Attachment 15

MARCH 31, 2026

DRAINAGE DESIGN REPORT

KAISER WOODS PARK DEVELOPMENT

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Property owner:	City of Olympia Parks, Arts and Recreation Department PO Box 1967 Olympia, WA 98507
Reference:	2022 City of Olympia Drainage Design and Erosion Control Manual (DDECM)

PROJECT ENGINEER'S CERTIFICATION

"I hereby certify that this Stormwater Site Plan for **Kaiser Woods Park Development** has been prepared under my supervision and meets minimum standards of the **City of Olympia Drainage Design and Erosion Control Manual** and normal standards of engineering practice."

(To be signed at engineering permit application)

DRAINAGE DESIGN REPORT

SECTION 1 – PROPOSED PROJECT DESCRIPTION

DESCRIPTION OF PERMIT APPLICATION & PROJECT SCOPE

Kaiser Woods Park consists of 11 parcels that cover approximately 77.6 acres in southwest Olympia including about 6.5 acres of right-of-way. The park has existing trails used for walking and biking, however, the majority of the park is undeveloped. There are currently two public access locations into the park: one at the end of Park Drive Southwest and one through an existing gravel access lane off Black Lake Boulevard. There are additional trail connections through surrounding private properties. The park has frontage on Park Drive to the east and Black Lake Boulevard to the southeast. It has undeveloped City of Olympia right-of-way to the west and south. The existing gravel access lane runs from Black Lake Boulevard to the southwest border of the park. It is used infrequently by the owners of the property to the west (Manke), Puget Sound Energy employees and those parking to access the Hope Community Church. The park contains three wetlands and two seasonal streams.

The proposed improvements consist of:

- 1,000-foot long paved access lane off Black Lake Boulevard
- Parking lot with 25 spaces including one ADA van accessible space
- Restroom with municipal water connection and storage vault for wastewater
- Frontage improvements on Black Lake Boulevard
- 3.5 miles of new trails for biking, hiking or shared use. New and existing trails will have hard-packed earth or gravel surfacing.
- 1.9 miles of maintenance on existing trails. Inside critical area buffers, only maintenance will occur which is exempt from the critical area requirements, per OMC 18.32.111. Outside critical area buffers, existing trails may by widened.
- 0.4 miles of existing trails to be abandoned
- Bicycle pump track for intermediate and advanced riders
- Bicycle skill station for intermediate and advanced riders
- Bicycle skill station for beginners
- Bicycle pump track for beginners

See Overall Site Map in Appendix A. The current permit application is for conditional use permit (CUP) and land use approval. A future permit application will be submitted for civil engineering.

A full ***Stormwater Site Plan*** is required for the Engineering permit issued by City of Olympia Community Planning & Development Department, per Figure I-3.1 in Volume 1 of the 2022 City of Olympia Drainage Design and Erosion Control Manual (DDECM). This draft *Drainage Design Report* is a component of that plan and meets the requirements of Volume I of the DDECM. The final report will be submitted with the civil engineering permit applications to the City of Tumwater and the City of Olympia.

SITE DATA

Site Address:	2549 Black Lake Boulevard SW Tumwater, WA 98501
Assessor Parcel Number(s):	12820420000, 12820420100, 12820420200, 12820420300, 12820420400, 12820420500, 12820430000, 12820430100, 12820430200, 12820430300, 12829120400

Abbreviated Legal Description:	See Table 1 below.
Olympia Zoning:	Residential Low Impact (RLI)
Tumwater Zoning:	Light Industrial (LI)
Site Use:	City Park
Site Area (all parcels):	71.1 acres
Park Area:	77.6 acres (includes 6.5 acres of right-of-way)
Project Area (disturbed land)	*2.9 acres*

Table 1: Abbreviated Legal Descriptions

Parcel Number	*Abbreviated Legal Description*
12820420000	Section 20 Township 18 Range 2W Quarter N2 NW SE LESS ROW 4657083
12820420100	20-18-2W NE-SW-SE LESS 4.90
12820420200	20-18-2W N2-SE-NW-SE
12820420300	Section 20 Township 18 Range 2W Quarter S2-SW-NW-SE LESS ROW 4657083
12820420400	Section 20 Township 18 Range 2W S2-SE-NW-SE
12820420500	Section 20 Township 18 Range 2W N2-SW-NW-SE LESS ROW 4657083
12820430000	Section 20 Township 18 Range 2W S2 SW-SE LESS PT PLATTED LESS ROW 4657083
12820430100	Section 20 Township 18 Range 2W N2-NW-SW-SE LESS ROW 4657083
12820430200	Section 20 Township 18 Range 2W S2-NW-SW-SE LESS ROW 4657083
12820430300	29-18-2W NW NW & NE NE NKA PTN TRACT B BLA-1363 13/583
12829120400	29-18-2W NW NE N 60F KA PTN TRACT B BLA-1363 13/587

