kitsap and Jefferson Counties, Washington”, Washington State Division of Geology and Earth Resources, Map Series 2013-03, Contreras, et al., October 2013.
- “Geologic Map of the Suquamish 7.5-minute Quadrangle and part of the Seattle North 7.5-minute x 15-minute Quadrangle, Kitsap County, Washington”, U.S. Geological Survey, Scientific Investigations Map 3181, Haugerud and Troost, 2011.
- “Geologic Map of the Seabeck and Poulsbo 7.5-minute Quadrangles, Kitsap and Jefferson Counties, Washington”, Washington State Division of Geology and Earth Resources, Map Series 2013-02, Polenz, et al., October 2013.
- Washington State Department of Ecology Water Well Logs – https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx.
- Kitsap County Online Parcel Information – https://psearch.kitsapgov.com/psearch/index.html.
- City of Poulsbo Critical Areas Ordinance – https://www.codepublishing.com/WA/Poulsbo/#!/Poulsbo16/Poulsbo1620.html#16.20.420.
- “Geological Hazard Areas Map,” City of Poulsbo Kitsap County, Washington, dated June 14, 2017.
- “Aquifer Critical Area Map,” City of Poulsbo Kitsap County, Washington, dated December 2, 2009.
- Aerial photographs provided by Google Earth and Kitsap County.
- 2015 International Building Code (IBC)
- U.S. Seismic Design Maps – https://seismicmaps.org/

Figure generated from Google Earth Pro, accessed 3-20-19.

EnviroSound Consulting

FIGURE 1. Site Vicinity

Project Name: Calavista Development
Location: Poulsbo, WA
Project: ESC19-G010
Client: Caldart Poulsbo, LLC.
Date: October, 2019

N.T.S.

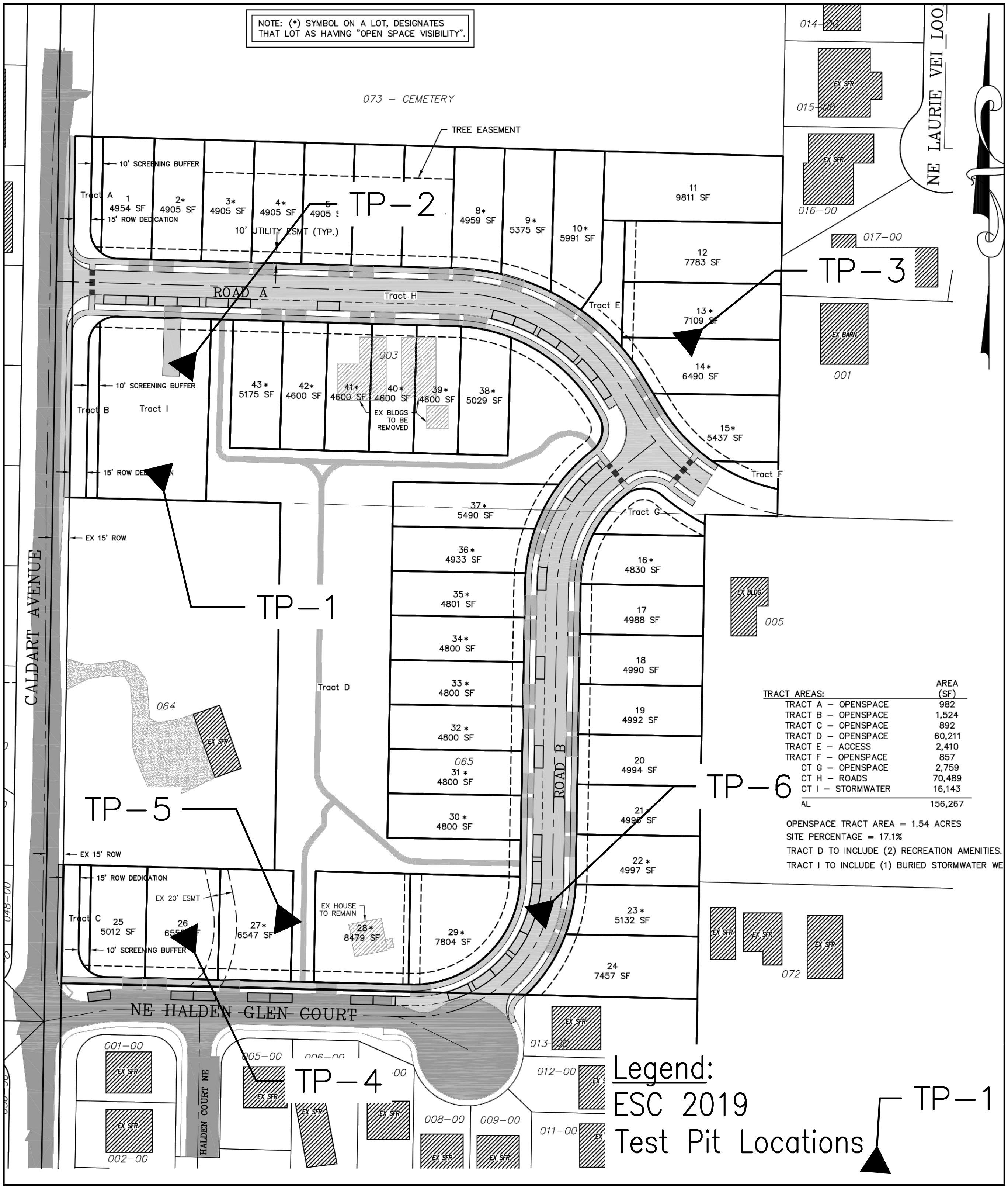


Figure generated from drawing provided by RDCJR Civil Engineering.

EnviroSound Consulting

FIGURE 2. Site Plan

Project Name: Calavista Development
Location: Poulsbo, WA
Project: ESC19-G010
Client: Caldart Poulsbo, LLC.
Date: October, 2019

N
N.T.S.

APPENDIX A

EnviroSound Exploration Logs

TEST PIT LOG – TP-1

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 307 feet
Test Pit Location: See Figure 2
Depth to Groundwater: None Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5’ Grass, topsoil.				
	SM	0.5’-4.0’ Loose to medium dense, orange-brown to brown-gray, slightly gravelly, silty SAND; moist, roots.	S-1 S-2	Grab Grab	1.0’ 2.0’	Gravel: 6.2% Sand: 76.7% Fines: 17.1% M.C.: 11%
5	SP	4.0’-4.5’ Medium dense to dense, gray, slightly gravelly, fine to medium SAND; moist.	S-3	Grab	4.0’	Gravel: 18.4% Sand: 62.3% Fines: 19.3% M.C.: 12%
	SP-SM	4.5’-6.5’ Dense, gray, slightly gravelly, slightly silty SAND; moist. -Scattered dense silty sand seams at 5.0’	S-4 S-5	Grab Grab	5.0’ 6.0’	
	SP	6.5’-8.0’ Dense, gray, SAND; moist, trace silt.	S-6	Grab	7.0’	
10	SP	8.0’-11.0’ Dense, gray, gravelly SAND; moist, trace silt.	S-7	Grab	11.0’	Gravel: 0.8% Sand: 94.3% Fines: 4.9% M.C.: 14%
		Total Depth: 11.0’ Groundwater: None Encountered				
15						

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

TEST PIT LOG – TP-2

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 307 feet
Test Pit Location: See Figure 2
Depth to Groundwater: Seepage at ~7.5’

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5’ Topsoil, forest duff.				
	SM	0.5’-2.0’ Loose to medium dense, orange-brown, slightly gravelly, silty SAND; moist, roots, charcoal.	S-1	Grab	1.0’	
	SM	2.0’-4.0’ Medium dense to dense, brown-gray, slightly gravelly, silty SAND; moist.	S-2	Grab	2.5’	Gravel: 1.1% Sand: 78.6% Fines: 20.3% M.C.: 14%
5	SW	4.0’-5.5’ Dense, gray, gravelly SAND; moist, trace silt.	S-3	Grab	4.5’	
	SP	5.5’-7.0’ Dense, gray, fine to medium SAND; moist, trace silt and gravel.	S-4	Grab	6.0’	Gravel: 0% Sand: 92.9% Fines: 7.1% M.C.: 17%
	SW	7.0’-9.0’ Dense to very dense, gray, gravelly SAND; moist to wet, trace silt.	S-5	Grab	8.5’	Gravel: 27.1% Sand: 64.8% Silt/Clay: 8.1% M.C.: 10%
10	SM	9.0’-11.0’ Dense to very dense, brown-gray, gravelly, silty SAND; moist, iron oxide staining.	S-6	Grab	10.0’	
		Total Depth: 11.0’ Groundwater: Seepage at ~8.0’				
15						

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

TEST PIT LOG – TP-3

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 356 feet
Test Pit Location: See Figure 2
Depth to Groundwater: None Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5’ Topsoil				
	SM	0.5’-3.0’ Medium dense to dense,orange-brown to brown gray, slightly gravelly, silty SAND; moist, iron-oxide staining, roots.	S-1 S-2	Grab Grab	1.5’ 3.0’	M.C.: 15% Gravel: 9.2% Sand: 63.2% Silt/Clay: 27.6% M.C.: 12%
5	SM	3.0’-8.0’ Dense to very dense, brown-gray to gray, slightly gravelly, silty SAND; moist, scattered cobbles, iron-oxide staining.	S-3 S-4	Grab Grab	5.0’ 8.0’	
10		Total Depth: 8.0’ Groundwater: None Encountered				
15						

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

TEST PIT LOG – TP-4

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 302 feet
Test Pit Location: See Figure 2
Depth to Groundwater: None Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5’ Topsoil, forest duff.				
	SM	0.5’-2.5’ Loose to medium dense, orange-brown to brown-gray, slightly gravelly, silty SAND; moist, roots.	S-1	Grab	1.0’	
5	SP-SM	2.5’-9.0’ Dense, gray, slightly silty, fine to medium SAND; moist.	S-2 S-3 S-4	Grab Grab Grab	3.0’ 6.0’ 6.5’	Gravel: 0% Sand: 88.1% Fines: 11.9% M.C.: 9% Gravel: 0.3% Sand: 79.6% Fines: 20.1% M.C.: 16%
10	SP	9.0’-9.5’ Dense, gray, gravelly SAND; moist, trace silt.	S-5	Grab	9.0’	
	SM	9.5’-11.0’ Dense, brown-gray, gravelly, silty SAND; moist.	S-6	Grab	10.5’	Gravel: 37.9% Sand: 43.1% Silt/Clay: 19.0% M.C.: 9%
15		Total Depth: 11.0’ Groundwater: None Encountered				

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

TEST PIT LOG – TP-5

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 305 feet
Test Pit Location: See Figure 2
Depth to Groundwater: None Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5' Topsoil, forest duff.				
	SM	0.5'-2.5' Loose to medium dense, orange-brown to light brown, silty, gravelly SAND; moist, scattered cobbles, roots.	S-1	Grab	1.0'	
	SM	2.5'-5.0' Medium dense to dense, brown-gray to gray, silty, slightly gravelly SAND; moist, roots, sand seams.	S-2 S-3	Grab Grab	3.0' 4.5'	Gravel: 12.3% Sand: 68.5 Fines: 19.2% M.C.: 9%
5	SP	5.0'-6.5' Dense, gray, SAND; moist, trace silt.	S-4	Grab	6.0'	Gravel: 1.4% Sand: 96.0% Fines: 2.6% M.C.: 5%
	SM	6.5'-9.5' Dense to very dense, gray, slightly gravelly, silty SAND; moist, sand seams.	S-5	Grab	9.0'	Gravel: 9.5% Sand: 71.1% Silt/Clay: 19.4% M.C.: 10%
10		Total Depth: 9.5' Groundwater: None Encountered				
15						

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

TEST PIT LOG – TP-6

Project Name: Calavista
Client: Caldart Poulsbo, LLC.
Project Number: ESC19-G010

Test Pit Elevation: 328 feet
Test Pit Location: See Figure 2
Depth to Groundwater: None Encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-0.5' Topsoil				
	SM	0.5'-2.5' Loose to medium dense, orange-brown, gravelly, silty SAND; moist, scattered cobbles, roots.	S-1	Grab	1.0'	
	GP	2.5'-4.0' Medium dense to dense, orange-brown, slightly silty, sandy GRAVEL; moist, trace silt, iron-oxide staining.	S-2	Grab	3.0'	Gravel: 56.9% Sand: 38.9% Silt/Clay: 42.2% M.C.: 5%
5	SP	4.0'-6.0' Dense, gray, fine to medium SAND; moist, trace silt.	S-3	Grab	5.0'	
	SM	6.0'-9.5' Dense to very dense, brown-gray to gray, slightly gravelly, silty SAND; moist, scattered iron-oxide staining.	S-4 S-5 S-6	Grab Grab Grab	6.5' 7.5' 8.0'	Gravel: 0.8% Sand: 57.0% Silt/Clay: 42.2% M.C.: 17%
10		Total Depth: 9.5' Groundwater: None Encountered				
15						

Excavation Contractor: Bullseye Excavation
Excavation Equipment: Mini-Trackhoe
Operator: Todd

Excavation Date: 2-27-19
ESC Representative: DPO
Page 1 of 1

APPENDIX B

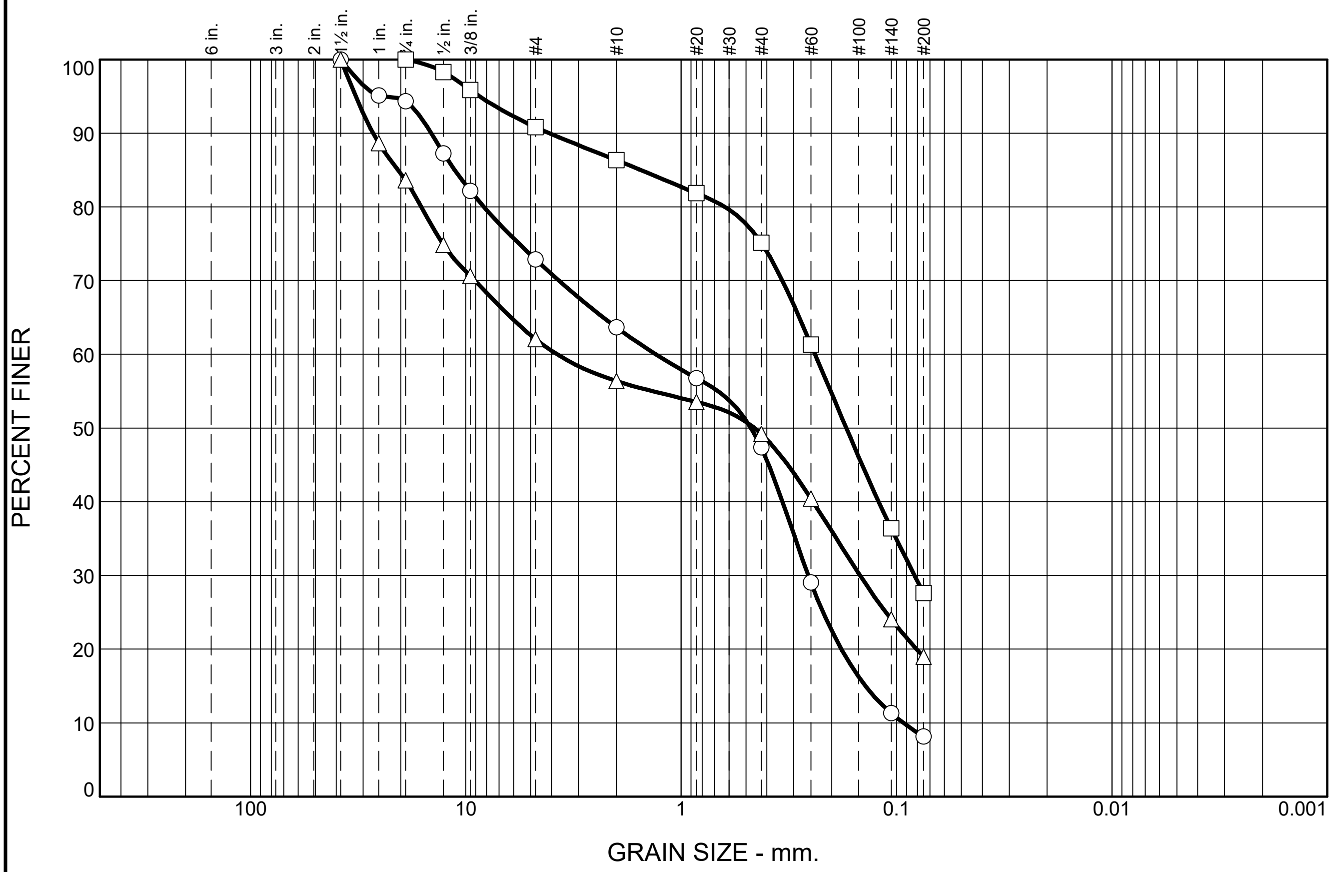
Laboratory Test Results

EnviroSound Consulting
ESC19-G010
CalaVista

Moisture Contents
ASTM D-2216
Table 1

Exploration Number	Sample Number	Depth(ft)	Moisture Content %
TP-1	S-2	2.0	11
TP-1	S-4	5.0	12
TP-1	S-6	7.0	14
TP-2	S-2	2.8	14
TP-2	S-4	6.0	17
TP-2	S-5	8.5	10
TP-3	S-1	1.5	15
TP-3	S-3	5.0	12
TP-4	S-2	3.0	9
TP-4	S-4	6.5	16
TP-4	S-6	10.5	9
TP-5	S-2	3.0	9
TP-5	S-4	6.0	5
TP-5	S-5	9.0	10
TP-6	S-2	3.0	5
TP-6	S-5	7.5	17

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	27.1	64.8	8.1		SP-SM	A-1-b	NP	NV
□	0.0	9.2	63.2	27.6		SM	A-2-4(0)	NP	NV
△	0.0	37.9	43.1	19.0		SM	A-1-b	NP	NV

SIEVE inches size	PERCENT FINER ○	□	△
1.5	100.0		100.0
1	95.1		88.6
0.75	94.3	100.0	83.6
0.5	87.3	98.3	74.8
0.375	82.2	95.8	70.6
	GRAIN SIZE		
D_{60}	1.3108	0.2391	3.7720
D_{30}	0.2571	0.0826	0.1477
D_{10}	0.0930		
	COEFFICIENTS		
C_c	0.54		
C_u	14.09		

SIEVE number size	PERCENT FINER ○	□	△
#4	72.9	90.8	62.1
#10	63.6	86.4	56.4
#20	56.8	81.8	53.5
#40	47.4	75.1	49.2
#60	29.1	61.3	40.4
#140	11.3	36.4	24.1
#200	8.1	27.6	19.0