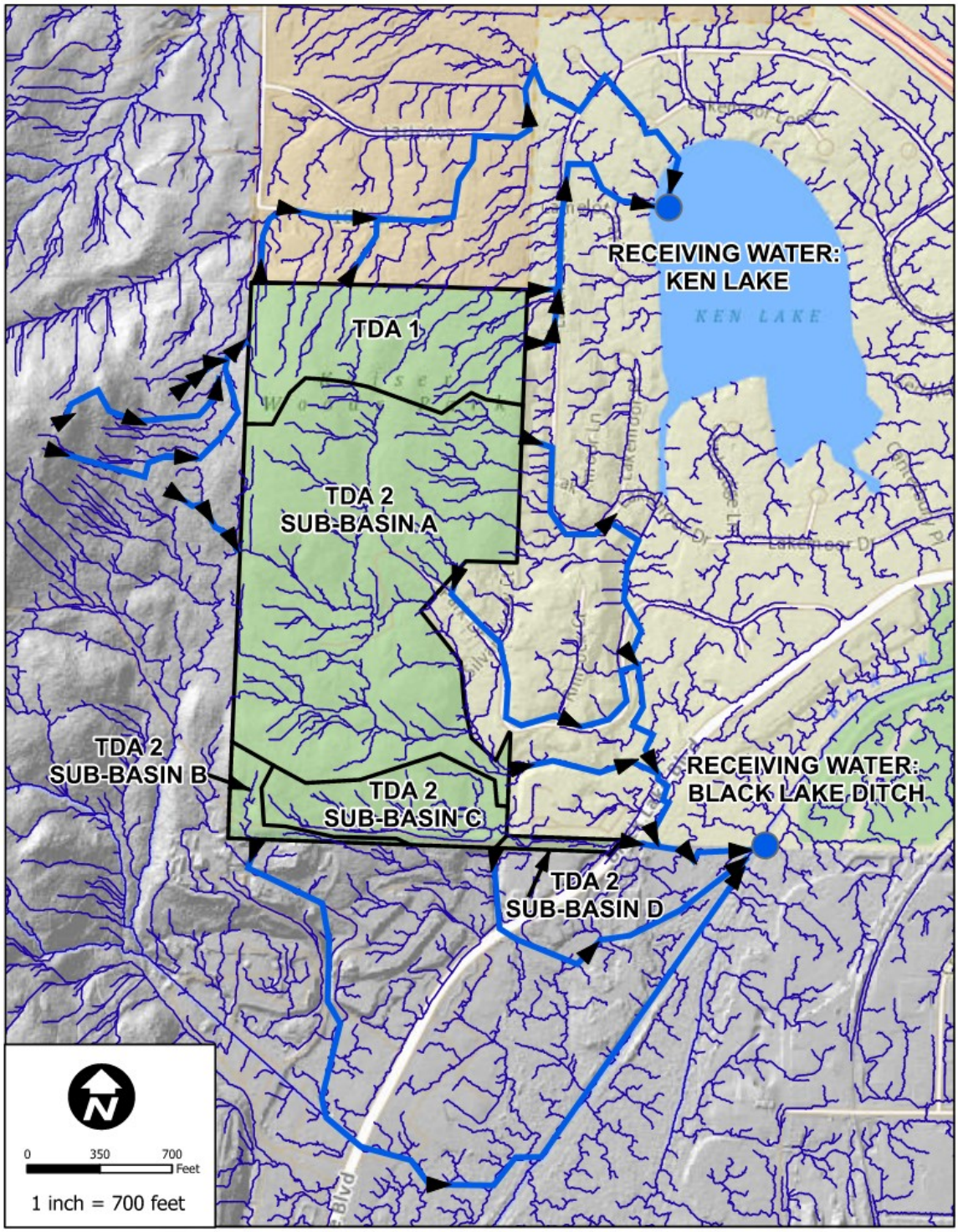
PROJECT DEVELOPMENT COVERAGE SUMMARY

Kaiser Woods Park consists of a mostly forested park area with existing trails throughout the park. The majority of the park area is heavily vegetated with large deciduous and conifer trees as well as a heavy underbrush layer consisting of vegetation native to the region as well as some non-native vegetation. The site slopes generally downward from the west to the east. Figure 1 shows a map of the project basin areas evaluated below.

The west boundary of the park has power lines running north-south in an unopened transportation right-of-way.

At the south end of the park are two parcels in the City of Tumwater, as well as an unopened City of Olympia right-of-way, that are not as heavily forested. There is an existing 9-foot-wide gravel access lane, most of which is built above underlying Crescent Formation basalt, according to the geologic map from the WA Department of Natural Resources. According to consultant Krazan & Associates, in one section of the existing roadway, the road appears to have been built upon a ridge of rock spall fill over bedrock.

Figure 1: Basin Map – Predeveloped and Post-Developed



Note: Drainage pattern and TDA boundaries will not be changed by the project.

The proposed access lane and parking lot will create new pollutant-generating impervious surfaces (PGIS). These areas are listed in Tables 2A and 2B and are used to determine the applicable Core Requirements for the project. Hard packed soil surfaces are not listed in the definition of pollution-generating impervious surfaces (PGIS) in the DDECM glossary, however, soil could be a pollutant if it enters waters of the state. For the purposes of this project, hard packed soil surfaces will be counted as PGIS.

Table 2A – Project Area and TDA Land Cover Summary

	TDA 1	***TDA 2***[1]	***Total***
Site Area[2]	*18.08 ac*	*59.51 ac*	*77.59 ac*
Project Area[3]	*0.40 ac*	*2.64 ac*	*2.90 ac*
Existing Impervious Area	*0.42 ac*	*1.93 ac*	*2.35 ac*
Percent of Site that is Existing Impervious Surfaces	*2.3%*	*3.2%*	*3.0%*
New Impervious Surfaces (New NPGIS and PGIS)	*0.31 ac*	*1.85 ac*	*2.16 ac*
Replaced Impervious Surfaces (Replaced NPGIS and PGIS)	*0.00 ac*	*0.34 ac*	*0.34 ac*
Maintained Impervious Surfaces	*0.37 ac*	*1.50 ac*	*1.87 ac*
Removed Impervious Surfaces (abandoned trails)	*0.05 ac*	*0.09 ac*	*0.14 ac*
Total Site Impervious Area after Project	*0.68 ac*	*3.69 ac*	*4.37 ac*
Percent of Site that will have Impervious Surfaces after Project	*3.8%*	*6.2%*	*5.6%*
Converted vegetation areas	*0.05 ac*	*0.09 ac*	*0.14 ac*
Undisturbed areas (Site minus project area minus maintained impervious areas)	*17.31 ac*	*55.37 ac*	*72.82 ac*
Percent of site undisturbed	*95.7%*	*93.0%*	*93.9%*

[1] *Table 2B denotes sub-basin breakdown of TDA 2 areas.*

[2] *The Site is defined as all legal tax parcels that contain the project activity. The table includes both the parcels in Olympia and Tumwater, as well as the affected rights-of-way.*

[3] *The Project Area is defined as the area of land disturbing activity within the Site. It includes trails to be abandoned but does not include trails being maintained but not altered.*

Table 2B – TDA 2 Sub-Basin Land Cover

	Sub-basin A	*Sub-basin B*	*Sub-basin C*	*Sub-basin D*	*TDA 2 Total*
Site Area (in TDA 2)	*47.80 ac*	*2.20 ac*	*8.74 ac*	*0.77 ac*	*59.51 ac*
Project Area	*1.31 ac*	*0.14 ac*	*0.87 ac*	*0.32 ac*	*2.64 ac*
Existing Impervious Area	*1.29 ac*	*0.11 ac*	*0.31 ac*	*0.22 ac*	*1.93 ac*
Percent of Site that is Existing Impervious Surfaces	*2.7%*	*5.0%*	*3.5%*	*28.6%*	*3.2%*
New Impervious Surfaces (New NPGIS and PGIS)	*1.10 ac*	*0.01 ac*	*0.64 ac*	*0.10 ac*	*1.85 ac*
Replaced Impervious Surfaces (Replaced NPGIS and PGIS)	*0.00 ac*	*0.00 ac*	*0.15 ac*	*0.19 ac*	*0.34 ac*
Maintained Impervious Surfaces	*1.20 ac*	*0.11 ac*	*0.16 ac*	*0.03 ac*	*1.50 ac*
Removed Impervious Surfaces (abandoned trails)	*0.09 ac*	*0.00 ac*	*0.00 ac*	*0.00 ac*	*0.09 ac*
Total TDA 2 Impervious Area after Project	*2.30 ac*	*0.12 ac*	*0.94 ac*	*0.33 ac*	*3.69 ac*
Percent of TDA 2 that will have Impervious Surfaces	*4.8%*	*5.5%*	*10.8%*	*42.9%*	*6.2%*
Converted Vegetation Areas	*0.09 ac*	*0.00 ac*	*0.00 ac*	*0.00 ac*	*0.09 ac*
Undisturbed areas (Site minus project area minus maintained impervious areas)	*45.29 ac*	*1.95 ac*	*7.71 ac*	*0.42 ac*	*55.37 ac*
Percent of site undisturbed	*94.7%*	*88.6%*	*88.2%*	*54.5%*	*93.0%*

APPLICABLE CORE REQUIREMENTS

The project has been evaluated against the development coverage thresholds of the DDECM, Volume I. The site has less than 35% existing impervious surface, as indicated in Table 2A above, and therefore has been evaluated as a new development project per Figure I-3.1 of the DDECM.

Development within the project limits proposes more than 5,000 square feet of new plus replaced impervious surface, as indicated in Table 2A above, and therefore must prepare a Stormwater Site Plan that addresses all nine of the Core Requirements listed in DDECM Volume I, Section I-3. All requirements apply to the new and replaced hard surfaces and converted vegetation areas, per Fig. I-3.1, Volume I, DDECM.

CORE REQUIREMENT #1 – PREPARATION OF STORMWATER SITE PLANS

Core Requirement #1 is met through preparation of a complete Stormwater Site Plan, meeting Section III-3 in Volume III of the DDECM. This report meets the Drainage Design Report requirement of that section.

CORE REQUIREMENT #2 – CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (C-SWPPP)

All projects are required to have a Construction Stormwater Pollution Prevention Plan (C-SWPPP) to fulfill Core Requirement #2. A full C-SWPPP will be submitted with the Engineering Plan Review permit applications as a separate submittal. Construction stormwater best management practices (BMPs) are also identified in the construction plan set with appropriate details and notes as necessary. Coverage under Ecology's Construction Stormwater General Permit (CSWGP) is required for this project as the disturbed project area is more than one acre.

In addition, the following erosion and sediment control measures should be implemented and maintained throughout construction, and revegetation should comply with local regulations:

- Clearing limits shall be shown on the plans and marked in the field prior to clearing and grading activities. Clearing/disturbance of native vegetation should be avoided outside of the proposed trail alignments.
- All stormwater runoff shall be managed with best management practices (BMPs), approved by the local jurisdiction.
- With approval from the City's engineer, earthwork activities can be performed in the wet season (October through April) during periods of dry weather.

CORE REQUIREMENT #3 – SOURCE CONTROL OF POLLUTION

The Olympia Parks, Arts, & Recreation Department manages its properties under a Pollution Source Control Plan and Integrated Pest Management Plan. The plans cover all parks in the system. The existing plans and standard operating procedures for parks maintenance will extend to this site as well which will fulfill Core Requirement #3. The proposed development of the Kaiser Woods Park does not warrant changes to those plans or introduction of special provisions for this site.

Permanent source control for sediment through erosion prevention measures also include the following, recommended by the Evergreen Mountain Biking Alliance (EMBA):

- Grade reversals. Singletrack trail requires a grade reversal every 40-80 ft.
- Beginner and intermediate flow trails will have some sections that consist almost entirely of grade reversals (rollers) every 8-12 ft creating a pump track experience.
- Exaggerated In-sloped turns. Turns are in-sloped so that tire pressure is perpendicular to the tread assisting soil compaction instead of degradation. Water sheds to the inside of the turns away from where the tires are riding up on the berm. As turns get sharper, steeper in-sloping is implemented.
- Speed and Sightline Management. Trails are designed to limit speed and provide appropriate sightlines to prevent over-braking (and resulting tread breakdown and erosion). Speed is controlled by grade, turning radius, obstacles in the tread, chicanes and other features.
- Rock armoring. Steeper technical trails may include rock armoring to prevent erosion on steepest sections. The need for this will follow guidelines from the International Mountain Bike Alliance (IMBA) and the US Forest Service.

CORE REQUIREMENT #4 – PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

The entire site comprises two threshold discharge areas (TDAs). Surface flow in the north TDA, number 1, flows to Ken Lake. The shortest flow path to the lake is less than ¼ mile from the border of the park. Surface flow from the south TDA, number 2, flows to Black Lake ditch, meeting at a point less than ¼ mile from the site. For ease of analysis, TDA 2 has been divided into four sub-basins, A through D.

Figure 1 shows the pre-development and post-development TDAs, sub-basins and flow paths. After the project, the drainage pattern will be the same as prior to the project. No TDA boundaries are proposed to be changed.

The use of full dispersion as a BMP for the trails and skills areas will also preserve the natural drainage systems and outfalls.

CORE REQUIREMENT #5 – ONSITE STORMWATER MANAGEMENT

On-Site stormwater BMPs are required to convey, infiltrate, disperse, and retain stormwater runoff onsite for new and replaced hard surfaces, where feasible. The impervious areas are summarized in Tables 2A and 2B above.

Most of the soils in this area are type D with underlying bedrock. Due to this, they have limited infiltration rates and are not appropriate for most onsite stormwater management BMPs. Each BMP in List #2 is listed below with a statement of feasibility.

Lawn and landscaped areas:

- Post Construction Soil Quality and Depth in accordance with BMP T5.13, **feasible**.

Roof (restroom):

- BMP T5.30 Full Dispersion, **feasible**

Other Hard Surfaces (access lane and parking lot):

- Full Dispersion in accordance with BMP T5.30, **infeasible** due to Type D soils and lack of sufficient native vegetated areas. Full dispersion may be feasible for a portion of the parking lot. That option will be explored during the design phase of the project and implemented, if feasible.
- Permeable Pavement in accordance with BMP T5.15, **infeasible** due to Type D soils
- Bioretention BMPs, **infeasible** due to Type D soils and lack of space in the lower access lane area. Setbacks with neighboring properties and the slope of the parcel reduces the area available for bioretention.
- Sheet Flow Dispersion in accordance with BMP T5.12 or Concentrated Flow Dispersion in accordance with BMP T5.11, **infeasible** due to type D soils and lack of suitable flow paths.

Other Hard Surfaces (trails, pump track and skills areas):

This part of the project will create or replace dirt pathways and mountain biking facilities. Stormwater runoff from these areas will be managed using the BMPs of List 2 in Table I-3.2, Volume I, DDECM. Thus, on-site stormwater management is **feasible** for these areas subject to the guidance and restrictions in the approved Stormwater Adjustment and Stormwater Memo submitted with the conditional use permit. Full dispersion will be used for all new trails and skills areas.

CORE REQUIREMENT #6 – RUNOFF TREATMENT

Section I-3.4.6 of Volume I of the DDECM states that stormwater treatment facilities are required when pollutant generating hard surface (PGHS) exceeds 5,000 square feet. The project will create more than 5,000 square feet of new and replaced PGHS so runoff treatment is required. Because this project ultimately drains to fish-bearing water bodies and Capitol Lake, which is sensitive to phosphorous, enhanced treatment for total suspended solids (TSS) and metals, as well as phosphorous removal is required.