Material Description

○ poorly graded sand with silt and gravel

□ silty sand

△ silty sand with gravel

REMARKS:

○

□

△

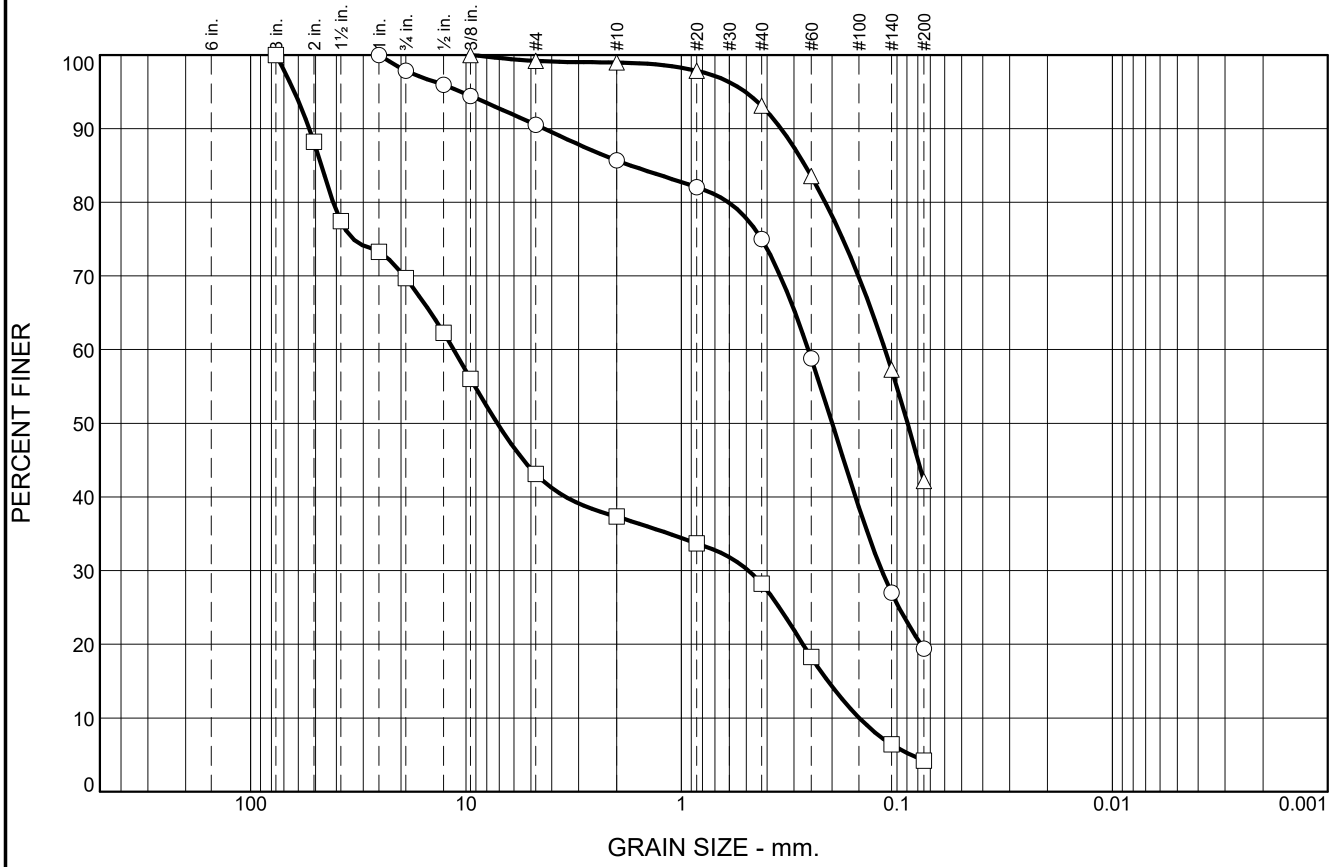
○ Depth: 8.5 Sample Number: TP2 S5
□ Depth: 5 Sample Number: TP3 S3
△ Depth: 10.5 Sample Number: TP4 S6

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010
Project No.: PSR19-9-0305 Figure 1

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	9.5	71.1	19.4		SM	A-2-4(0)	NP	NV
□	0.0	56.9	38.9	4.2		GP	A-1-a	NP	NV
△	0.0	0.8	57.0	42.2		SM	A-4(0)	NP	NV

SIEVE inches size	PERCENT FINER ○	□	△
3		100.0	
2		88.2	
1.5		77.4	
1	100.0	73.3	
0.75	97.9	69.7	
0.5	95.9	62.3	
0.375	94.4	56.0	100.0
	GRAIN SIZE		
D_{60}	0.2580	11.4164	0.1135
D_{30}	0.1174	0.4883	
D_{10}		0.1495	
	COEFFICIENTS		
C_c		0.14	
C_u		76.38	

SIEVE number size	PERCENT FINER ○	□	△
#4	90.5	43.1	99.2
#10	85.7	37.3	99.0
#20	82.0	33.7	97.8
#40	75.0	28.2	93.1
#60	58.8	18.3	83.5
#140	27.0	6.4	57.3
#200	19.4	4.2	42.2

Material Description

○ silty sand

□ poorly graded gravel with sand

△ silty sand

REMARKS:

○

□

△

○ Depth: 9 Sample Number: TP5 S5

□ Depth: 3.0 Sample Number: TP6 S2

△ Depth: 7.5 Sample Number: TP6 S5

Phoenix Soil Research

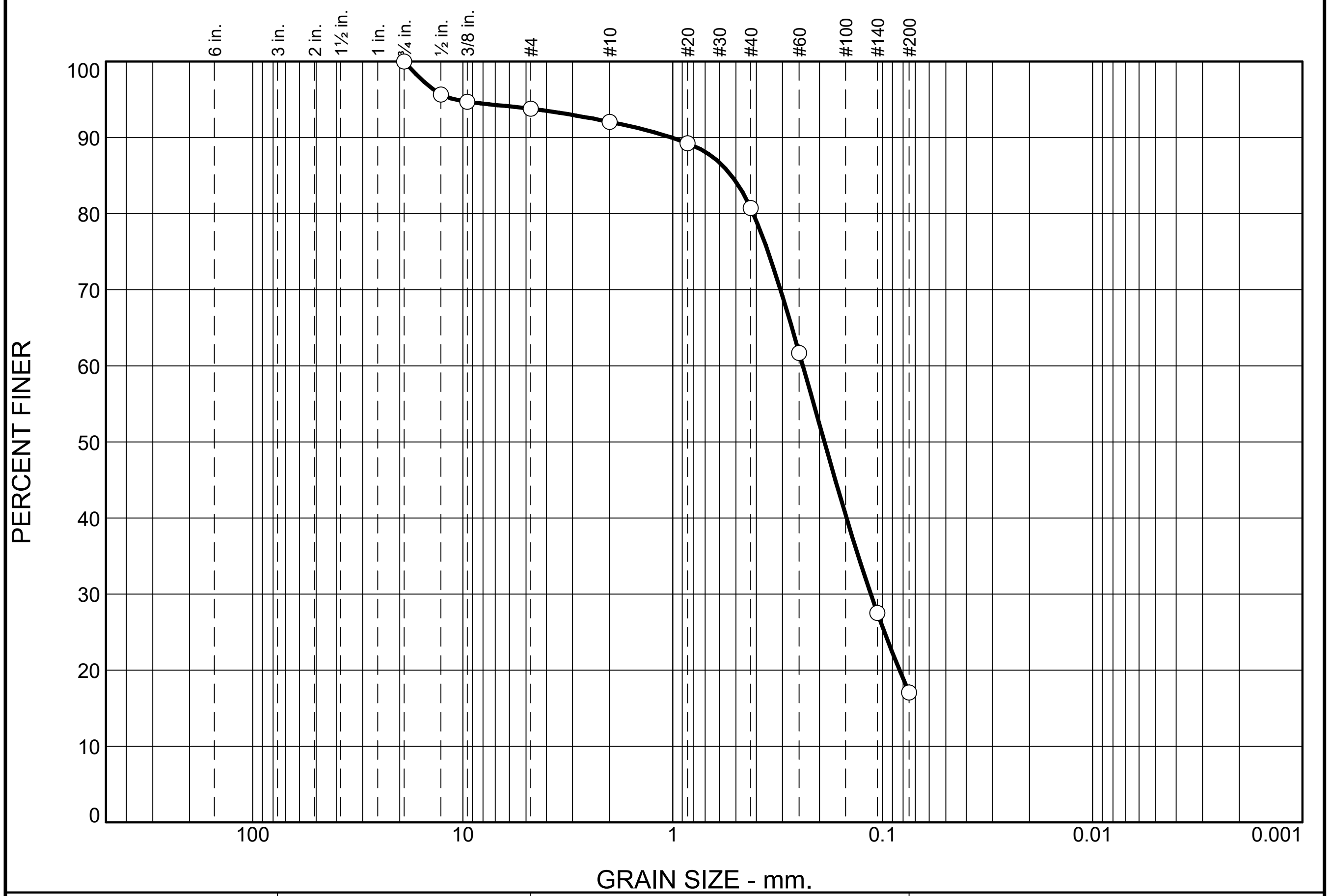
Kingston, WA

Client: EnviroSound Consulting

Project: CalaVista ESC19-G010

Project No.: PSR19-9-0305 Figure 2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	6.2	1.7	11.4	63.6	17.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.5	95.7		
0.375	94.7		
#4	93.8		
#10	92.1		
#20	89.2		
#40	80.7		
#60	61.7		
#140	27.5		
#200	17.1		

* (no specification provided)

Material Description

silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 1.0133 D_{85}= 0.5251 D_{60}= 0.2400
D_{50}= 0.1894 D_{30}= 0.1140 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample Number: TP1 S2 **Depth:** 2

Date:

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 3

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	18.4	9.0	10.5	42.8	19.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.5	96.5		
0.375	95.4		
#4	81.6		
#10	72.6		
#20	67.8		
#40	62.1		
#60	50.5		
#140	26.7		
#200	19.3		

* (no specification provided)

Material Description

silty sand with gravel

Atterberg Limits

PL= NP
LL= NV
PI=

Coefficients

D_{90}= 6.8754	D_{85}= 5.5424	D_{60}= 0.3762
D_{50}= 0.2457	D_{30}= 0.1210	D_{15}=
D_{10}=	C_u=	C_c=

Classification

USCS= SM
AASHTO= A-2-4(0)

Remarks

Sample Number: TP1 S4 **Depth:** 5.0

Date:

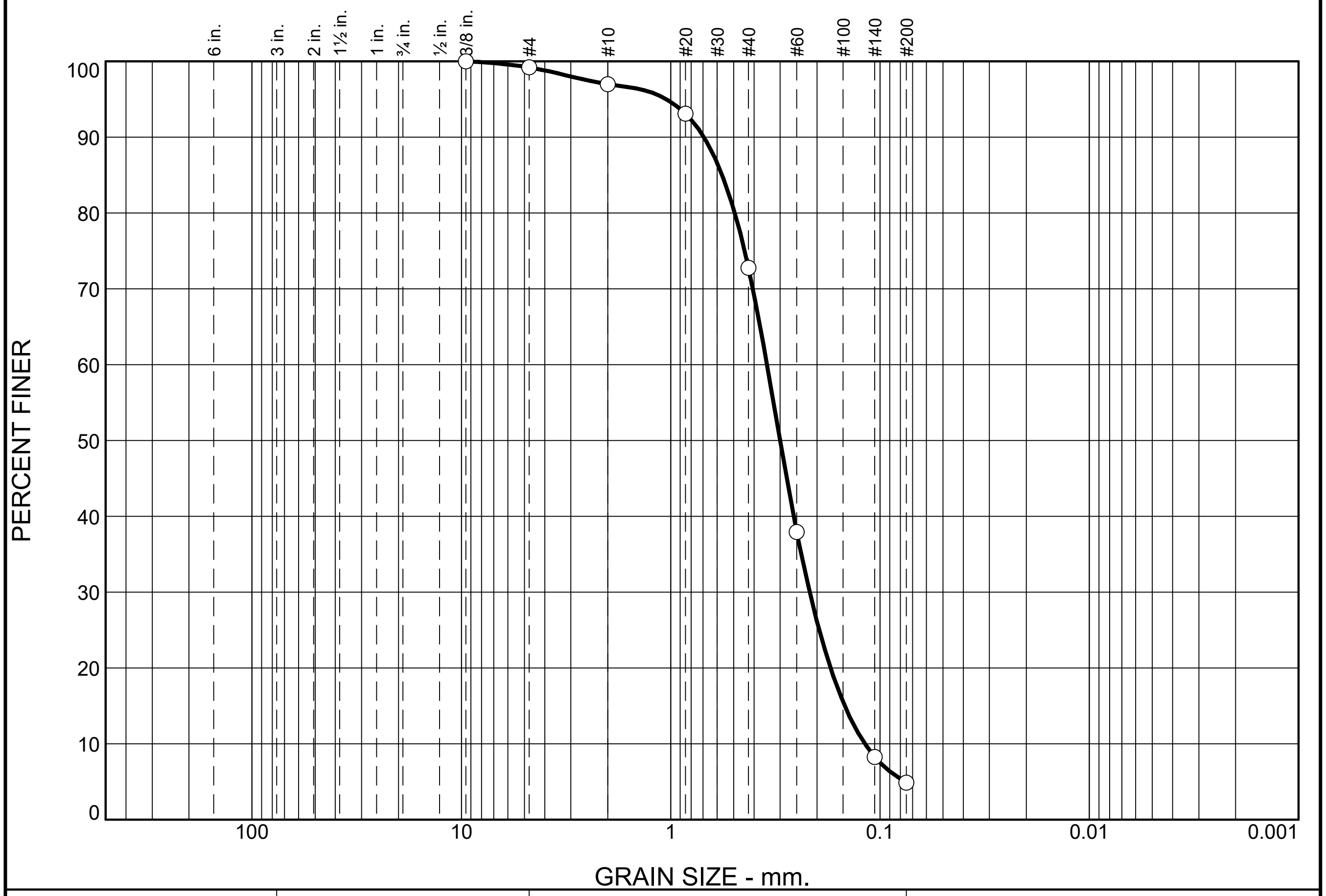
Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.8	2.2	24.3	67.8	4.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.2		
#10	97.0		
#20	93.1		
#40	72.7		
#60	37.9		
#140	8.3		
#200	4.9		

* (no specification provided)

Material Description

poorly graded sand

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.6946 D_{85}= 0.5679 D_{60}= 0.3468
D_{50}= 0.3001 D_{30}= 0.2169 D_{15}= 0.1473
D_{10}= 0.1182 C_u= 2.93 C_c= 1.15

Classification

USCS= SP AASHTO= A-3

Remarks

Sample Number: TP1 S6 **Depth:** 7

Date:

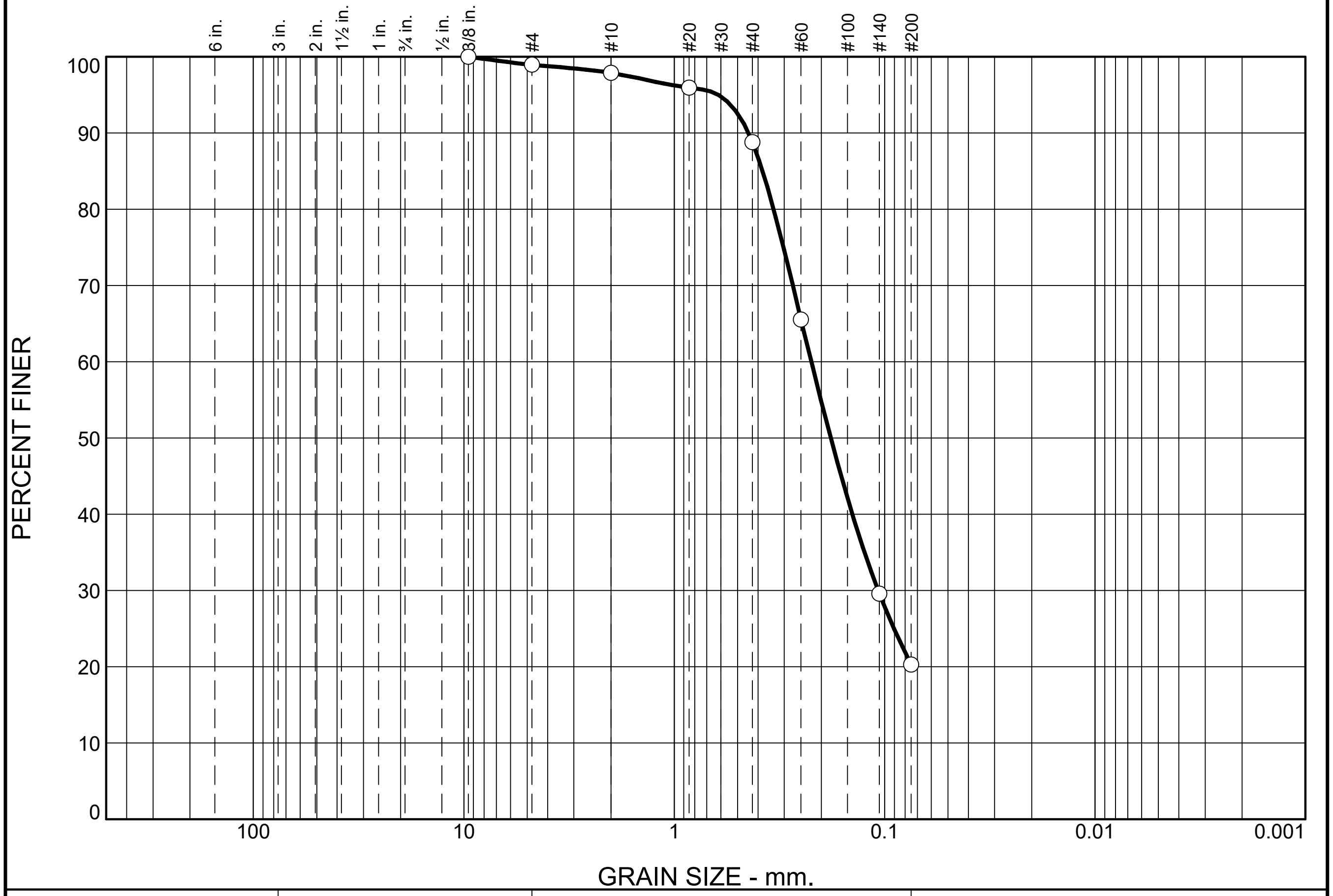
Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 5

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	1.1	1.0	9.1	68.5	20.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	98.9		
#10	97.9		
#20	95.9		
#40	88.8		
#60	65.5		
#140	29.6		
#200	20.3		