Two Western Washington Hydrology Model (WWHM) reports for runoff treatment are attached as Appendix C. Version 4.2.18 of WWHM2012, dated 8/18/2021 was used. The reports state (on page 12 of each) that treatment for 0.0580 cfs of runoff is required for the parking lot and west access lane and 0.0511 cfs of runoff for the east access lane. Two manufactured treatment devices are proposed onsite. The manufactured treatment devices proposed are Filterra systems, by Contech Engineered Solutions, from the list of devices approved by the Department of Ecology.

Each 4'x4' Filterra device treats up to 0.12 cfs and is approved to treat for TSS, metals and phosphorous (General Use Level Designation through Ecology's TAPE protocol). One device is for runoff from the parking lot and upper access lane, prior to discharge to the detention pond. The other device is for runoff from the lower access lane, prior to discharge to the existing catch basin in Black Lake Boulevard. Both devices incorporate internal high flow bypass mechanisms.

The Filterra device near Black Lake Boulevard is on the north side of the access lane. We are asking Hope Community Church to reduce the setback requirement to 10 feet on that side of the property. If they are not able to approve that, we will change the design to relocate the Filterra device to the south side of the access lane. We already have approval from Puget Sound Energy to reduce the setback with their property line to 10 feet. An email to that effect has been submitted with the Conditional Use Permit application.

The trails and skill area portion of the project will be treated with Full Dispersion as a treatment BMP. While hard packed earth surfaces are not explicitly listed as PGIS in the glossary of the DDECM, suspended sediment could act as a pollutant if allowed to enter waters of the state. Full dispersion will allow the suspended sediment to settle out of the runoff before it leaves the site or enters waters of the state.

CORE REQUIREMENT #7 – FLOW CONTROL

Per section I-3.4.7 of Volume I of the DDECM, the project is not flow control exempt.

The trails and skills areas (in TDA 1 and TDA 2) will utilize Full Dispersion, BMP T5.30 for flow control. Table 3 shows applicable areas for the use of full dispersion.

Table 3 – Full Dispersion Area Calculations

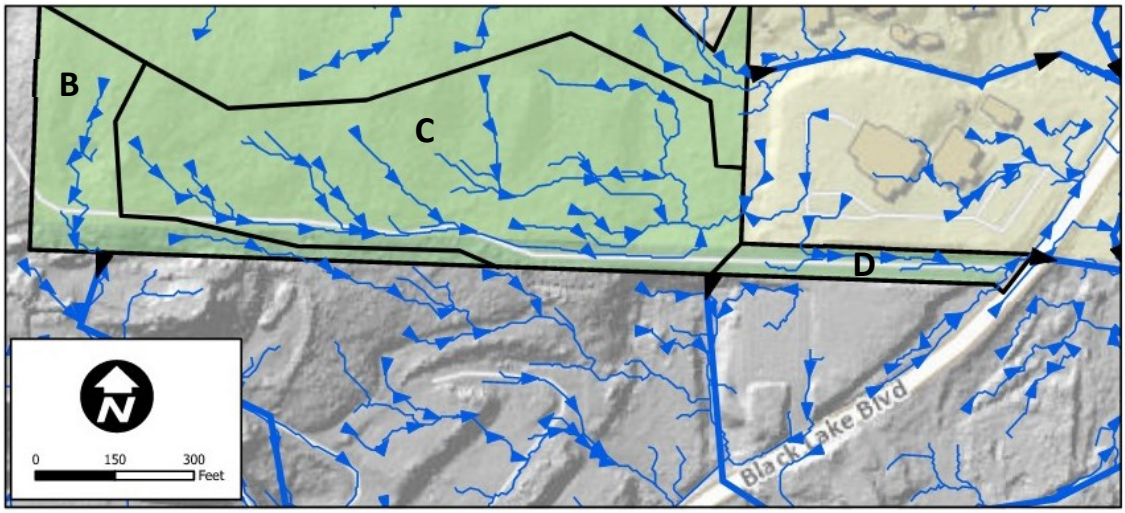
	Areas (acre)	
Surface Type	**TDA1**	**TDA2**
A. Total Area	18.08	59.51
B. Roadways and Parking	0	0.75
C1. New Trails	0.31	1.28
C2. Existing Trails	0.36	1.28
D. Pump Tracks	0	0.03
E. Skills Areas	0	0.05
F. Other Impervious Areas (gravel areas, pond)	0	0.34
G. Critical Areas and Buffers	0	15.57
H. Dispersion Flow Path Area (Full Dispersion)	4.16	11.66
I. Compacted Soil in Full Dispersion Flow Paths (subset of G)	0.09	0.52
% of Dispersion Flow Path Area with compacted soils = I/(H), must be **less than 8%**	**2.2%**	**4.5%**
Ratio of dispersion flow path area to new impervious area = H/(C1+D+E), must be **at least 6.5**	**13.4**	**8.6**
J. Forest or Native Condition Area = A-B-C1-C2-D-E-F	17.41	55.78
% of site in Forest or Native Condition = J/A, must be **at least 65%**	**96.3%**	**93.7%**

This parking lot and access lane portion of the project in TDA 2 will utilize BMP D.1: Detention Pond. The detention pond will be constructed in an existing, natural depression. The depression has two, existing parallel 30" culverts as outlets. The geotechnical report from GeoEngineers, revised October 31, 2025 (separate permit submittal) states infiltration is not appropriate in this location due to high ground water and underlying bedrock. The detention pond has been modeled with no infiltration. A flow control structure in the pond will be constructed to limit the flow out of the pond to match or be lower than pre-development flows the the existing culverts.

While the flow in sub-basin D does not flow to the pond, it is in the same TDA 2. The model for the pond includes all effective impervious areas in TDA 2, as required in the DDECM. Additional flow will be detained by the pond to account for the increased flow from the east access lane to the existing city stormwater system. The net flow leaving the park from this TDA is lower after the development than before as demonstrated in the WWHM report in Appendix D.

The TDA and sub-basin boundaries were constructed using the Olympia GIS swSurfaceWaterFlow feature class. Figure 2 shows a close-up of the existing flow patterns in sub-basins B, C and D in TDA 2. The detention pond has been designed to match the proposed flow pattern to the existing flow pattern.

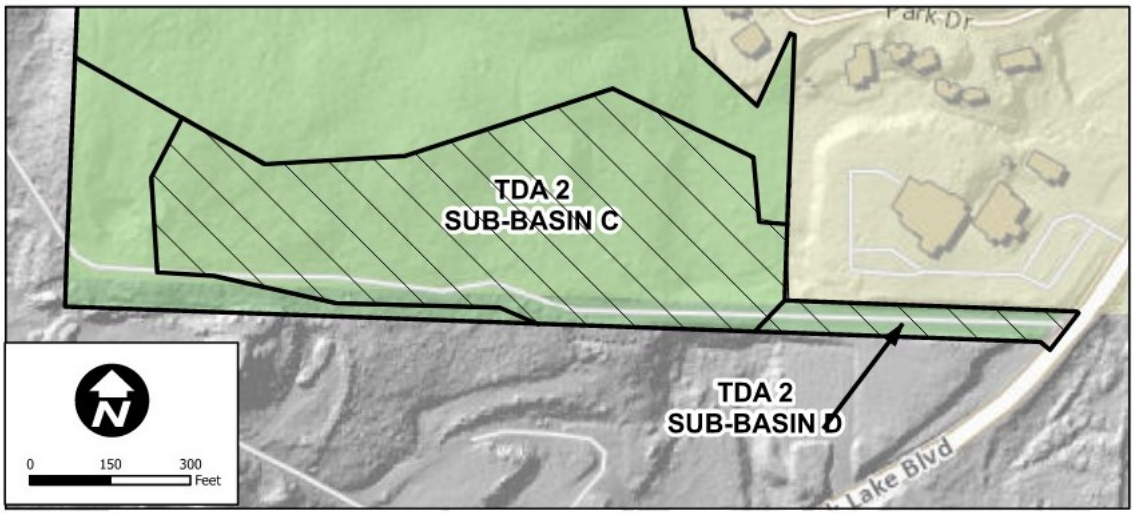
Figure 2: Existing Flow Patterns, TDA 2, Sub-Basins B, C And D



The pond will use existing contours on the south, adjacent to the access lane, with no grading needed. The slopes on the west and north will be graded per the plans to meet the existing ground. On the east, a berm will be constructed. Berms must be treated as dams if they are greater than 6’ in height at the downstream toe or impound a volume more than 10 acre-feet. Neither condition is met for this project. The proposed berm will be 5’ in height at the downstream toe and the impound volume for the 50-year storm will be 0.17 acre-feet.

The area proposed for the detention pond was sampled, tested for infiltration potential, and analyzed by GeoEngineers. Their geotechnical report is a separate permit submittal. The proposed stormwater design satisfies the flow control core requirement. The WWHM report for flow control for TDA 2 is attached as Appendix D and the area represented is shown in Figure 3 as a diagonal hatch.

Figure 3: Area Represented by TDA 2 Flow Control WWHM Model



CORE REQUIREMENT #8 – WETLAND PROTECTION

Core Requirement #8 applies to projects that discharge to a wetland, either directly or indirectly through a conveyance system. The project site contains three existing wetlands. The drainage pattern to the wetland will not be altered by this project. The wetland nearest the access lane is uphill from the proposed detention pond.

CORE REQUIREMENT #9 – OPERATION AND MAINTENANCE

A Stormwater Site Management Plan will be created for the proposed stormwater improvements and the existing onsite stormwater features. The project is owned and operated by the City of Olympia Park, Arts and Recreation Department, and therefore a maintenance agreement is not required.

SECTION 2 – EXISTING CONDITIONS DESCRIPTION

EXISTING LAND USE AND GROUND COVER

The project site is undeveloped land that is currently used as a nature park as part of the City of Olympia park system. Almost the entire site is heavily vegetated with deciduous and conifer trees with a heavy underbrush layer. The project site contains three existing wetlands. See wetland and critical areas reports as separate permit submittals. The area surrounding the wetlands contains native wetland grasses, plants and brush. There are existing trails throughout the park and a gravel access lane near the south border.

EXISTING DRAINAGE PATTERNS AND HYDROLOGIC CONDITIONS

The site is heavily forested and generally slopes from west to east. Runoff currently enters the site from the west into both TDA 1 and TDA 2 and flows to the northeast and southeast. The drainage patterns will not be changed with the proposed development.

A draft report entitled “Ken Lake Hydrologic Evaluation 2012” has been submitted with the conditional use permit for this project. It details the hydrologic conditions in the drainage basin around Ken Lake which includes the project area. There have been problems in the past with flooding on private property and drainage systems (off site) that were undersized for large rain events. This project will not exacerbate those problems because this project will provide flow control designed to match pre-developed hydrologic patterns for impacted site areas. The project will actually decrease the rate runoff leaves the site compared to current conditions.

PROXIMITY TO AQUIFIR RECHARGE OR WETLAND PROTECTION AREAS

The upper northeast corner of the site, approximately 2 acres, is in the 10-year time of travel wellhead protection area. No activities in that area would pose a threat to groundwater. There are no pollution-generating surfaces proposed in that area.

PROXIMITY TO SURFACE WATERS, SHORELINES, AND CRITICAL AREAS

The site encompasses three wetland areas and a seasonal stream. The characteristics of the wetlands are outlined in the technical memoranda from SCJ Alliance and KPG Psomas. One wetland is adjacent to the parking lot and access lane portion of the project. Protection of that wetland is addressed in the technical memoranda.

Downstream of TDA 1 is Ken Lake. Downstream of TDA 2 is Black Lake Drainage Ditch and Percival Creek.

OFFSITE DRAINAGE TO OR THROUGH THE PROJECT

Stormwater enters the site through the west border. Stormwater leaves the site through many locations to the north, east and south.

Figure 4: Existing and Proposed Offsite Drainage

LID FEASIBILITY

The LID infeasibility criteria for the BMPs selected to meet Core Requirement #5 (full dispersion) were evaluated. Some on-site flow control BMPs (dispersion) are feasible in areas, however lack of infiltration capacity restricts other BMP use; see Section 1 Core Requirement #5 above.

SECTION 3 – SOILS INVESTIGATION

According to an assessment performed by Landau Associates, dated October 6, 2020, overburden soil is present throughout the site. This consists of a thin mantle of recessional outwash, glacial till, or weathered basalt extending between 0.5 and 15 feet below ground surface. Landau Associates observed bedrock underlying the overburden soil. This unit is present through the site and consists of fresh, dark gray, aphanitic basalt.

Per the Revised Hydrogeologic and Geotechnical report from GeoEngineers, dated September 6, 2024, infiltration is not appropriate for the stormwater detention pond area due to likely high groundwater. Due to this, an estimate of water holding capacity of infiltration soils was not calculated.

See soil map in Appendix F.

SECTION 4 – WELLS & SEPTIC SYSTEMS

There are two drinking water well reports, on or adjacent to the site, per the Department of Ecology web site. Based on the address, one is more than 2,000 feet from the site. The other one is reported as "Dry". It is presumed there are three drinking water wells on 16th Lane Southwest, one for each lot with a house, because there is no drinking water main on that street. These were not found on the Ecology map. All wells are upgradient from the proposed pond and more than 2,000 feet away. There are no wells on site requiring decommissioning.

There were two septic systems on the site but they have been decommissioned. Both septic systems were upgradient from the proposed pond and more than 800 feet away. No new wells or septic systems are proposed.