* (no specification provided)

Material Description

silty sand

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.4443 D_{85}= 0.3803 D_{60}= 0.2233
D_{50}= 0.1802 D_{30}= 0.1074 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample Number: TP2 S2 **Depth:** 2.8

Date:

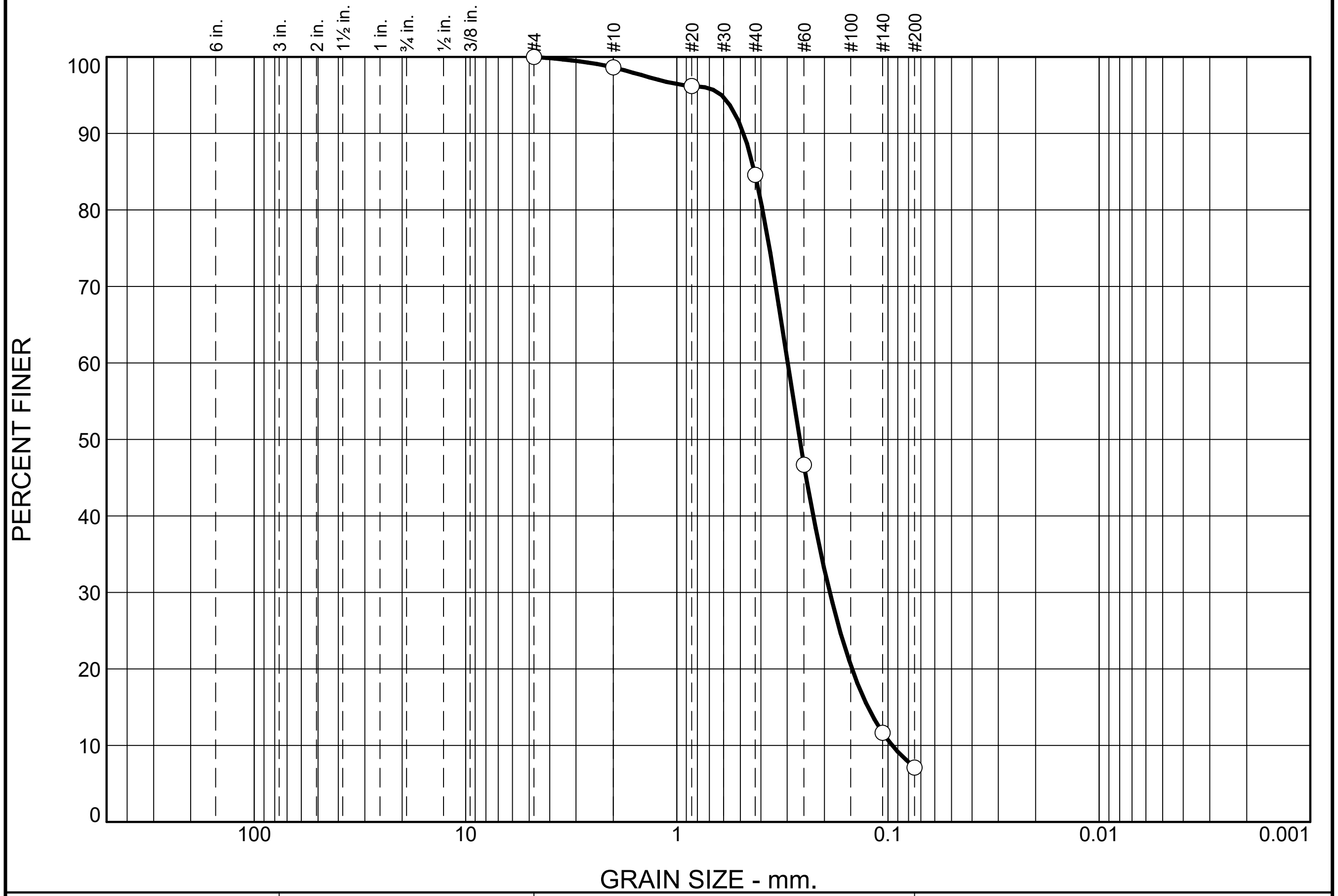
Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 6

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.0	1.4	14.0	77.5	7.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	98.6		
#20	96.2		
#40	84.6		
#60	46.7		
#140	11.7		
#200	7.1		

* (no specification provided)

Material Description

poorly graded sand with silt

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.4836	D_{85}= 0.4287	D_{60}= 0.2984
D_{50}= 0.2618	D_{30}= 0.1887	D_{15}= 0.1243
D_{10}= 0.0955	C_u= 3.13	C_c= 1.25

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Sample Number: TP2 S4 **Depth:** 6

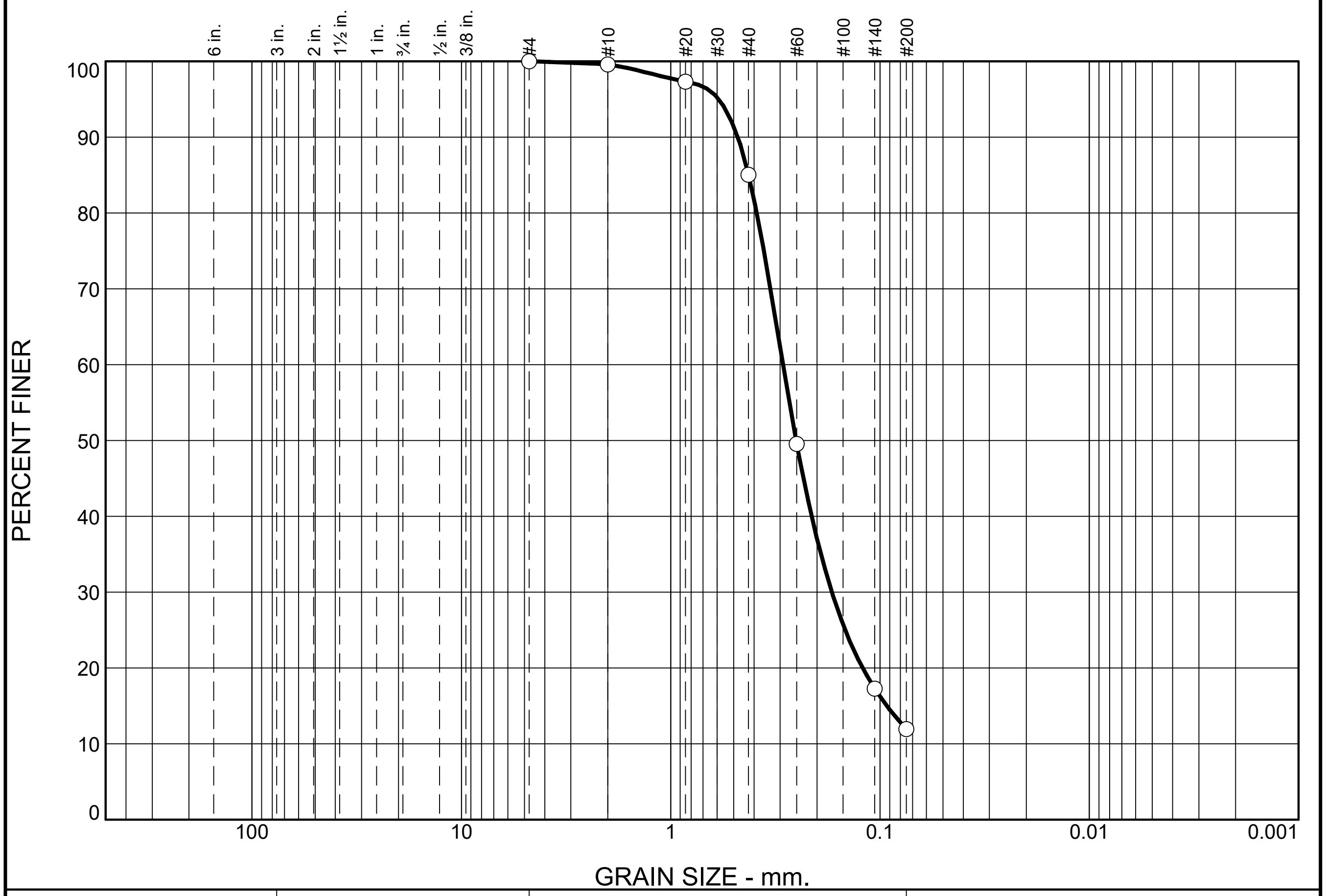
Date:

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010
Project No: PSR19-9-0305 **Figure** 7

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.0	0.4	14.5	73.2	11.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#20	97.3		
#40	85.1		
#60	49.5		
#140	17.3		
#200	11.9		

* (no specification provided)

Material Description

poorly graded sand with silt

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.4785 D_{85}= 0.4246 D_{60}= 0.2907
D_{50}= 0.2518 D_{30}= 0.1698 D_{15}= 0.0927
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-2-4(0)

Remarks

Sample Number: TP4 S2 **Depth:** 3

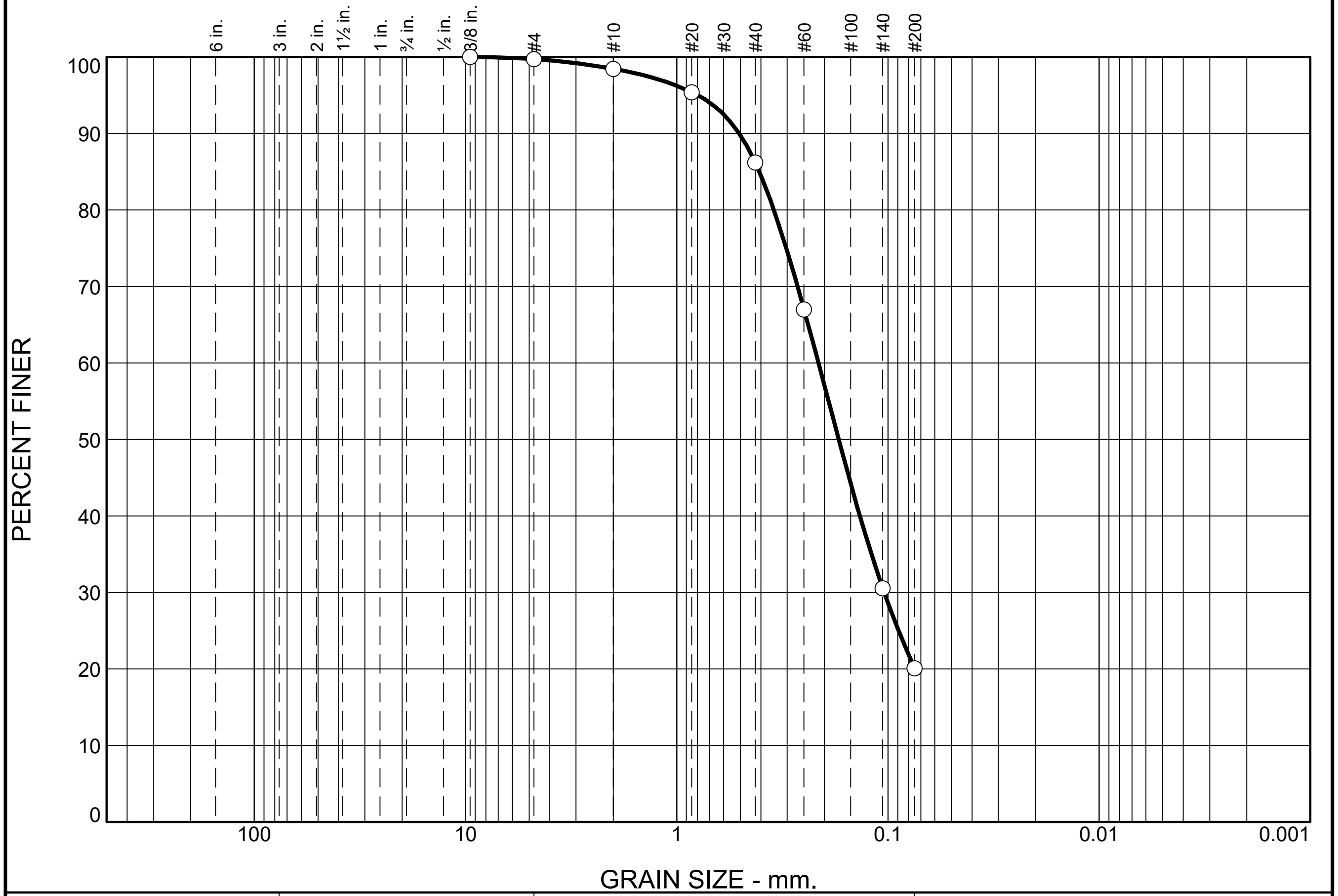
Date:

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010
Project No: PSR19-9-0305 **Figure** 8

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	0.3	1.3	12.2	66.1	20.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.7		
#10	98.4		
#20	95.4		
#40	86.2		
#60	67.0		
#140	30.5		
#200	20.1		

* (no specification provided)

Material Description

silty sand

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 0.5070 D_{85}= 0.4068 D_{60}= 0.2135
D_{50}= 0.1710 D_{30}= 0.1043 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample Number: TP4 S4 **Depth:** 6.5

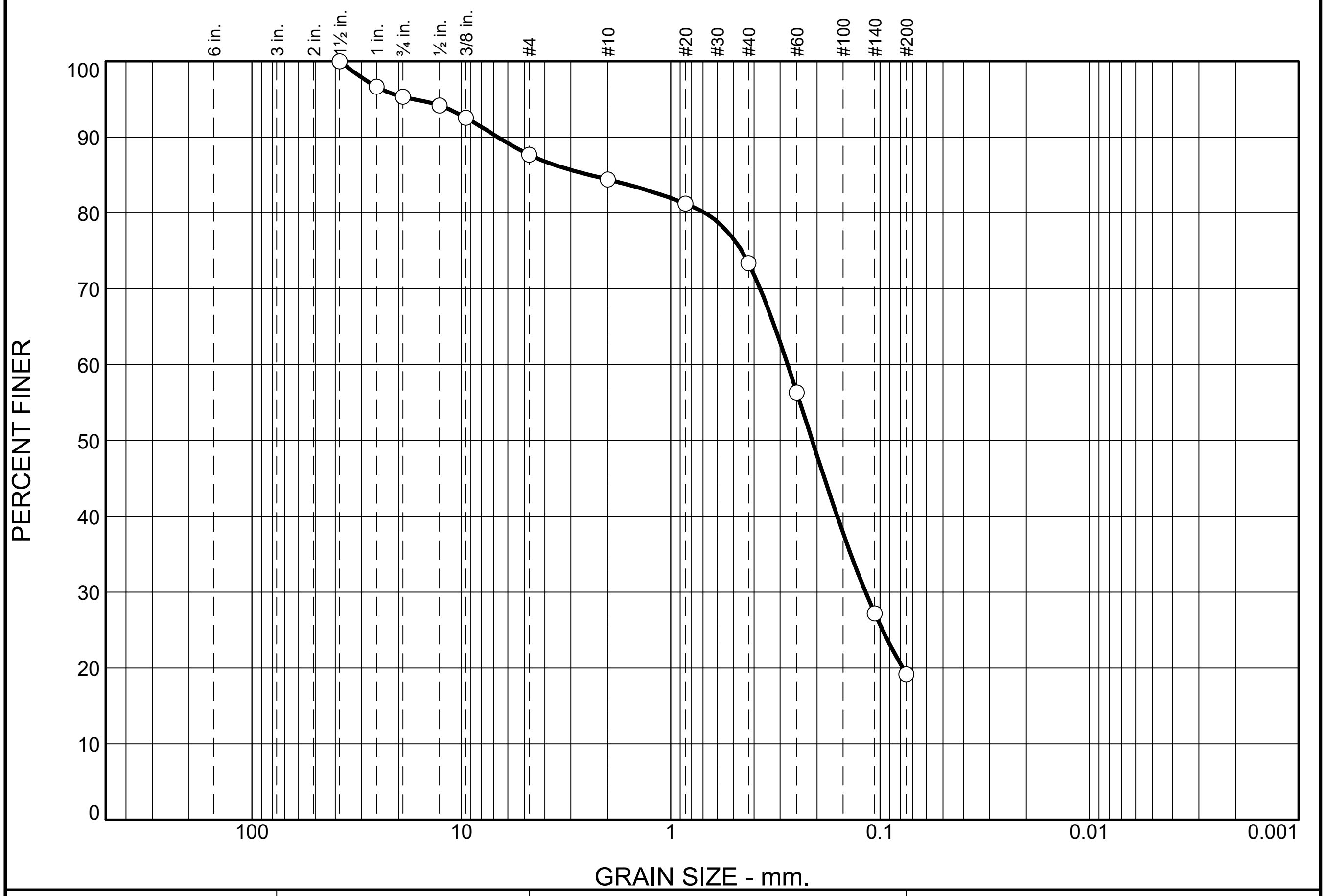
Date:

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010
Project No: PSR19-9-0305 **Figure** 9

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	4.7	7.6	3.3	11.0	54.2	19.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	96.6		
0.75	95.3		
0.5	94.2		
0.375	92.5		
#4	87.7		
#10	84.4		
#20	81.2		
#40	73.4		
#60	56.3		
#140	27.2		
#200	19.2		

* (no specification provided)

Material Description

silty sand

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 6.7029 D_{85}= 2.4314 D_{60}= 0.2764
D_{50}= 0.2110 D_{30}= 0.1173 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample Number: TP5 S2 **Depth:** 3.0

Date:

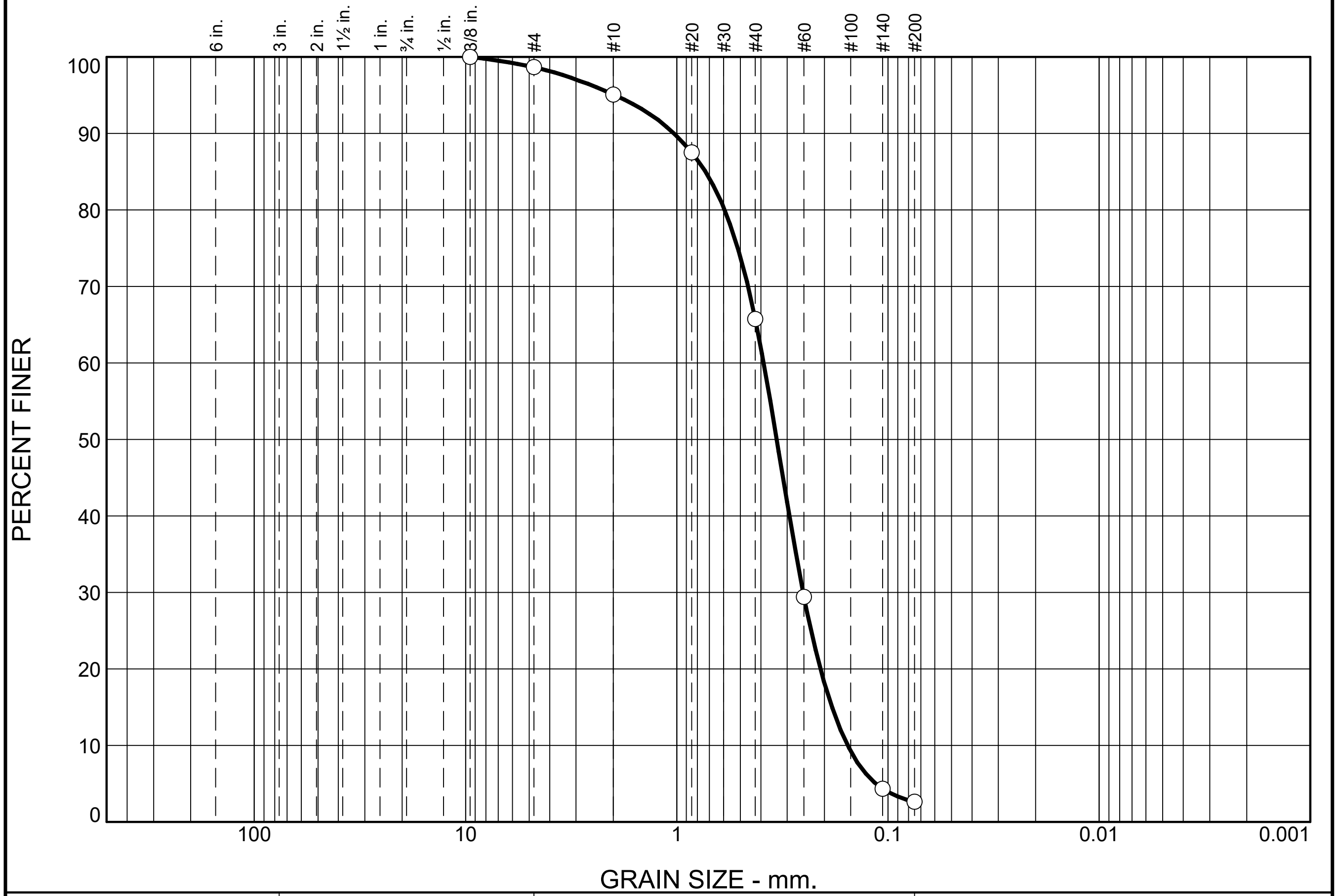
Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 10

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0.0	0.0	1.4	3.5	29.4	63.1	2.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	98.6		
#10	95.1		
#20	87.5		
#40	65.7		
#60	29.4		
#140	4.3		
#200	2.6		

* (no specification provided)

Material Description

poorly graded sand

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 1.0312	D_{85}= 0.7316	D_{60}= 0.3878
D_{50}= 0.3363	D_{30}= 0.2524	D_{15}= 0.1841
D_{10}= 0.1551	C_u= 2.50	C_c= 1.06

Classification

USCS= SP AASHTO= A-3

Remarks

Sample Number: TP5 S4 **Depth:** 6.0

Date:

Phoenix Soil Research

Kingston, WA

Client: EnviroSound Consulting
Project: CalaVista ESC19-G010

Project No: PSR19-9-0305 **Figure** 11

Soundview Consultants LLC
Environmental Assessment • Planning • Land Use Solutions

2907 Harborview Dr., Suite D, Gig Harbor, WA 98335
Phone: (253) 514-8952 Fax: (253) 514-8954

Technical Memorandum

To: **Barry Margolese** **File Number: 1001.0027**

From: **Don Babineau, Soundview Consultants LLC** **Date: September 24, 2019**

Re: **Stream Assessment for Stormwater Outfall – 19700 and 19840 Caldart Ave NE, Poulsbo, WA (File No. 18-152 229 PSD & 18152235 SPA)**

Dear Mr. Margolese,

This technical memorandum documents the downstream assessment of the South Fork of Dogfish Creek that Soundview Consultants LLC (SVC) conducted to determine potential impacts to the drainage associated with an offsite stormwater outfall for the Calavista PRD project. In July 2019, Soundview Consultants LLC (SVC) conducted an assessment of one-mile segment of the South Fork of Dogfish Creek from its intersection with Highway 305 to the proposed outfall location immediately south of Mosjon Circle. The South Fork of Dogfish Creek is located in the City of Poulsbo within Kitsap County, Washington (Figure 1). The drainage starts in the Southeast ¼ of Section 14, Township 26 North, Range 01 East, W.M. It continues on to Section 23, Township 26 North, Range 1 East, W.M. before turning back into the Western ½ of the previous section (Section 14).

Figure 1. South Fork Dogfish Creek Location

Background Data

Prior to the site investigation, SVC staff conducted background research using the Kitsap County Geographic Information System (GIS) data, Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) and SalmonScape mapping tools, U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI), and Washington Department of Natural Resources (DNR) water typing system. SVC also reviewed stormwater and drainage as-built drawings (Attachment D).

The South-Fork of Dogfish Creek is located in a urban/residential setting and is bordered by residential development, single family residences, and Wilderness Park. Topography throughout headwaters consists of a flat hilltop that drains toward the moderately incised ravine in the lower reaches (Attachment C6).

The DNR stream typing map (Attachment C2) and the Kitsap County stream inventory (Attachment C4) identify this drainage as a fish bearing stream (Type F) up to the upper reaches within Myroeboe Wilderness Park. Upstream of the Wilderness Park, the DNR and Kitsap County designate this stream as non-fish-bearing (Type N) from the north boundary of the park to NE Odessa Way. WDFW's SalmonScape and PHS maps (Attachments C1 & C3) designate the end of fish far downstream of the endpoint marked by the DNR or Kitsap County. WDFW (PHS & Salmonscape) has the end of fish use located south of SR-305.

In 2003, the City of Poulsbo contracted Fishman Environmental Services, LLC to conduct stream habitat studies on multiple streams within the city. The associated report (Attachment D) is titled the "*Report on Best Available Science and Recommended Protection Measures for Fish and Wildlife Habitat*" (Fishman, 2003). This report identified the origin of these stream in a similar location as the DNR and Kitsap county. This report documented the end of anadromous fish use in the same location that the DNR and Kitsap County documented the end of all fish use. Based on the Fishman study, the City of Poulsbo contracted IFC International to draft the *South Fork Dogfish Creek Restoration Master Plan.*

In 2017, the City of Poulsbo adopted a new Critical Areas Ordinance (CAO) that outlined a conservation status and area for Dogfish Creek. The associated map of the South Fork of Dogfish Creek identifies the end of fish use in the same location as the DNR, Kitsap County; however, the origin of South Fork of Dogfish Creek is identified ~1 km north of any of the aforementioned data sources.

Precipitation

Precipitation data was obtained from the National Oceanic and Atmospheric Administration (NOAA) weather station at the Seattle-Tacoma International Airport Station in order to acquire percent of normal precipitation during and preceding the site investigation. A summary of data collected is provided in Table 1.

Table 1. Precipitation Summary[1].

Site Visit Date	Day Of	Day Before	1 Week Prior	2 Weeks Prior	30 Days Prior (Observed/Normal)	Year to Date (Observed/Normal)[2]	Percent of Normal[3]
7/31/2019	0.00	0.00	0.23	0.00	1.15/0.67	16.02/19.71	172/81

1. Precipitation volume provided in inches. Data obtained from NOAA (http://w2.weather.gov/climate/xmacis.php?wfo=sew) for Sea-Tac Airport.
2. Year-to-date precipitation is for the calendar year (beginning January 1) to the onsite date.
3. Percent of normal is shown for the 2019 calendar year to date.

Methods

In addition to the background research, SVC conducted a site investigation to collect data and assess portions of the South Fork of Dogfish Creek for 1 mile downstream of a proposed stormwater outfall. The drainage was assessed by investigating the upper reaches of each segment at culvert crossings and in between culverts where accessible. Bankfull widths and Ordinary High Water (OHW) widths were taken at between each culvert crossings in areas that are outside of influence of the culverts. Photographs were taken at these locations within the reach to document findings (Attachment B).

This investigation was conducted on July 31, 2019 by Don Babineau, Project Manager and Environmental Planner, and Jacob Layman, Environmental Scientist with Soundview Consultants LLC. A summary of staff qualifications are presented in Appendix D.

Results

Consistent with Figure 1 (Attachment D) of the stream reach assessment conducted for the City of Poulsbo by Fishman Environmental Services LLC (Fishman, 2003), SVC assessed the seasonal portion of headwater reach of the South Fork of Dogfish Creek as originating south of NE Watland Street adjacent to the neighborhood park/open space Tract D of the Caldart Heights Division 1 plat. SVC observations of this area indicate this as the beginning of a Type Ns water per PMC 16.20.310 and WAC 222-16-030 based on the first evidence of sorting of substrate observed and an area of scour (26 inches wide) with an average approximate OHWM and BFW of 30 inches. These channel characteristics indicate regular enough flow to be a seasonal system and not an ephemeral, stormwater driven system.

Upslope of the seasonal portion of the drainage, the stream is fed by a 24-inch culvert to the north which crosses under NE Watland Street. This culvert drains what appears to be a narrow constructed drainage between Lots 3 and 4 of the Caldart Heights plat. This segment of the drainage appears to be ephemeral based on the density of vegetation and lack of a continuous, defined channel. Within this area, the drainage has some segments of unsorted substrate on the bottom of the channel and the vegetation is dominated by Quaking Aspen (Populus tremuloides) Himalayan blackberry (Rubus armeniacus), horsetail (Equisetum sp) and creeping buttercup (Ranunculus repens). Upslope of this is a constructed ditch/swale as documented in the attached as-built Road and Drainage Plan for the Poulsbo Gardens Division I plat and noted as a “sculptured drainage swale” within a “play area” between Lots 10 and 22. Based on the swale profile figure in the as-built drawing, the existing grade was lowered by approximately 2 feet to create the swale within the play area. The as-built drawings are consistent with observations made by SVC staff. The drainage in this area currently exhibits characteristics indicative of an ephemeral stormwater conveyance. The channel gradually loses any horizontal relief on each bank and is totally devoid of sorting of the substrate within ~30 feet south of the culvert under Mosjon Circle which drains to the swale at its north end. This part of the drainage is completely vegetated within the swale and is dominated by creeping buttercup (Ranunculus repens), spotted ladysthumb (Persicaria maculosa), common plantain (Plantago major), and soft rush (Juncus effuesus). In the play area immediately adjacent to the Caldart heights plat, the drainage flattens out into a lawn. In this area, the transition from upland lawn to drainage course is indistinct and drainage appears to have been mowed along with the adjacent lawn prior the July 2019 site visit. The approximate average width of the constructed ditch upslope of the lawn is approximately 50 inches. Further upslope north of Mosjon Circle, consistent with observations made by SVC staff, the as-built Road and Drainage Plan shows the drainage as a stormwater detention swale which was lowered from existing grade by approximately 4 to 6 feet to create the detention area.

A Restoration Master Plan for the South Fork of Dogfish Creek prepared for the City of Poulsbo by IFC International (IFC, 2010) depicts the drainage in Figure 2 (Attachment D) of the report noting it as South Fork Dogfish Creek Stream Alignment. Figure 2 of the IFC report shows the stream alignment extending through the play area depicted on the as-built storm drainage plans and continuing north of Mosjon Circle within the detention swale for the Poulsbo Gardens Division I plat. In Section 3.2 of the IFC report, the drainage is generally described upstream of Wilderness park and west of Caldart Avenue NE as a seasonal channel and bioswale. Based on SVC's observations and as-built documentation, the portion of the drainage within the Poulsbo Garden plat where the proposed outfall is located would be consistent with IFC's reference to a bioswale as this drainage segment appears to be an ephemeral manmade stormwater detention and conveyance system discharging into the origin of the seasonal channel starting south of NE Watland Street.

Downstream from the point of origin of the season portion of the drainage, the substrate returns to a silty, unsorted profile within a short distance and the channel begins to widen and lose incision. Approximate average OHWM in this lower section is 54 inches and the BFW is approximately 100 inches. Dominant vegetation includes and Himalayan blackberry (Rubus armeniacus). Although this section of reach was dry during the site visit and appears to lack viable fish habitat, this reach of the drainage is the location cited within the 2003 Fishman study as having stream/riparian function to protect for resident fish use.

Once this drainage passes under NE Odessa Street, it once again exhibits scour below the culvert, but quickly returns to a silty, unsorted substrate profile. Within this area is the stream begins to display a more defined incision to the channel. BFW in this area is 65 inches with an OHWM of ~ 20 inches. Below the reach located between NE Odessa Way and NE Fontaine Way the stream becomes heavily forested. However, access is not allowed in this area by the property owner.

The next accessible portion of this stream is located between NE Lincoln Rd and NE Mesford Street. The substrate profile remains silty, but incision continues throughout the channel in this reach. BFW is ~55 inches and OHWM is ~29 inches. Dominant vegetation includes red alder (Alnus rubra) and salmonberry (Rubus spectabilis).

Between NE Mesford Street and Poulsbo Wilderness Trail park the stream incises even more with the change in local elevation. The substrate profile in this area is still quite silty, but areas of sorting start to appear. OHWM in this area is ~29 inches and the BFW is ~34 inches. Dominant vegetation in this reach includes red alder (Alnus rubra), redosier dogwood (Cornus alba), and coastal hedgenettle (Stachys chamissonis).Inside of the upper reaches of Dogfish creek within Poulsbo Wilderness Trail park, the stream begins to take on the more common riparian characteristics of a stream in a northwest coastal forest. Although there are still areas of unsorted silty substrate, more consistent areas of scour occur in this reach. Sections of the stream flow over areas of bedrock and gravel. In much of this section the substrate is covered in moss indicating a seasonality to the flows within this section and above. There are areas of very deep incision above the confluence with a tributary ~ 385 feet west of Caldart Ave NE that indicate some heavy flashy flows during the winter and spring. However, this section of stream was still lacking any visible flow. Dominant overstory vegetation in this area includes Western red cedar (Thuja plicata), broadleaf maple (Acer macrophyllum) with Swordfern (Polystichum munitum) trailing blackberry (rubus ursinus), and salmonberry (rubus spectabalis) in the understory. The Department of Natural Resources marks the end of fish use in the area of this confluence. This determination is supported by the lack of structure upstream of this area, the beginning of perennial flows below this location, and the beginning of fully defined incision and sorted substrate within this area.

Below the confluence of dogfish creek and the aforementioned unnamed tributary, the stream displays a perennial flow and displays a habitat profile much more indicative of consistent fish use. A more sorted substrate profile starts appearing with gravel the dominant substrate. The stream becomes more deeply incised and the undercutting of banks occurs much more frequently. Pool, riffle structuring is much more evident and woody materials are much more evident within reach structure. The vegetation profile is the same as the upper reaches of Dogfish creek. Stream width measurements were taken above the culvert under SR 305 and they are an OHWM of 72 inches and a BFW of 89 inches.

Discussion

The contributing basin associated with the South Fork of Dogfish Creek contains areas of relatively undisturbed forest interspersed within urban land use of varying intensity ranging from high intensity commercial development to single-family residential subdivisions. As is typical with the historic conversion of forested land cover to urban land use, the drainage has experienced increased flow rates with the reduction in pervious surface over time. This increased flow has resulted in undercutting of the streambanks located within Wilderness Park where the contributing basin begins to be large enough to result higher flow volumes for such erosional features to occur. These erosional features appear to be well established. The headwater reach of the drainage contains low energy stream characteristics with no undercutting far less channel definition. SVC staff observed no recent signs of significant streambank erosion anywhere within the one mile assessment.

The storm system proposed for the project will use the most current design criteria adopted by the City of Poulsbo. To meet stormwater mitigation requirements, stormwater generated onsite with be treated for water quality, and the system will be designed to detain runoff to match flow rates consistent with a forested condition onsite. The metered stormwater discharge to the outfall location from the proposed project will not result in increased flow rates or erosion. In addition, the existing outfall to which the proposed storm system will connect will be upgraded with a 24-inch diameter pipe (Attachment A) to meet conveyance requirements to handle emergency overflow capacity in excess of the 100-year stormwater design event. Under normal conditions up to the 100-year event, discharge velocity at the outfall will be lower than with the current stormwater outfall which should reduce erosion potential over the current condition.

Temporary impacts within the vicinity of the stormwater outfall will be limited to outside the ordinary high water of the existing bioswale south of Mosjon Circle. These impacts will consist of ground disturbance associated with the excavation and backfill required to upgrade the existing outfall pipe. Temporary sedimentation and erosion control best management practices (TESC BMPs) will be used to prevent temporary impacts to the drainage during construction, and the disturbed area will be stabilized using a native seed mix to prevent sediment delivery following pipe installation activities.

Conclusion

The proposed stormwater outfall is located within a portion of the drainage consistent with a grass-lined stormwater bioswale. With the use of TESC BMPs and stabilization of disturbed areas with the application of a native seed mix, temporary impacts associated with the upgrade of the existing outfall pipe will be fully addressed upon completion of the outfall pipe installation. Using current stormwater design for the proposed onsite improvements and outfall pipe, there should be no long term impacts to the drainage from the project, and there could potentially be a reduction in the impacts with the reduced discharge velocity associated with the upgraded outfall pipe.

Please do not hesitate to contact our office with any question or concerns you may have.

Sincerely,

Don Babineau
Environmental Planner/Forester
Office 253.514.8952x017
Fax: 253.514.8954
don@soundviewconsultants.com

References

Fishman Environmental, 2003. *City of Poulsbo, Washington: Report on Best Available Science and Recommended Protection Measures for Fish and Wildlife Habitat*. Fishman Environmental Services, LLC with Buell and Associates, INC.

IFC International, 2010. *South Fork Dogfish Creek Restoration Master Plan.*

Poulsbo Municipal Code, Title 16.20 - Critical Areas, 2019.