SECTION 5 – FUEL TANKS

A review of Washington State Department of Ecology's Underground Storage Tank (UST) list does not indicate any recorded tanks on the site.

SECTION 6 – SUBBASIN DESCRIPTION

OFFSITE TRIBUTARY DRAINAGE

Stormwater flows to the site into TDA 1 and TDA 2 Sub-basin A from the property to the west owned by Manke Timber Company. See Figure 4 in Section 2. Land cover on the Manke Timber Company property is presently forest and is zoned as Rural Residential/Resource. The existing pattern of stormwater entry and flow through the site will not be changed by development of the site.

OFFSITE DRAINAGE SYSTEMS

Downstream of TDA 1, there is flow to Ken Lake. Downstream of TDA 2, stormwater flows to Black Lake Drainage Ditch and from there to Percival Creek. Percival Creek flows to Capital Lake and ultimately Budd Inlet. The Ken Lake Hydrologic Evaluation, dated July 2012, identified surface flooding issues on properties located on the East boundary of the project site. The proposed development of Kaiser Woods Park will not exacerbate or improve these issues.

Flow patterns and sub-basin boundaries will not be changed by the development.

SECTION 7 – FLOODPLAIN ANALYSIS

FEMA ZONE DESIGNATION

The project site is located entirely within FEMA Flood Zone X – Outside the 0.2 percent annual chance floodplain and in the zone of "Area of Minimal Flood Hazard". There are no historic records of flooding at the site. See Appendix E for FIRM panel and zone designation.

PROPOSED FLOOD PROTECTION MEASURES

There is no flood risk to the site, and therefore no flood protection measures will be taken.

SECTION 8 – AESTHETIC CONSIDERATIONS FOR FACILITIES

There are two Filterra systems and one stormwater detention pond proposed for the parking lot and access lane portion of this park development. These features will be aesthetically positive due to plantings.

A planting plan for the detention pond and Filterra devices will be developed at engineering permit stage.

Other than tree protection, no soil and vegetation protection areas were identified on the site.

Vegetation and landscapes at the storm facilities will be maintained by Parks maintenance workers, as recommended for the plant type. The crews are experienced with a variety of plants. In addition, a Landscape Plan will be created.

SECTION 9 – FACILITY SELECTION AND SIZING

STORMWATER DISPERSION

A portion of the impervious surfaces shall disperse runoff to the adjacent forested areas by way of full flow dispersion meeting BMP T5.30 of Volume V, DDECM. All dispersion flow paths will be through native or replanted vegetation, except where they cross trails as allowed by the BMP.

STORMWATER DETENTION POND

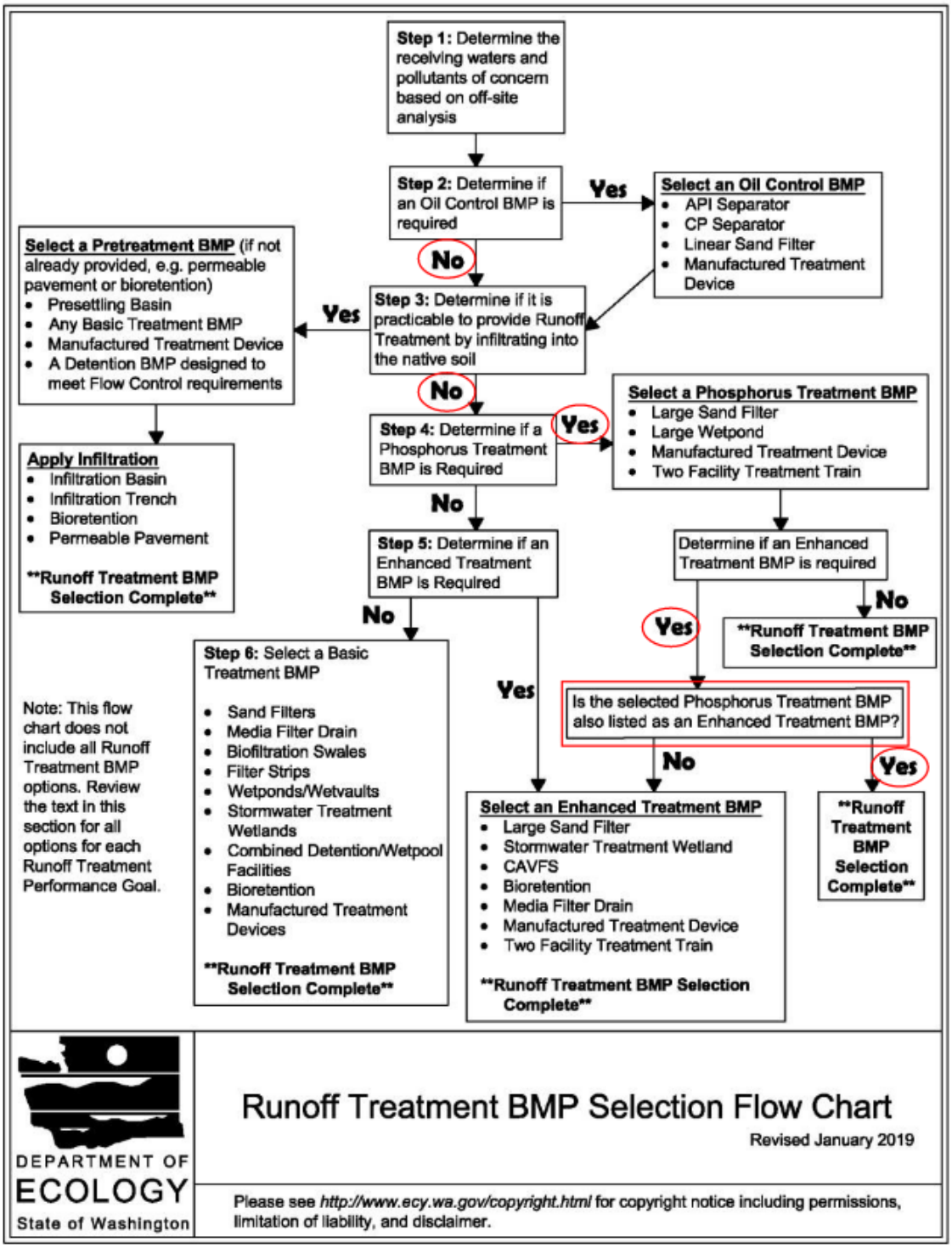
A portion of the impervious surfaces will flow to a detention pond facility just north of the access lane. The pond was sized using the WWHM software to meet the flow duration standard and comply with Core Requirement #7. A stage-storage-discharge table was developed to represent the pond; this was based on CAD measurements of the contours from the proposed grading plan. The pond was designed assuming no infiltration occurs in the soils. The side slopes of the pond will be 3H:1V where constructed, and 2H:1V where the natural contours are used. Appendix D includes the WWHM model report and stage-storage-volume table for the proposed pond.