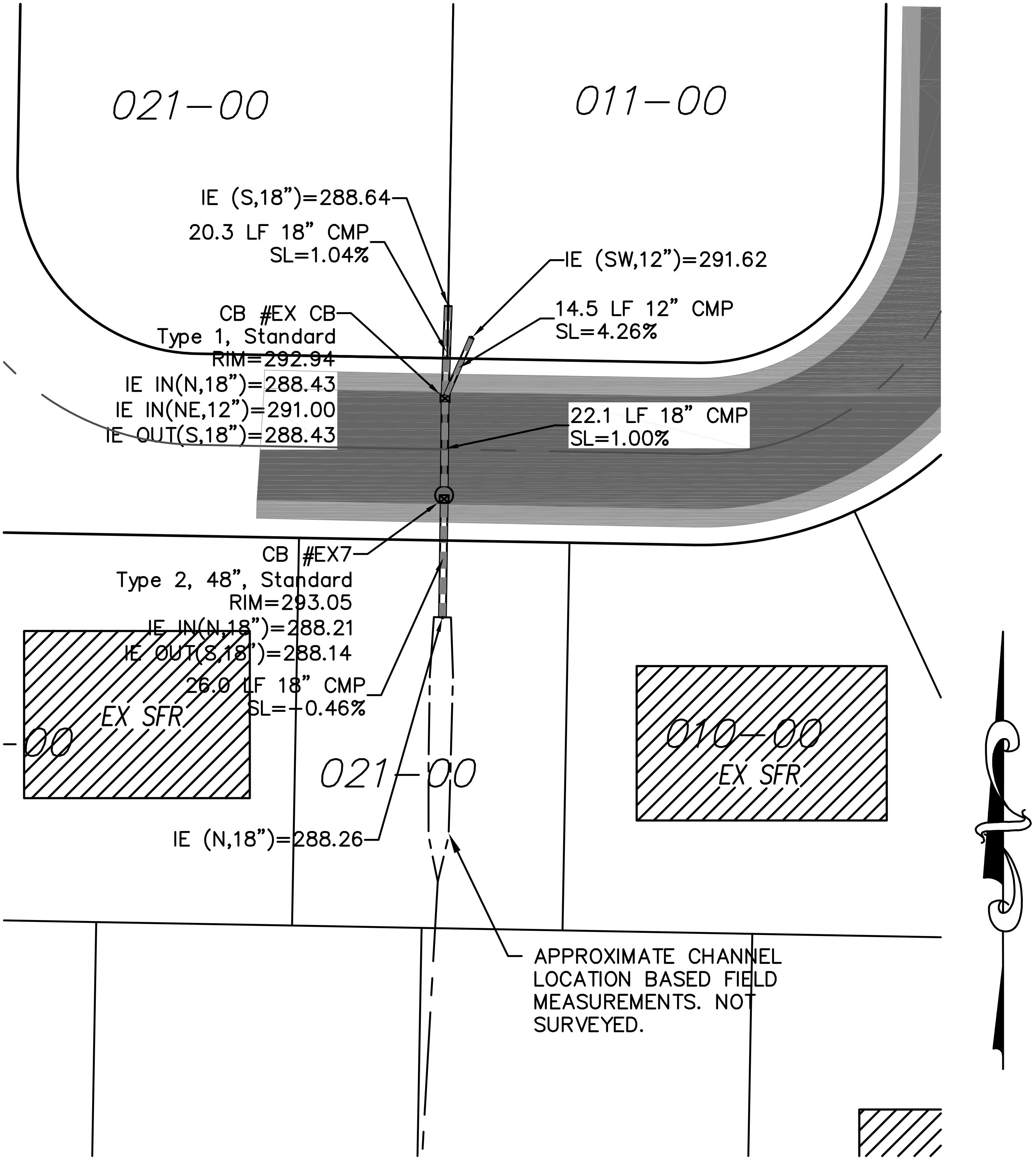
Washington State Department of Ecology, 2010, revised 2016. Publication #16-06-029. *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State*.

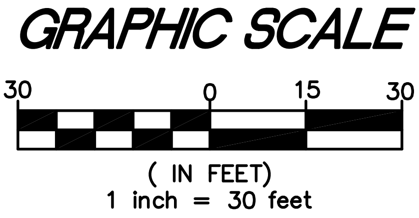
Washington State Department of Natural Resources, 2004. *Forest Practices Board Manual, Section 2 - Standard Methods for Identifying Bankfull Channel Features and Channel Migration Zones*.

Attachment A – Existing Conditions Map and Conceptual Outfall Plan

This attachment includes conceptual drawings from Team 4 Engineering

CALAVISTA – PRD



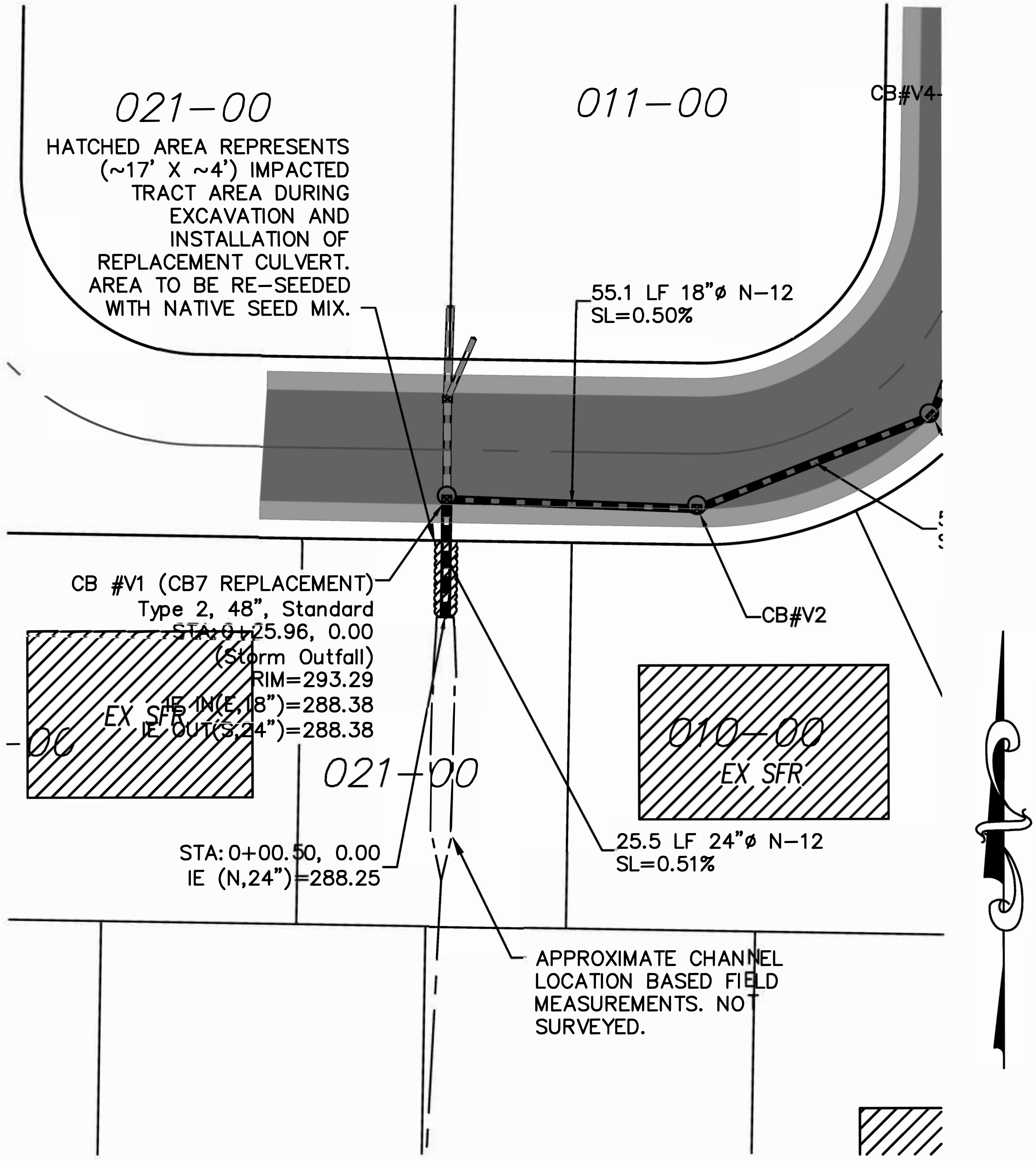


PREDEVELOPED CONDITIONS MAP

THIS MAP SHOWS DISCHARGE LOCATION IN THE "POULSBO GARDENS" RECREATION TRACT 021–00.

X:\1222 Barry Plat\1222 PRD.dwg, 9/16/2019 1:21:01 PM, 1:1

CALAVISTA – PRD



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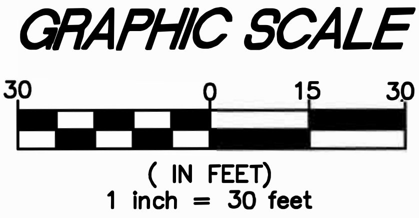


POSTDEVELOPED CONDITIONS MAP

THIS MAP SHOWS DISCHARGE LOCATION IN THE "POULSBO GARDENS" RECREATION TRACT 021–00.

Attachment B – Site Photographs

Detention swale above Mosjon Circle NE

Bioswale above NE Watland St

North end of culvert above NE Watland St

Drainage downstream of NE Watland St

Drainage upstream NE Fontaine Way

Drainage downstream of NE Lincoln Rd

Drainage upstream NE Mesford Rd

Drainage upstream of Wilderness Park

Drainage in the upper reach of Wilderness Park

Drainage below confluence with unnamed tributary

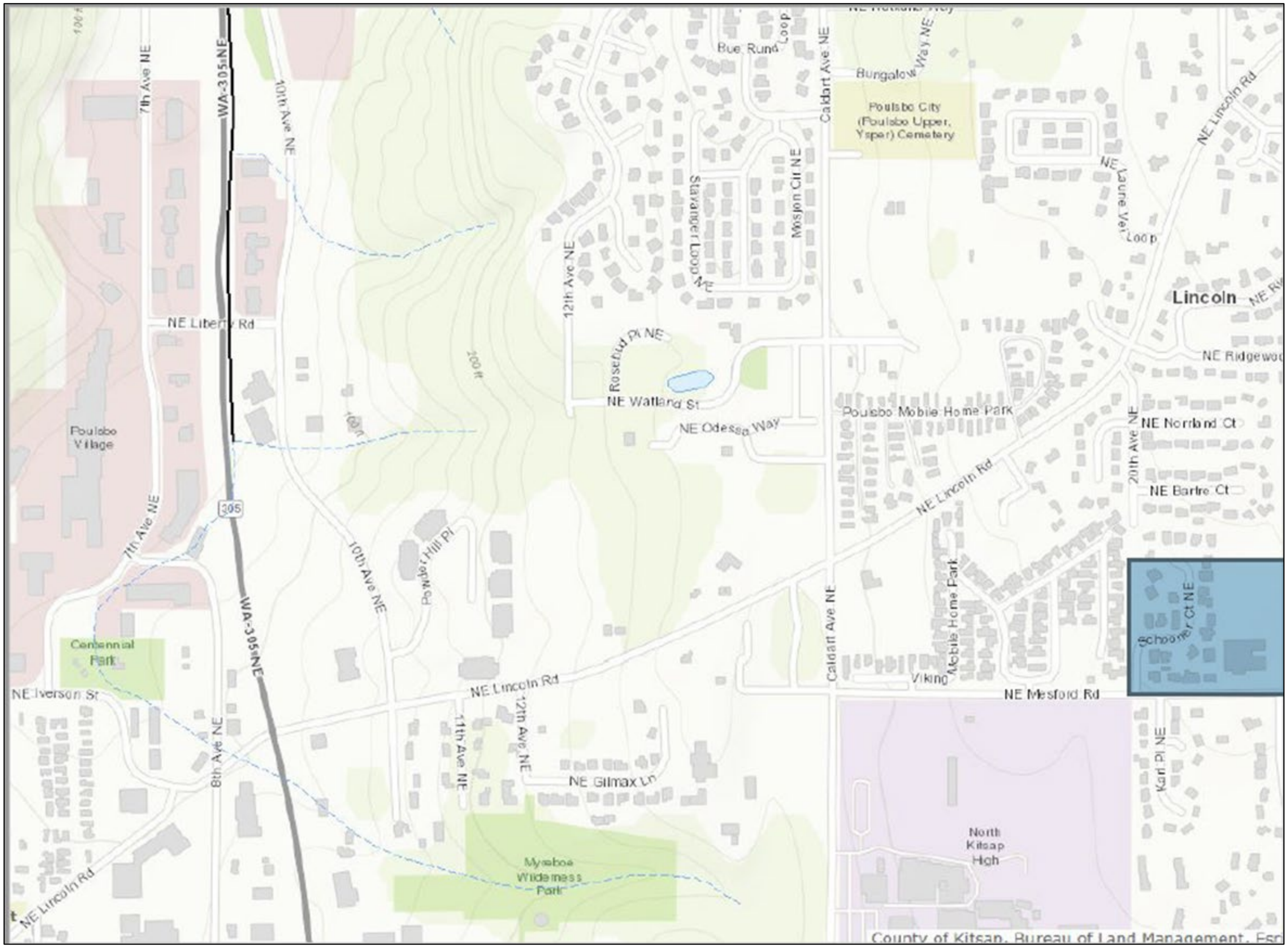
Drainage upstream of SR-305

Drainage and culvert under SR-305

Attachment C – Background Exhibits

This attachment includes WDFW Salmonscape map (C1); DNR Stream Typing Map (C2); WDFW PHS Map (C3); Kitsap County Streams map (C4); WDFW Stream Catalog 1975 (C5). City of Poulsbo Figure CAO-4 (C6)

Attachment C1 – WDFW SalmonScape map



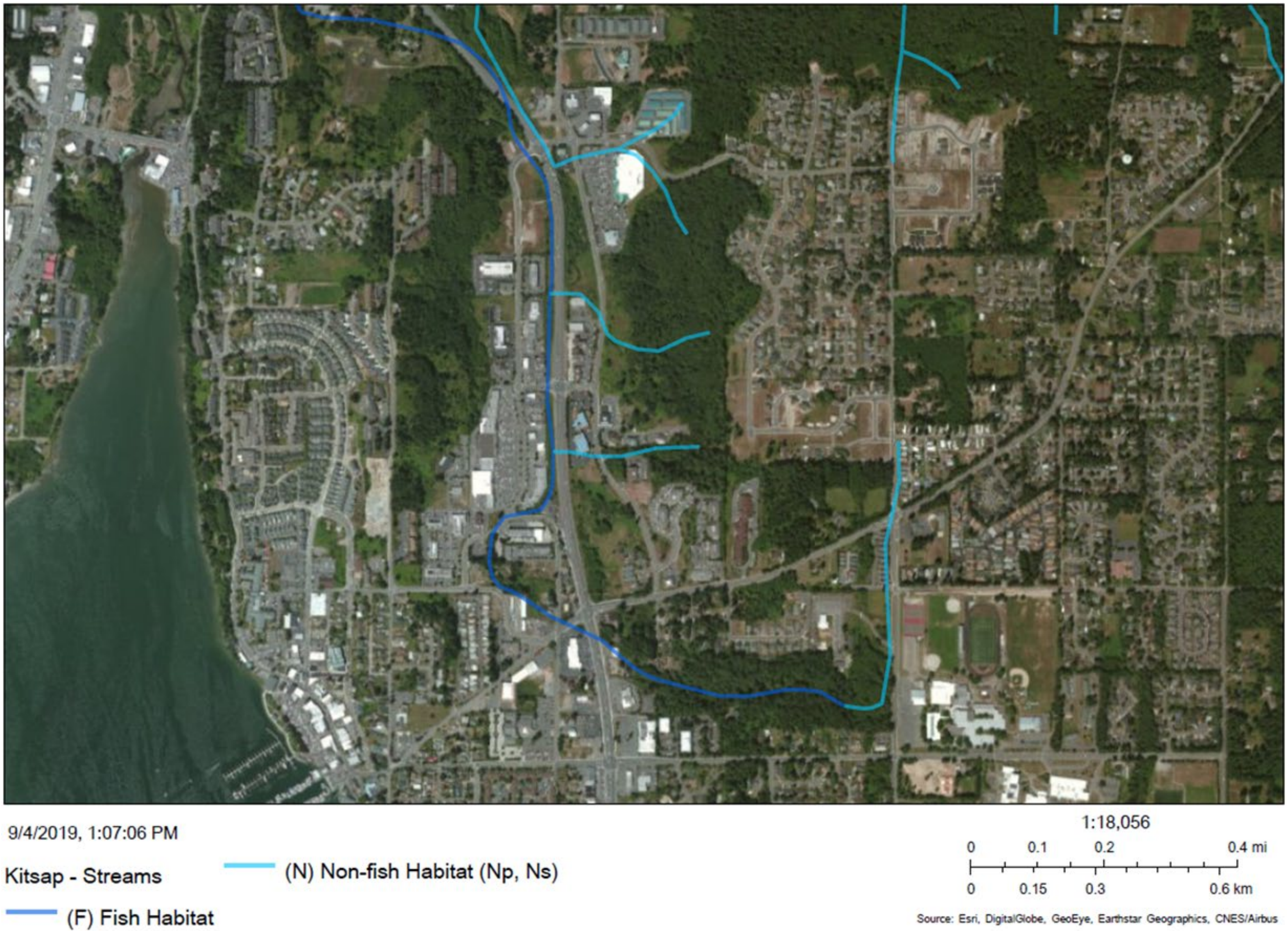
Attachment C2 – DNR Stream Typing

Attachment C3 – WDFW PHS Map

9/4/2019, 1:12:09 PM

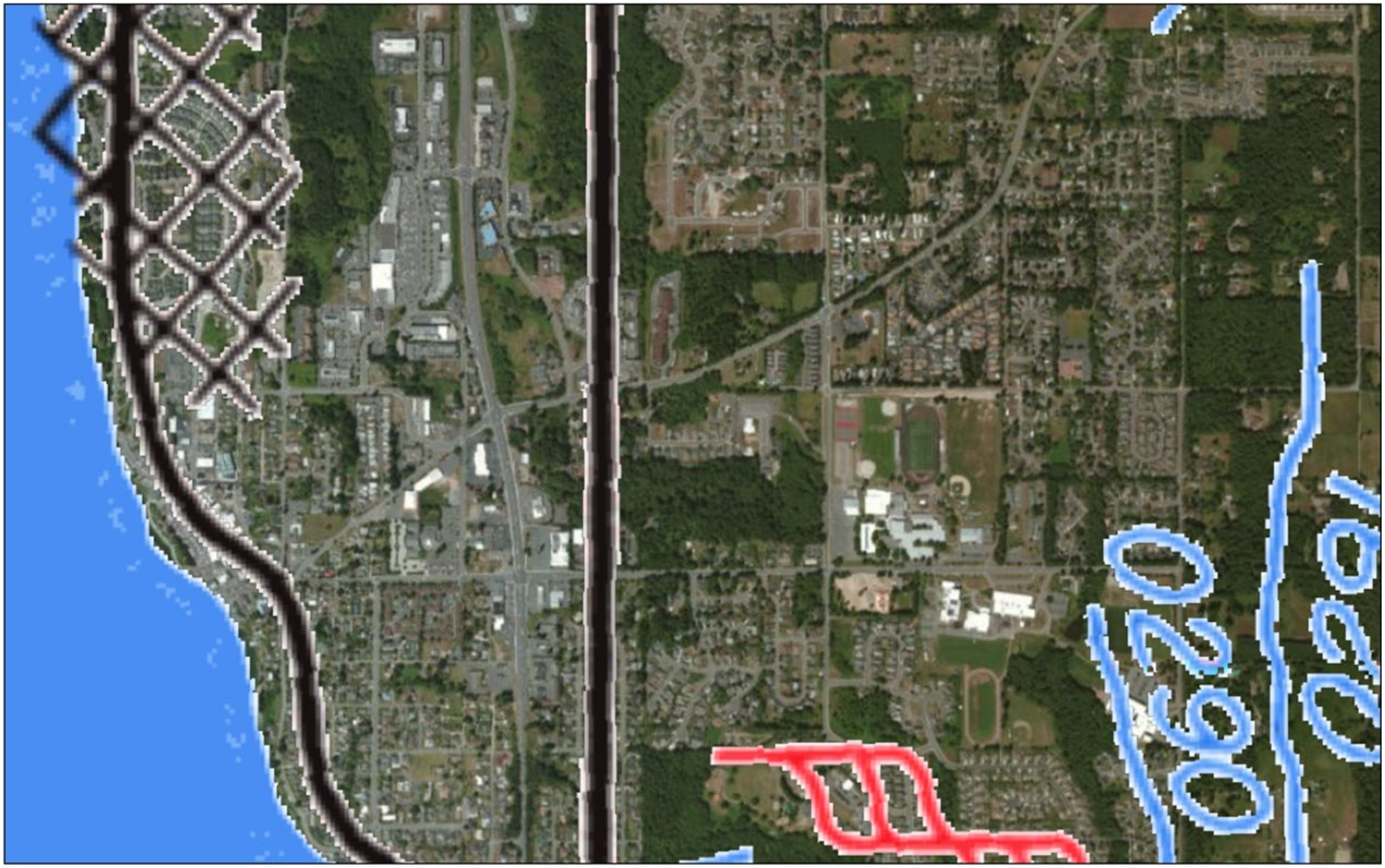
1:18,056

Attachment C4 – Kitsap County Streams Map



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus

Attachment C5 – WDFW Stream Catalog (1975)



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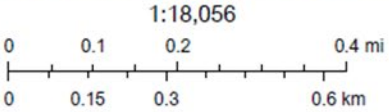
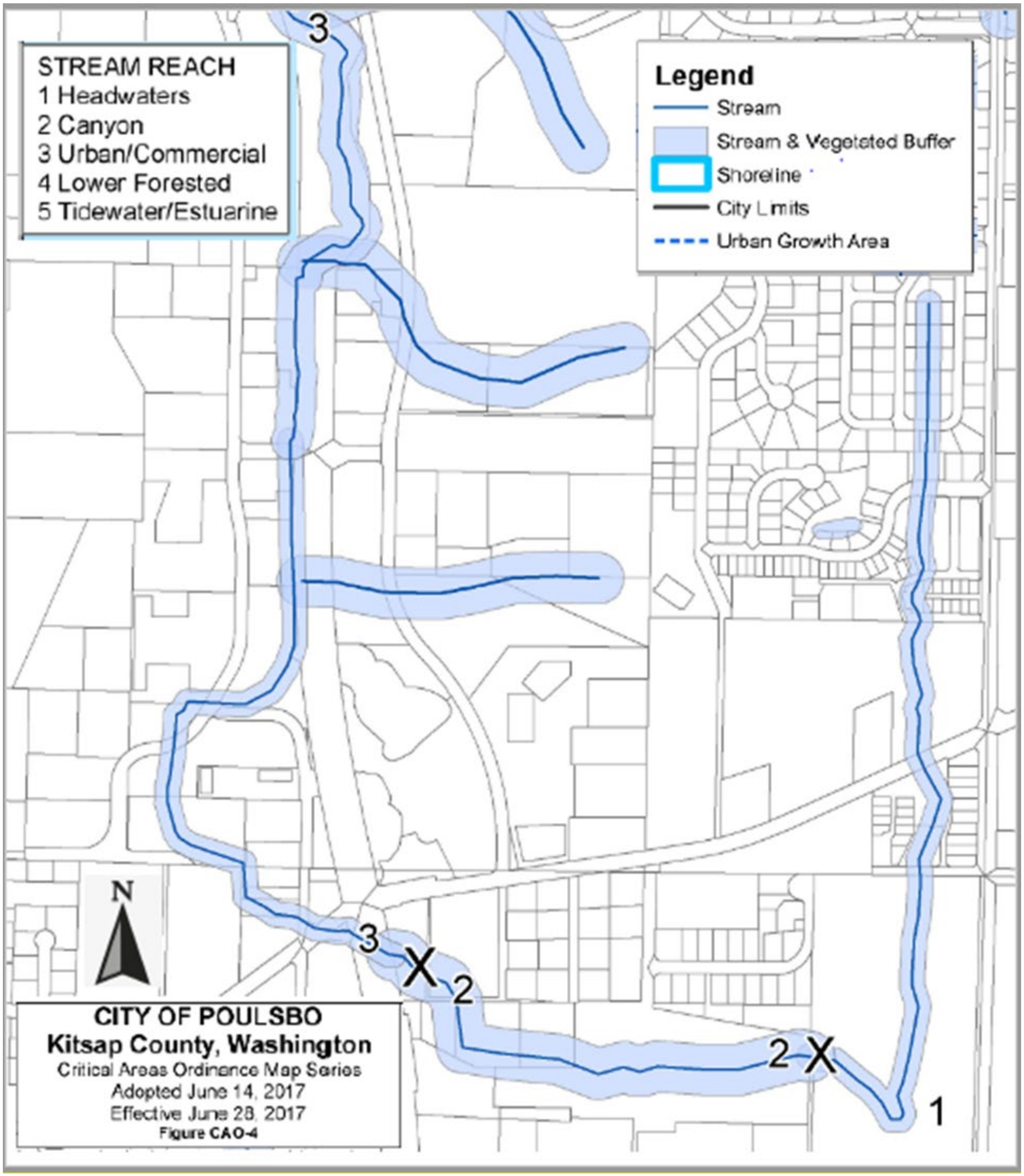


Attachment C6 – City of Poulsbo Southfork Dogfish Creek Reach Map



Attachment D – Previous Report Figures and As-built Plan

This attachment includes Figure 1 from the 2003 Fishman study, Figure 2 from the 2010 IFC study, and the as-built Road and Drainage Plan for the Poulsbo Gardens Division I plat

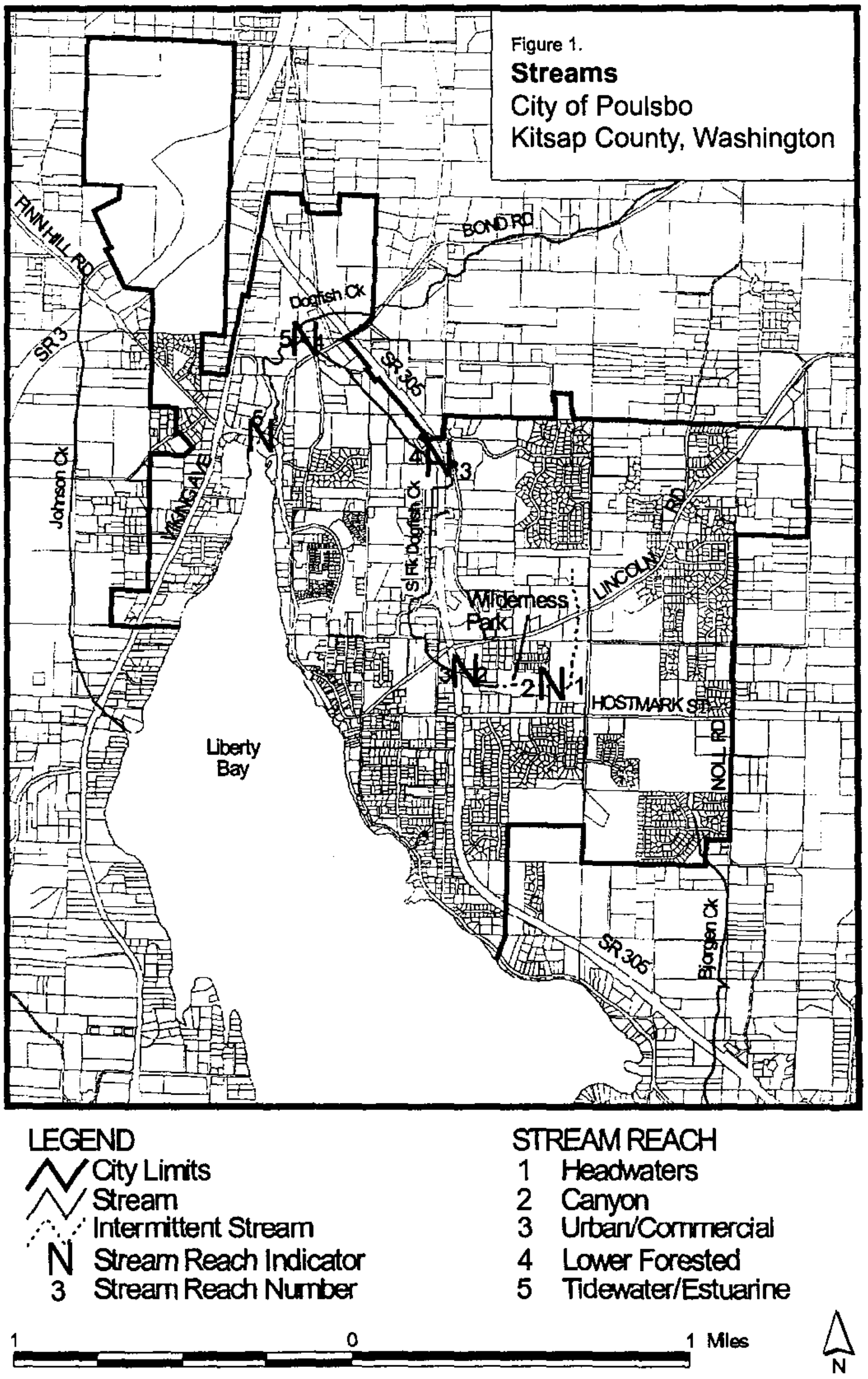
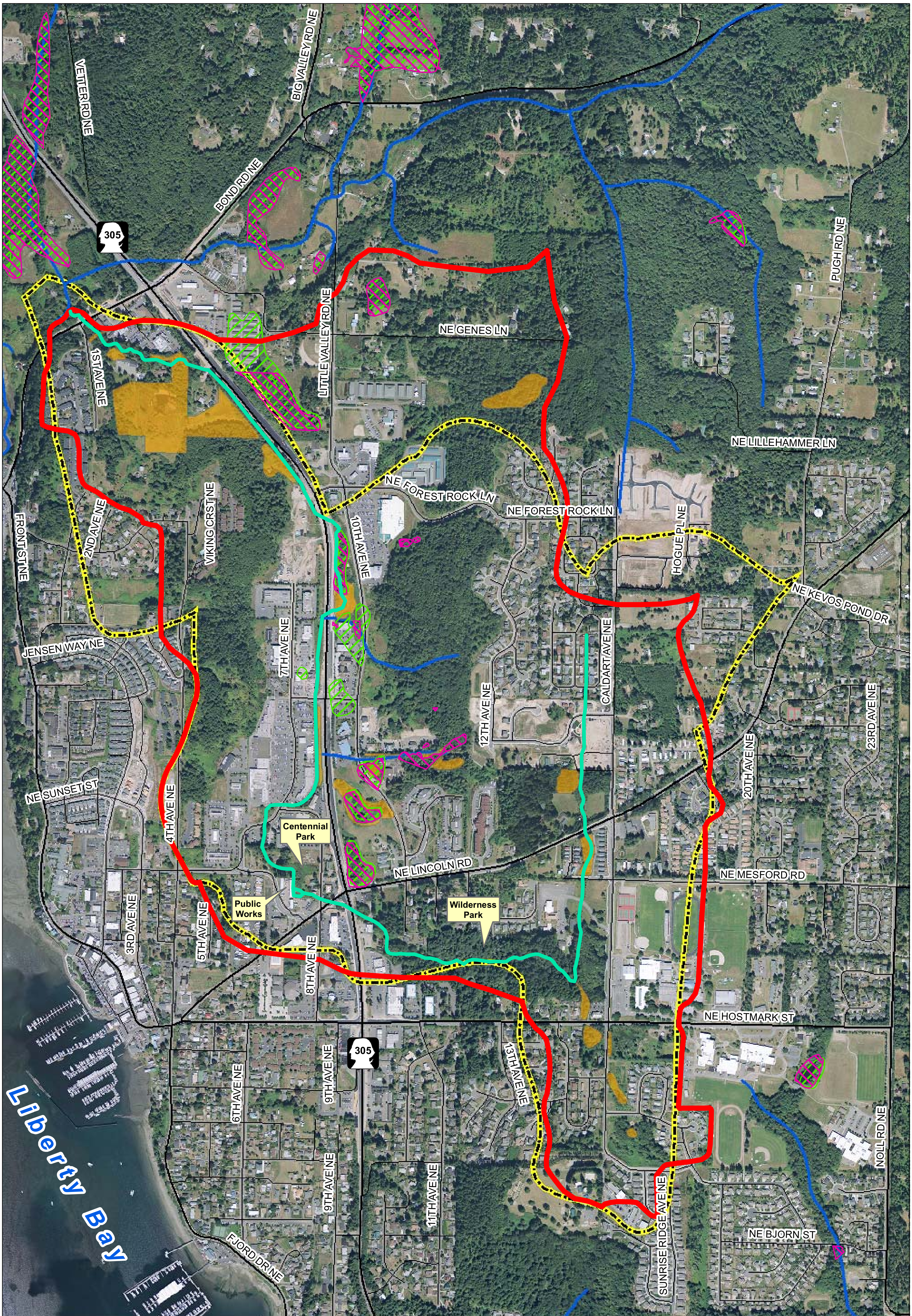


Figure 1.
Streams
City of Poulsbo
Kitsap County, Washington

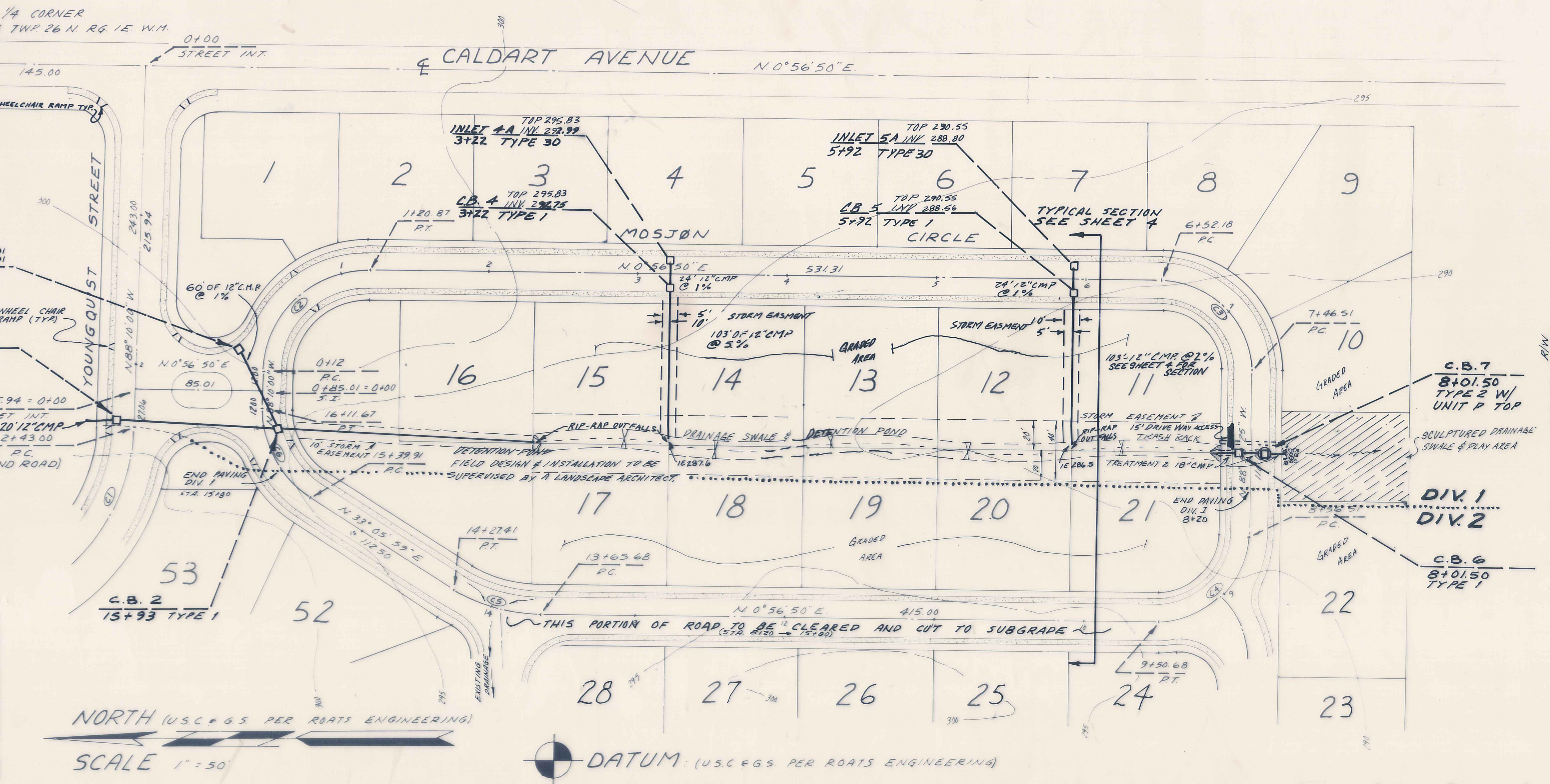


ICF INTERNATIONAL

Figure 2.
Existing Conditions
South Fork Dogfish Creek
Restoration Master Plan

July 2010

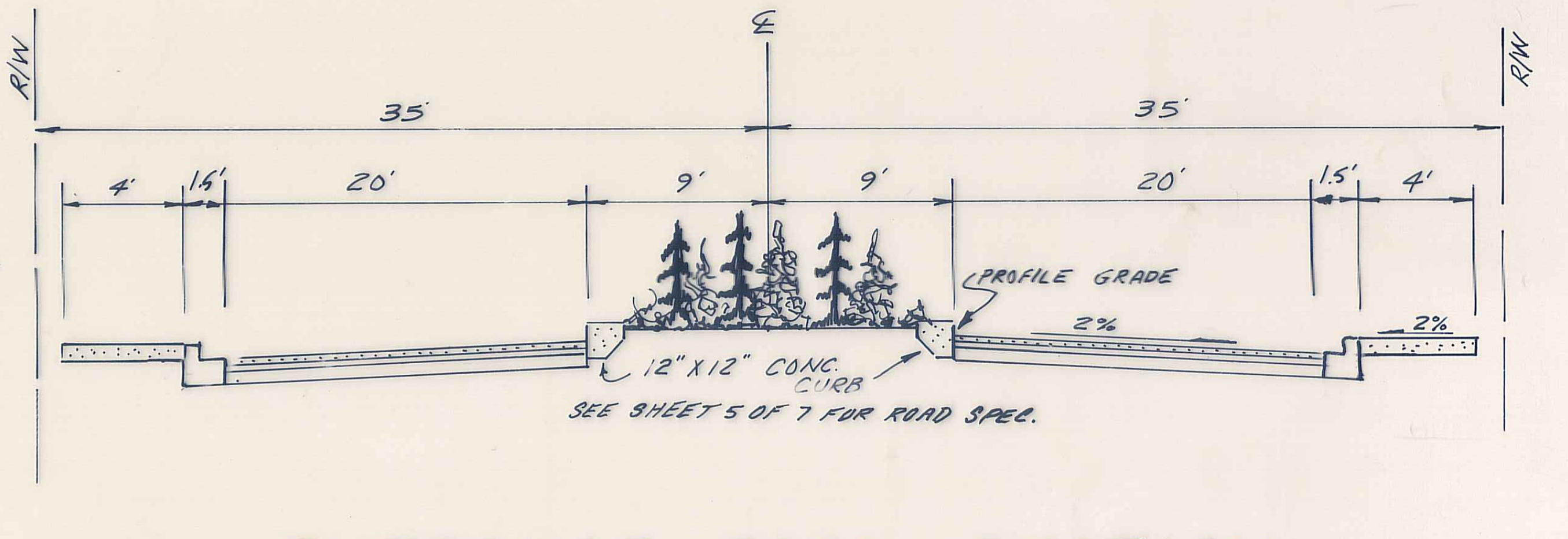
N.E. 1/4 S.E. 1/4 SEC. 14, TWP. 26 N., RG. 1 E., W.M.