FILTERRA TREATMENT SYSTEM

Two Filterra treatment systems are proposed. Sizing of the manufactured treatment device has been developed through the WWHM. See Appendix C for flow calculations. Filterra biofiltration system has received General Use Level Designation (GULD) from Ecology for Basic, Enhanced, and Phosphorus treatment. The system incorporates an internal flow bypass that meets Ecology requirements that the system be sized for off-line flow rates. Figure 5 shows the selection of treatment facilities process.

Figure 5: Runoff Treatment BMP Selection Flow Chart

Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



PRESERVING NATIVE VEGETATION

Full Dispersion BMP T5.30 of Volume V, DDECM will be employed for the trail and skills areas. Most of the native vegetation on site will be preserved. Vegetation preservation is a top priority for the Parks department. Prior to any clearing, trail alignments will be marked in the field and approved by the Parks arborists to ensure impacts to vegetation and tree roots are minimized. The Soil & Vegetation report specifies areas of tree protection fencing (around trees marked with blue paint). Trees identified for removal will be marked with orange paint. Areas of replanting have also been identified in the report.

The estimated project impact area is 4.4 acres (5.7%) of the site. The remaining 73.4 acres are to be undisturbed by this project.

BETTER SITE DESIGN

BMP T5.41 of Volume V, DDECM will be employed. The site development design is largely integrated with the natural topography and the new effective impervious area is limited to the southern portion of the site. The protected areas of the site – existing trees, critical areas and their buffers – have been identified and disturbance to those areas will be minimized.

SETBACKS

The project will maintain the required setbacks for steep slopes and property lines.

SECTION 10 – CONVEYANCE SYSTEM ANALYSIS AND DESIGN

INLETS AND PIPES

There is an existing catch basin near the site on Black Lake Boulevard. Its outlet is a 12” PVC pipe. They are both components of the City of Olympia MS4. The pipe discharges to the Black Lake drainage ditch. Stormwater from TDA 2 sub-basin D will discharge through a new pipe to the existing catch basin, after stormwater treatment. See Appendix B for the schedule of structures for conveyance system structure design information. New pipes will be sized to convey developed 25-yr flowrates based on a Manning’s analysis of pipe capacity. Pipe capacity analysis shows all the pipes in the system are oversized. For this reason, and the factor that the site has ample slope, backwater analyses were not performed. Minimum lateral pipe size per the EDDS is 8-inches which will allow for maintenance.

SECTION 11 – OFFSITE ANALYSIS AND MITIGATION

UPSTREAM ANALYSIS

Stormwater enters the site through two low spots on the power line trail (the west boundary of the site) as shown in Figure 4 in Section 2. The existing pattern of stormwater entry and flow through the site will not be changed by development of the site.

DOWNSTREAM ANALYSIS

Stormwater leaves the site through many locations to the north, east and south. Some runoff enters Ken Lake and flows out through a seasonal stream to the Black Lake drainage ditch, and eventually to Percival Creek. Some runoff flows more directly to the Black Lake drainage ditch. The existing patterns of stormwater runoff will not be changed by development of the site. Most onsite stormwater from the project area will be detained onsite, and no increased offsite discharge rates will be generated. The downstream drainage course was observed during a field inspection on January 3, 2025 at 9:30 am. The WRIA watershed is #13, Deschutes River.

The project ultimately drains to fish-bearing water bodies and Capitol Lake, which currently has a 303(d) listing for phosphorous.

CAPACITY ISSUES OR STREAM BANK EROSION

There are known pipe capacity issues with the City storm drain system downstream of the project site. The development of hiking and biking trails, skills areas, an access lane, and a parking lot at Kaiser Woods Park will not increase these capacity issues. The project could have a beneficial impact in downstream areas from TDA 2 due to the pond capacity.

SECTION 12 – UTILITIES

Domestic water and sanitary sewer services are available to the park. There is a restroom proposed with water service and a vault toilet that will be pumped out as needed.

No existing utilities exist where stormwater improvements are proposed.

There are no onsite sewage systems (OSS) on the site. Two OSS were decommissioned prior to this project.

SECTION 13 – COVENANTS, DEDICATIONS, EASEMENTS, AGREEMENTS

There is an existing easement with Puget Sound Energy for the overhead power lines. It allows construction in the easement but no buildings. Blasting is allowed but requires notice be given. The City is not anticipating blasting will be used during construction.

An existing easement for access to the neighboring property to the east (owned by Manke Timer Company) will not be changed by the project.

An easement is proposed with Puget Sound Energy (PSE) for the maintenance of the existing 30” culverts, since a portion of each is on PSE property. The culverts will be owned and maintained by the City of Olympia Parks, Arts & Recreation Department. If approved, the easement will be submitted at time of engineering permit.

Critical area buffers are shown on the site plan, including the proposed modified buffer for Wetland A.

SECTION 14 – OTHER PERMITS OR CONDITIONS

The following permits and review are required for the project:

- Conditional Use Permit
- Civil Engineering Permit, Olympia
- Civil Engineering Permit, Tumwater
- Right of Way Permit, Tumwater
- Onsite Sewage System Permit, Thurston County
- Building Permit
- Signage Permit

Any conditions placed on the project by the hearings examiner decision related to stormwater will be added to this report after the decision is made.