CURVE DATA

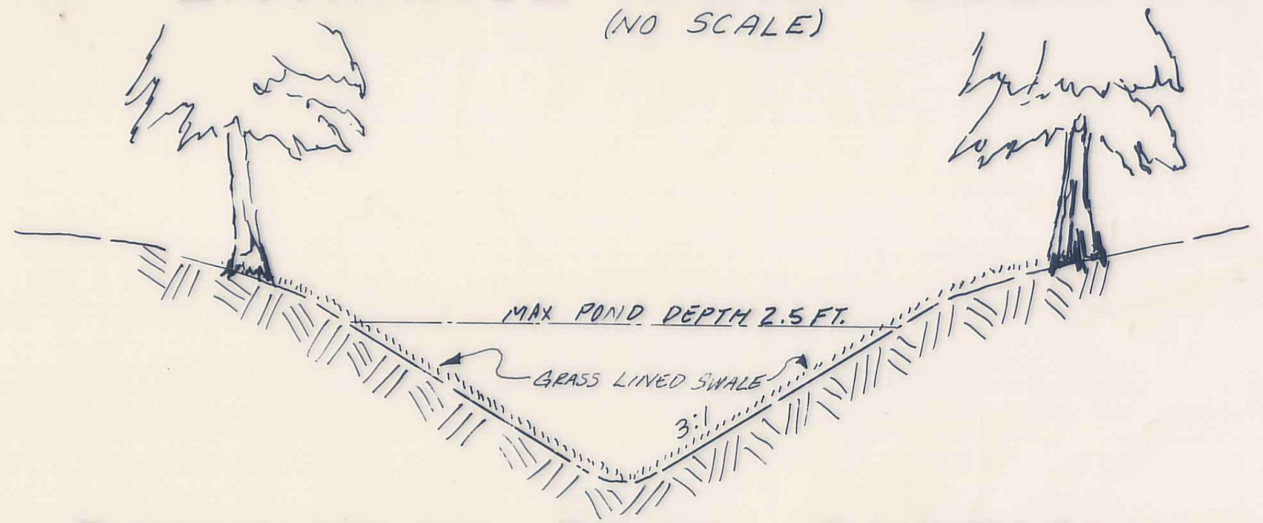
NO.	DELTA	RADIUS	ARC	CORD	TANG.
1	46°06'42"	130.386	104.94	102.13	55.50
2	89° 06'50"	70.00	108.87	98.23	68.93
3	90° 04' 45"	60.00	94.33	84.91	60.08
4	89° 55' 15"	60.00	94.17	84.79	59.92
5	32° 09' 09"	110.00	61.73	60.92	31.70
6	58° 44' 01"	70.00	71.76	68.66	39.39

DATUM (U.S.C.&G.S. PER ROATS ENGINEERING)



ENTRANCE ROAD SECTION

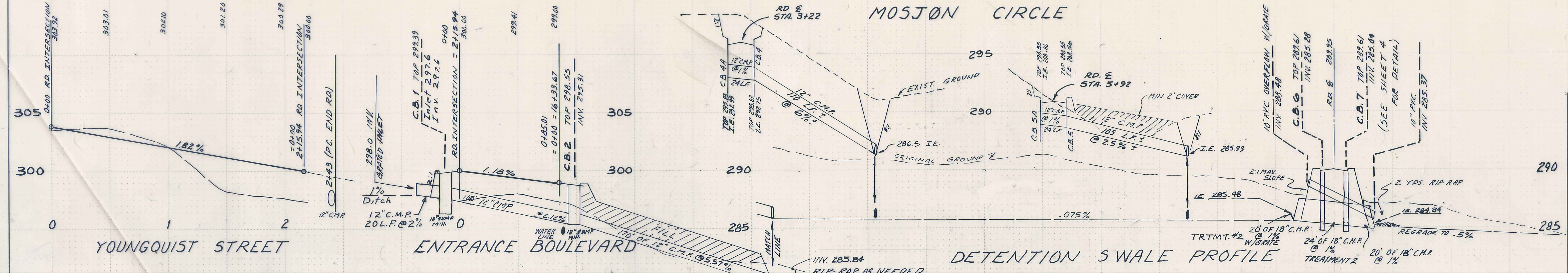
(NO SCALE)



DETENTION POND SECTION

(NO SCALE)

MOSJØN CIRCLE



YOUNGQUIST STREET   ENTRANCE BOULEVARD   DETENTION SWALE PROFILE

SCALE: HORZ. 1" = 50'
VERT. 1" = 5'

REVISED 5-6-86
Revised 4-17-86
REVISED 4-8-86

ROAD & DRAINAGE PLAN
POULSBO GARDENS DIV. I

FOR: STARKE INDUSTRIES
6535 SEAVIEW N.W.
SEATTLE WA. 98117

AS BUILT

JAMES D. EVANS
11757

TRITEC ASSOCIATES INC.
ENGINEERS • SURVEYORS • PLANNERS
P.O. BOX 906 • SILVERDALE, WASHINGTON 98383 • 692-6400
3472 N.W. LOWELL "OLD SILVERDALE"

Attachment E – Author Qualifications

Don Babineau

Environmental Planner/Project Manager
Professional Experience: >15 years

Don Babineau is an Environmental Planner and Project Manager with a diverse background in urban and commercial forestry, land planning, landscape architecture, stormwater monitoring and civil engineering. Don has experience as a Forester with Washington State Department of Natural Resources stream typing and delineating stream protection zones, as well as implementing Washington State's Habitat Conservation Plan to foster the creation of old-growth forest characteristics on state trust lands. Don currently provides permitting and regulatory compliance assistance for land use projects from their planning stages through review, approval, and construction. Don performs wetland and Ordinary High Water delineations; provides land use planning assistance for residential, commercial, and industrial projects; conducts code and regulation analysis; prepares reports and permit applications; and prepares restoration and mitigation plans. Don earned a Bachelor of Science degree in Forest Ecosystems Management and a Bachelor of Landscape Architecture degree, both from the University of Idaho.

Don has received 40-hour wetland delineation training (Western Mtns, Valleys, & Coast and Arid West Regional Supplement) and has been formally trained by the Washington State Department of Ecology in the use of the Washington State Wetland Rating System and How to Determine the Ordinary High Water Mark. In addition, he has experience as certified erosion and sediment control lead (CESCL). He is also a Pierce County qualified Professional Forester.

Jake Layman

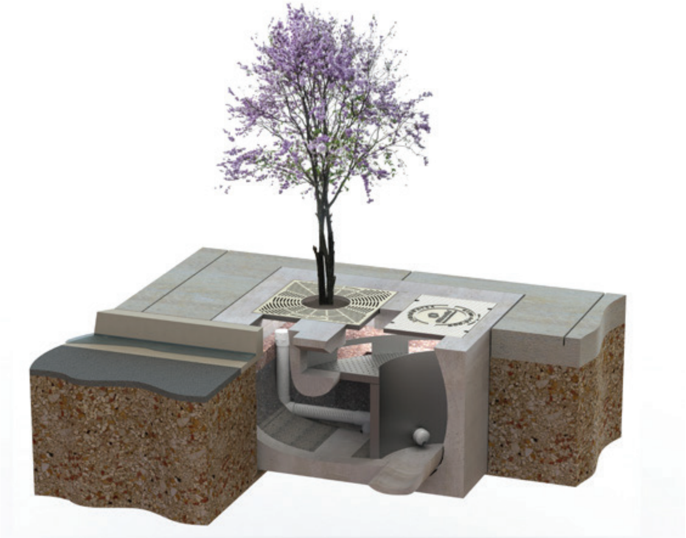
Environmental Scientist
Professional Experience: 10+ years

Jake Layman is an Environmental Scientist with a varied background in fisheries, wildlife, and aquatic invertebrate biology and stream and lake ecology. Jakes's expertise includes endangered species monitoring, lake limnology assessments, water chemistry profiles, off-channel habitat characterization, laboratory management, and terrestrial and aquatic amphibian identification with associated habitat assessments. Jake also has experience in fish population assessments, stream typing, spawning escapement, environmental disaster recovery, and amphibian toxicology research. Jake has over 10 years of experience at the federal and state level conducting ecological monitoring surveys throughout eastern and western Washington. He worked with the National Park Service to conduct environmental compliance monitoring on park construction projects, infrastructure maintenance projects, and federal highways projects. This position also included environmental spill response, fish exclusion surveys in support of construction, and effectiveness monitoring on Engineered Log Jam (ELJ) projects. Jake has worked with the Washington State Department of Fish and Wildlife (WDFW) to assess and inventory fish passage barriers and monitor culvert removal projects throughout Western Washington. Also while working for WDFW, Jake managed the daily operation for the intensive habitat study, on off-channel wetlands, for the Chehalis Aquatic Resources Protection Plan (ASRP).

Jake earned Bachelor's degrees in both Biology, with an Ecology specialization, and Geography, with a Natural Resource Management specialization, from Central Washington University. In addition, Jake also has a Minor in Environmental Studies and a Certificate in Geographic Information Systems (GIS) and Cartography form Central Washington University. Jake has received training from the Washington State Department of Ecology in *Environmental Negotiations*; *Navigating SEPA*, *Puget Sound Coastal Processes, Shoreline Modifications, and Beach Restoration*, and *Using the Marine Shoreline Design Guidelines for Marine Shoreline Stabilization*. Jake has electro-fisher operation and safety training from Smith-Root INC and Department of the Interior. (DOI). Jake also has *Operational Leadership Training* from DOI and *Leading with Integrity* training from WDFW.

BIOPOD™

SUBMITTAL PACKAGE



Oldcastle Infrastructure
(800) 579-8819
OldcastleStormwater.com

TABLE OF CONTENTS

SECTION 1

FEATURES & BENEFITS

Oldcastle Infrastructure™
A CRH COMPANY

Stormwater Treatment, NATURALLY

BIOPOD™ SYSTEM WITH STORMMIX™ MEDIA

Sustainable Green Infrastructure for Stormwater Management

BioPod systems utilize an advanced biofiltration design for filtration, sorption and biological uptake to remove Total Suspended Solids (TSS), dissolved metals, nutrients, gross solids, trash and debris as well as petroleum hydrocarbons from stormwater runoff. Environmentally friendly and aesthetically pleasing, BioPod systems are a proven, Low-Impact Development (LID) solution for stormwater treatment. BioPod systems integrate seamlessly into standard site drainage and can accommodate a wide variety of vegetation to meet green infrastructure requirements.

STANDARD SIZES

BioPod units are available in many standard and custom sizes to meet most site-specific requirements. Contact your local Oldcastle Infrastructure representative for additional sizes.

4′ x 4′
4′ x 6′
4′ x 8′
4′ x 10′
6′ x 6′
6′ x 8′
6′ x 12′
8′ x 16′

Oldcastle Infrastructure™
A CRH COMPANY

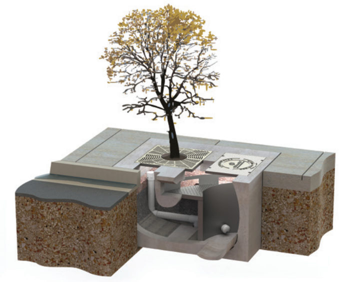
Stormwater Treatment,
NATURALLY

BIOPOD™ SYSTEM WITH STORMMIX™ MEDIA

BioPod systems use StormMix media, an engineered high-flow rate media (153 in/hr) to remove stormwater pollutants. The BioPod system has received a General Use Level Designation (GULD) approval from the Washington State Department of Ecology for Basic (TSS), Phosphorus, and Enhanced (dissolved metals) treatment.

State of Washington
TAPE
GULD
Basic
Enhanced/Metals
Phosphorus

Offering flexibility of design and construction for your storm drain system, the BioPod system comes as an all-in-one, single-piece unit composed of durable precast concrete for ease of installation and a long service life. The BioPod system is offered in four configurations:

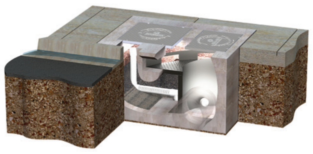


BIOPOD TREE

Vault with media and tree(s).

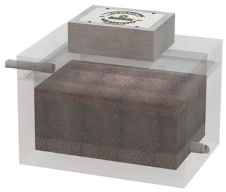
BIOPOD PLANTER

Vault with media and vegetation.



BIOPOD SURFACE

At-grade vault with media only, no vegetation.



BIOPOD UNDERGROUND

Below-grade vault with media only, no vegetation.

High-Flow Bypass

BioPod system offers an optional internal high-flow bypass that eliminates the need for a separate bypass structure, reducing costs and simplifying design so unit can be placed in a "sag" condition.

Hydromodification

BioPod system can be used in conjunction with other Oldcastle detention systems to address hydromodification and water treatment requirements. Collected flows may be utilized to supplement irrigation of the unit or surrounding vegetated areas by integrating a harvesting system, reducing consumption of local potable water.

LEED WITH BIOPOD

Can assist in earning LEED credits for:

- Sustainable Sites (6.1, 6.2)
- Water Efficiency (1.1, 1.2, 3.1, 3.2)
- Materials & Resources (4.1, 4.2; 5.1, 5.2 in AZ, CA, NV, UT)

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SECTION 2

WA ECOLOGY GULD APPROVAL

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

May 2019

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), DISSOLVED METALS (ENHANCED), AND PHOSPHORUS TREATMENT

For

Oldcastle Infrastructure, Inc.'s
The BioPod™ Biofilter
(Formerly the TreePod Biofilter)

Ecology's Decision:

Based on Oldcastle Infrastructure, Inc. application submissions for the The BioPod™ Biofilter (BioPod), Ecology hereby issues the following use level designation:

1. **General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus Treatment:**
   - **Sized at a hydraulic loading rate of 1.6 gallons per minute (gpm) per square foot (sq ft) of media surface area.**
   - **Constructed with a minimum media thickness of 18-inches (1.5-feet).**

2. **Ecology approves the BioPod at the hydraulic loading rate listed above, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**
   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**
   - **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
   - **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **The GULD has no expiration date, but may be amended or revoked by Ecology.**

Ecology's Conditions of Use:

The BioPod shall comply with these conditions:

1) **Applicants shall design, assemble, install, operate, and maintain the BioPod installations in accordance with Oldcastle Infrastructure, Inc.'s applicable manuals and the Ecology Decision.**

2) **BioPod media shall conform to the specifications submitted to and approved by Ecology**

3) **Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

    - **The BioPod is designed for a target maintenance interval of 1 year. Maintenance includes replacing the mulch, assessing plant health, removal of trash, and raking the top few inches of engineered media.**
    - **A BioPod system tested at the Lake Union Ship Canal Test Facility in Seattle, WA required maintenance after 1.5 months, or 6.3% of a water year. Monitoring personnel observed similar maintenance issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may be unusual and maintenance requirements of systems installed at the Test Facility may not be indicative of maintenance requirements for all sites.**
    - **Test results provided to Ecology from a BioPod System evaluated in a lab following New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs have indicated the BioPod System is capable of longer maintenance intervals.**
    - **Owners/operators must inspect BioPod systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
    - **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.**

4) Install the BioPod in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.

5) Discharges from the BioPod shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Oldcastle Infrastructure, Inc.

Applicant's Address:
7100 Longe St, Suite 100
Stockton, CA 95206

Application Documents:

Technical Evaluation Report TreePod™ BioFilter System Performance Certification Project, Prepared for Oldcastle, Inc., Prepared by Herrera Environmental Consultants, Inc. February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., February 2018

Technical Memorandum: Response to Board of External Reviewers' Comments on the Technical Evaluation Report for the TreePod™ Biofilter System Performance Certification Project, Oldcastle, Inc. and Herrera Environmental Consultants, Inc., January 2018

Application for Pilot Use Level Designation, TreePod™ Biofilter – Stormwater Treatment System, Oldcastle Stormwater Solutions, May 2016

Emerging Stormwater Treatment Technologies Application for Certification: The TreePod™ Biofilter, Oldcastle Stormwater Solutions, April 2016

Applicant's Use Level Request:

- General Use Level Designation as a Basic, Enhanced, and Phosphorus Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims the BioPod™ Biofilter operating at a hydraulic loading rate of 153 inches per hour is able to remove:

- 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 60% dissolved zinc for influent concentrations 0.02 to 0.3 mg/L.
- 30% dissolved copper for influent concentrations 0.005 to 0.02 mg/L.

- 50% or greater total phosphorus for influent concentrations 0.1 to 0.5 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Oldcastle Infrastructure, Inc. has shown Ecology, through laboratory and field testing, that the BioPod™ Biofilter is capable of attaining Ecology's Basic, Total Phosphorus, and Enhanced treatment goals.

Findings of Fact:

Field Testing

1. Herrera Environmental Consultants, Inc. conducted monitoring of the BioPod™ Biofilter at the Lake Union Ship Canal Test Facility in Seattle Washington between November 2016 and April 2018. Herrera collected flow-weight composite samples during 14 separate storm events and peak flow grab samples during 3 separate storm events. The system was sized at an infiltration rate of 153 inches per hour or a hydraulic loading rate of 1.6 gpm/ft^2.
2. The D_{50} of the influent PSD ranged from 3 to 292 microns, with an average D_{50} of 28 microns.
3. Influent TSS concentrations ranged from 17 mg/L to 666 mg/L, with a mean concentration of 98 mg/L. For all samples (influent concentrations above and below 100 mg/L) the bootstrap estimate of the lower 95 percent confidence limit (LCL 95) of the mean TSS reduction was 84% and the bootstrap estimate of the upper 95 percent confidence limit (UCL95) of the mean TSS effluent concentration was 8.2 mg/L.
4. Dissolved copper influent concentrations from the 17 events ranged from 9.0 µg/L to 21.1 µg/L. The 21.1 µg/L data point was reduced to 20.0 µg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean dissolved copper reduction was 35%.
5. Dissolved zinc influent concentrations from the 17 events ranged from 26.1 µg/L to 43.3 µg/L. A bootstrap estimate of the LCL95 of the mean dissolved zinc reduction was 71%.
6. Total phosphorus influent concentrations from the 17 events ranged from 0.064 mg/L to 1.56 mg/L. All influent data greater than 0.5 mg/L were reduced to 0.5 mg/L, the upper limit to the TAPE allowed influent concentration range, prior to calculating the pollutant removal. A bootstrap estimate of the LCL95 of the mean total phosphorus reduction was 64%.
7. The system experienced rapid sediment loading and needed to be maintained after 1.5 months. Monitoring personnel observed similar sediment loading issues with other systems evaluated at the Test Facility. The runoff from the Test Facility may not be indicative of maintenance requirements for all sites.

Laboratory Testing

1. Good Harbour Laboratories (GHL) conducted laboratory testing at their site in Mississauga, Ontario in October 2017 following the New Jersey Department of Environmental Protection Laboratory Protocol for Filtration MTDs. The testing evaluated a 4-foot by 6-foot standard biofiltration chamber and inlet contour rack with bypass weir. The test sediment used during

the testing was custom blended by GHL using various commercially available silica sands, which had an average d_{50} of 69 µm. Based on the lab test results:

   a. GHL evaluated removal efficiency over 15 events at a Maximum Treatment Flow Rate (MTFR) of 37.6 gpm, which corresponds to a MTFR to effective filtration treatment area ratio of 1.80 gpm/ft^2. The system, operating at 100% of the MTFR with an average influent concentration of 201.3 mg/L, had an average removal efficiency of 99 percent.
   b. GHL evaluated sediment mass loading capacity over an additional 16 events using an influent SSC concentration of 400 mg/L. The first 11 runs were evaluated at 100% of the MTFR. The BioPod began to bypass, so the remaining 5 runs were evaluated at 90% of the MTFR. The total mass of the sediment captured was 245.0 lbs and the cumulative mass removal efficiency was 96.3%.

2. Herrera Environmental Consultants Inc. conducted laboratory testing in September 2014 at the Seattle University Engineering Laboratory. The testing evaluated the flushing characteristics, hydraulic conductivity, and pollutant removal ability of twelve different media blends. Based on this testing, Oldcastle Infrastructure, Inc. selected one media blend, Mix 8, for inclusion in their TAPE evaluation of the BioPod™ Biofilter.
   a. Herrera evaluated Mix 8 in an 8-inch diameter by 36-inch tall polyvinyl chloride (PVC) column. The column contained 18-inches of Mix 8 on top of 6-inches of pea gravel. The BioPod will normally include a 3-inch mulch layer on top of the media layer; however, this was not included in the laboratory testing.
   b. Mix 8 has a hydraulic conductivity of 218 inches per hour; however, evaluation of the pollutant removal ability of the media was based on an infiltration rate of 115 inches per hour. The media was tested at 75%, 100%, and 125% of the infiltration rate. Based on the lab test results:
      - The system was evaluated using natural stormwater. The dissolved copper and dissolved zinc concentrations in the natural stormwater were lower than the TAPE influent standards; therefore, the stormwater was spiked with 66.4 mL of 100 mg/L Cu solution and 113.6 mL of 1,000 mg/L Zn solution.
      - The BioPod removed an average of 81% of TSS, with a mean influent concentration of 48.4 mg/L and a mean effluent concentration of 9.8 mg/L.
      - The BioPod removed an average of 94% of dissolved copper, with a mean influent concentration of 10.6 µg/L and a mean effluent concentration of 0.6 µg/L.
      - The BioPod removed an average of 97% of dissolved zinc, with a mean influent concentration of 117 µg/L and a mean effluent concentration of 4 µg/L.
      - The BioPod removed an average of 97% of total phosphorus, with a mean influent concentration of 2.52 mg/L and a mean effluent concentration of 0.066 mg/L. When total phosphorus influent concentrations were capped at the TAPE upper limit of 0.5 mg/L, calculations showed an average removal of 87%.

Other BioPod Related Issues to be Addressed By the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at https://oldcastleprecast.com/stormwater/bioretention-biofiltration-applications/bioretention-biofiltration-solutions/

Contact Information:

Applicant:

Chris Demarest
Oldcastle Infrastructure, Inc.
(925) 667-7100
Chris.demarest@oldcastle.com

Applicant website: https://oldcastleprecast.com/stormwater/

Ecology web link: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Ecology:

Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	**Revision**
March 2018	GULD granted for Basic Treatment
March 2018	Provisional GULD granted for Enhanced and Phosphorus Treatment
June 2016	PULD Granted
April 2018	GULD for Basic and Provisional GULD for Enhanced and Phosphorus granted, changed name to BioPod from TreePod
July 2018	GULD for Enhanced and Phosphorus granted
September 2018	Changed Address for Oldcastle
December 2018	Added minimum media thickness requirement
May 2019	Changed language on who must Install and maintain the device from Oldcastle to Applicants

SECTION 3

INSPECTION & MAINTENANCE

Oldcastle Infrastructure™
A CRH COMPANY

BIOMOD®

MODULAR BIORETENTION SYSTEM

Maintenance Specifications

DRAINAGE PROTECTION SYSTEMS
DPS

A division of
Oldcastle Infrastructure

Water

Scope

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that post-construction stormwater Best Management Practices (BMPs) be performed on a recurring basis. The intent of the regulations is to ensure that the BMPs, on a continuing basis, efficiently remove pollutants from stormwater runoff, thereby preventing pollution of the nation's water resources. These requirements apply to the BioMod Modular Bioretention System.

Recommended Frequency of Service

Properly designed and installed bioretention cells require some regular maintenance, most frequently during the first year or two of establishment. Oldcastle Infrastructure recommends that installed BioMod units be inspected and serviced on a recurring basis for sediment buildup, trash removal, erosion, and to evaluate the health of the vegetation. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris and litter; however, it is recommended that each installation be serviced at least two times per year. Drainage Protection Systems (DPS), a division of Oldcastle Infrastructure, is available to do an onsite evaluation upon request.

Recommended Timing of Service

Guidelines for the timing of service are as follows:

1. For areas with a definitive rainy season: Prior to and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least two times per year).
3. For areas with winter snow and summer rain: Prior to and after the snow season.
4. For installed devices not subject to the elements (wash racks, parking garages, etc.): On a recurring basis (no less than two times per year).

Service Procedures

1. Bioretention cells will require supplemental irrigation during the first 2-3 years after planting. Drought tolerant species may need little additional water after this period, except during prolonged drought, when supplemental irrigation may become necessary for plant survival. Verify that the maintenance plan includes a watering schedule for the establishment period and in times of extreme drought after plants have been established.
2. Inspect the inlet surface adjacent to the BioMod unit and the inlet opening for trash and debris accumulation. Remove and dispose as required.
3. For units with pre-filtration, open the access cover of the pre-filtration chamber and inspect for collected pollutants. Remove and dispose of all materials. (Pre-filtration chamber allows for the use of industrial vacuum equipment if available). Close pre-filter access cover.
4. For units with internal bypass overflow screens, check for any blockage or obstructions to the flow path and remove as necessary. Check for any potential future blockage or obstruction beneath and around the overflow screens. Remove and dispose of all materials.
5. Inspect the area beneath the tree grate (when applicable), and if necessary, remove the tree grate and dispose of any collected trash or debris.
6. For units without pre-filtration, remove and replace the mulch layer as necessary, taking care to disturb the plant's roots as little as possible. Units without pre-filtration may see more sediment enter the system. If sediment buildup reaches 25% of the ponding depth, it should be removed, taking care to minimize soil disturbance.

7. Inspect for standing water. If present, or if soil media is appreciably moist more than 72 hours following a rain event, carefully remove and replace the top 4-6 inches of soil media (as well as the mulch layer) taking care to disturb the plant's roots as little as possible. Mulch should be re-applied when erosion is evident. In areas expected to have low metal loads in the runoff, mulch is needed to maintain a 2-3 inch depth. In areas with relatively high metal loads, replace the mulch once per year.
8. While vegetation is being established, remove weeds by hand (weeding frequency should decrease over time, as the vegetation grows). Inspect and prune the plants as needed to maintain adequate shape and health. If vegetation appears to be in poor health with no obvious cause, a landscape specialist should be consulted. Although occasional pruning or trimming might be needed, bioretention cells should generally not be mowed on a regular basis. In some instances where it is desired to maintain fast-growing, annual herbaceous plant cover, annual mowing may be appropriate.
9. Replace dead plants. If a particular species proves to be prone to mortality, it may need to be replaced with a different species that is more likely to succeed on the particular site.

Disposal of Collected Debris, Hydrocarbons and Sediment

The collected debris, hydrocarbons and sediment shall be disposed of in accordance with local, state and federal agency requirements. Where hazardous materials are encountered, these standard maintenance procedures will be ceased immediately and the property owner notified for further work authorization.

DPS also has the capability of servicing all manner of catch basin inserts and catch basins with or without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined-space trained and certified. Call us at (888) 950-8826 for further information and assistance.

BIOMOD®

MODULAR BIORETENTION SYSTEM

OUR MARKETS

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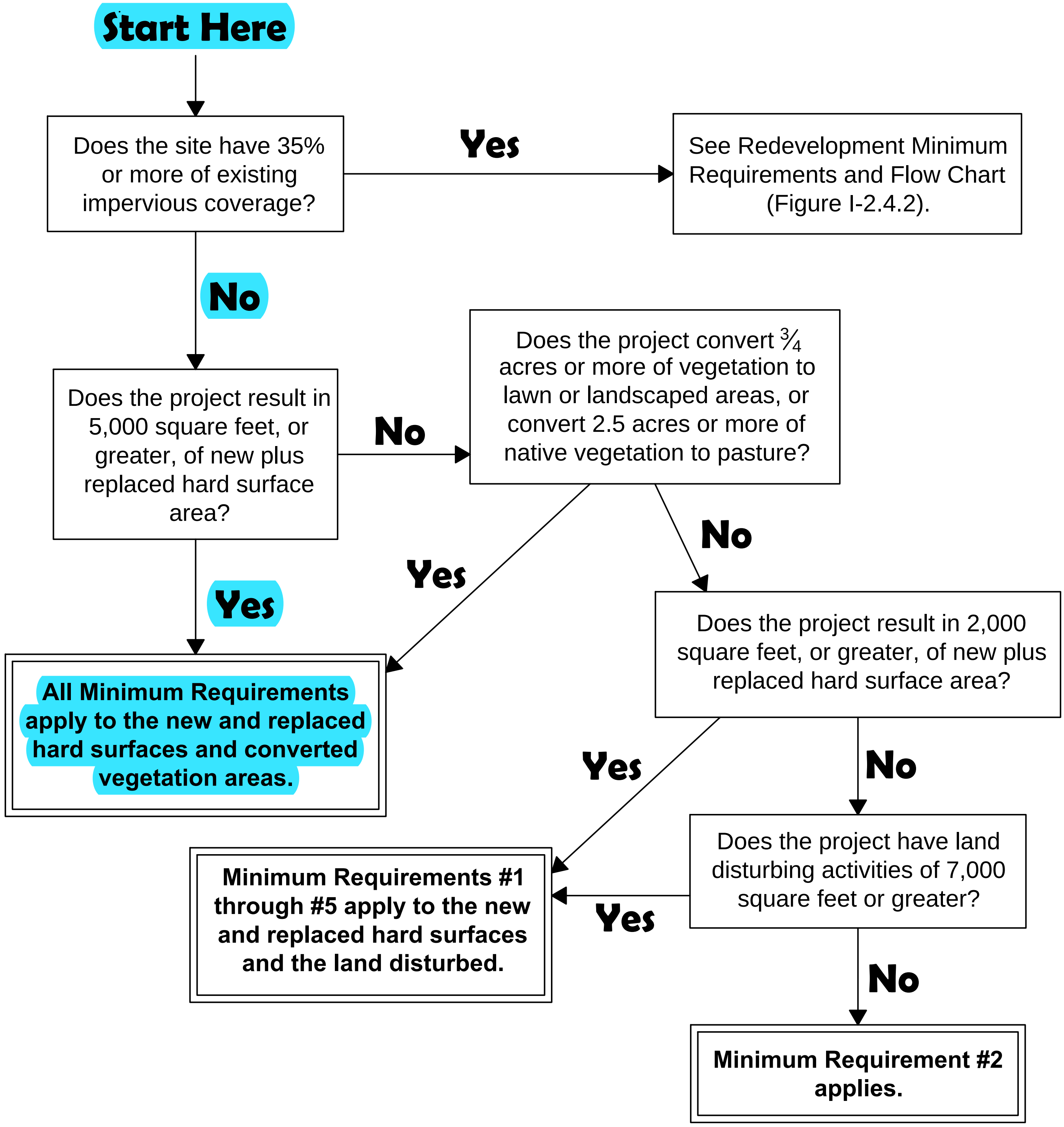
Water
December 2018 v.1

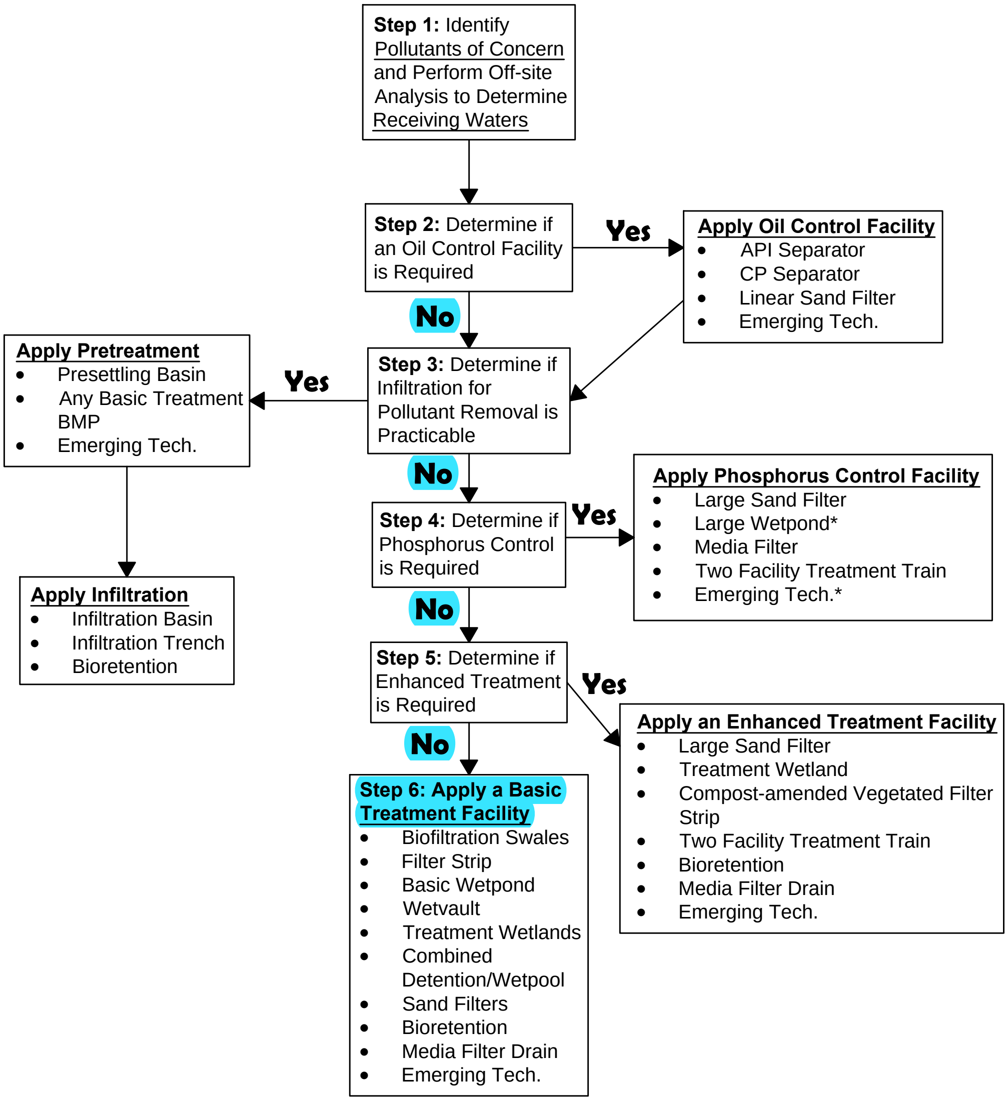


DEPARTMENT OF
ECOLOGY
State of Washington

Figure I-2.4.1
Flow Chart for Determining Requirements for New Development

Revised June 2015

Figure V-2.1.1 Treatment Facility Selection Flow Chart



*When **Phosphorus Control and Enhanced** treatment are required, the Large Wetpond and certain types of emerging technologies will not meet both types of treatment requirements. A different or an additional treatment facility will be required to meet Enhanced treatment.

DEPARTMENT OF
ECOLOGY
State of Washington

Figure V-2.1.1
Treatment Facility Selection Flow Chart

Revised December 2015