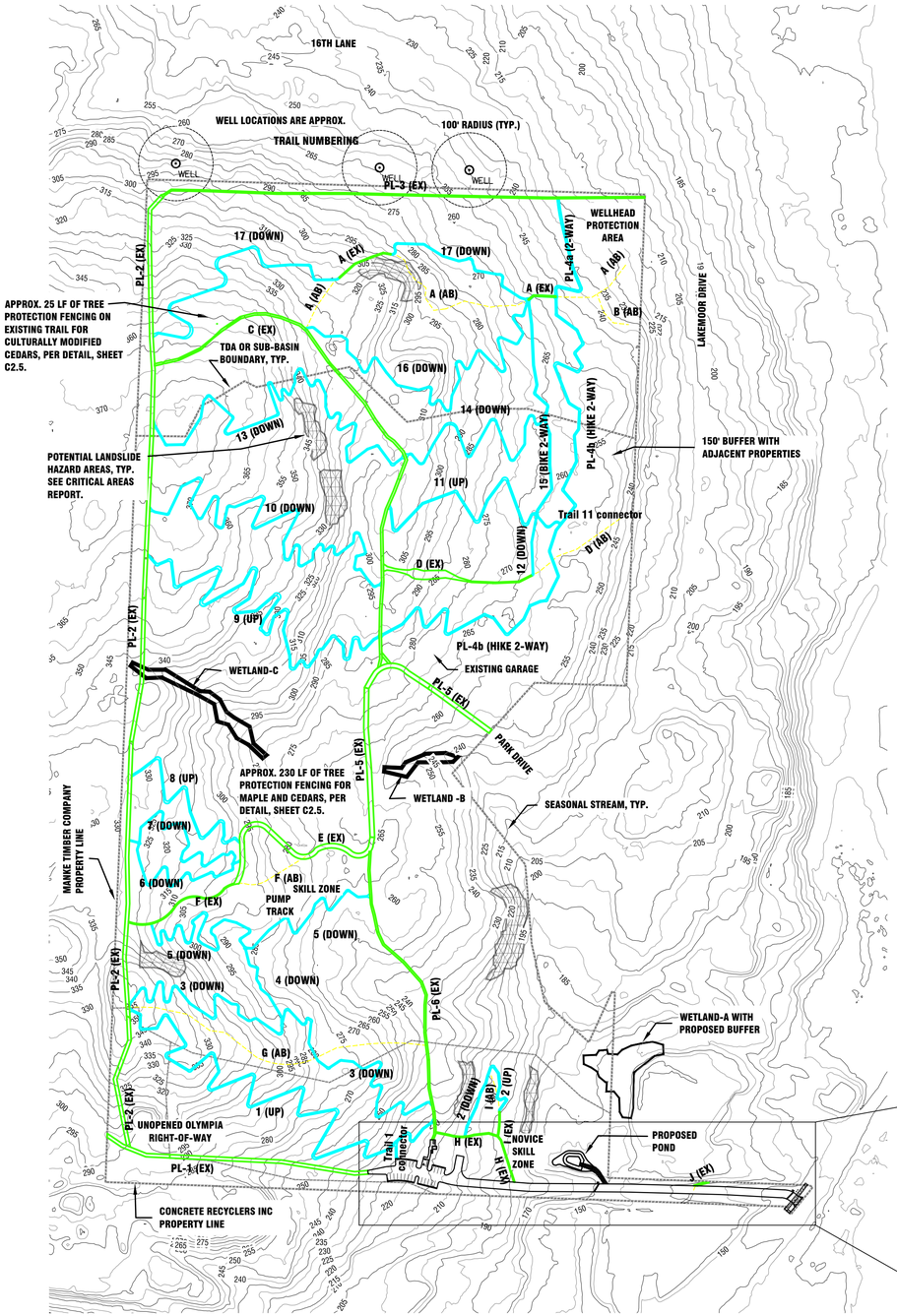
SECTION 15 – BOND QUANTITIES WORKSHEET

No bond is required for this project because the applicant is a City of Olympia department.

APPENDIX LIST

APPENDIX A – OVERALL SITE PLAN, OVERALL STORMWATER PLAN & LANDSCAPE PLAN

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



SCALE: 1"=200 FEET
0 100 200 400

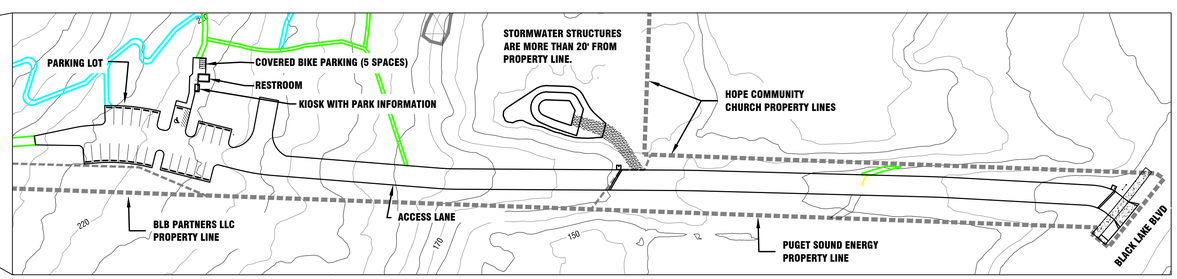
LEGEND

- WETLAND BOUNDARY
- POTENTIAL LANDSLIDE AREA
- SITE, TDA AND SUB-BASIN BOUNDARY, SEE SHEET C0.3
- CRITICAL AREA BUFFER
- PARCEL BOUNDARY
- EXISTING POWER POLES AND OVERHEAD POWER LINES
- NEW TRAIL, FULL DISPERSION
- EXISTING TRAIL, TO BE MAINTAINED, NOT ALTERED
- EXISTING TRAIL, TO BE ABANDONED

IMPERVIOUS AREA OF PUMP TRACK AND SKILLS ZONES:
BEGINNER: 1,000 SF
INTERMEDIATE: 2,400 SF

PROPOSED IMPERVIOUS COVERAGE:
IN OLYMPIA: 3.6 ACRES (4.8%)
IN TUMWATER: 0.83 ACRES (32.2%)

Trail Designation	TDA or sub-basin	Bike or Hike	Ex Length (LF)	Prop Length (LF)	Ex Width (FT)	Prop Width	Ex. Imp. Area (SF)	Prop. Imp. Area
Trail ex PL1-1 TDA 2-B (Tum)	TDA 2-B	Hike & bike	181	181	9	9	1,632	1,632
Trail ex PL1-2 TDA 2-C (Tum)	TDA 2-C	Hike & bike	534	534	9	9	4,814	4,814
Trail ex PL2-1 TDA 1	TDA 1	Hike & bike	656	656	9	9	5,908	5,908
Trail ex PL2-2 TDA 2-A	TDA 2-A	Hike & bike	434	434	9	9	3,912	3,912
Trail ex PL2-3 TDA 2-A Crit Area	TDA 2-A	Hike & bike	388	388	9	9	3,499	3,499
Trail ex PL2-4 TDA 2-A	TDA 2-A	Hike & bike	740	740	9	9	6,645	6,645
Trail ex PL2-5 TDA 2-B	TDA 2-B	Hike & bike	363	363	9	9	3,219	3,219
Trail ex PL3	TDA 1	Hike & bike	1299	1299	4	4	5,205	5,205
Trail PL 4a 2-way	TDA 1	Hike & bike		347		5		1,762
Trail PL 4b TDA 1	TDA 1	Hike		490		4		2,068
Trail PL 4b TDA 2-A	TDA 2-A	Hike		1198		4		4,976
Trail ex PL5-1 12-foot Crit Area	TDA 2-A	Hike & bike	203	203	12	12	2,438	2,438
Trail ex PL5-2 12-foot	TDA 2-A	Hike & bike	213	213	12	12	2,562	2,562
Trail ex PL5-3 12-foot Crit Area	TDA 2-A	Hike & bike	400	400	12	12	4,789	4,789
Trail ex PL6-1 TDA 2-A 5-foot	TDA 2-A	Hike & bike	217	217	5	5	1,080	1,080
Trail ex PL6-2 TDA 2-A 5-foot Crit Area	TDA 2-A	Hike & bike	392	392	5	5	1,957	1,957
Trail ex PL6-3 TDA 2-C	TDA 2-C	Hike & bike	217	217	5	5	1,087	1,087
Trail ex A-1 (ab)	TDA 1	N/A	168		3		504	
Trail ex A-2	TDA 1	Bike	158	158	3	3	470	470
Trail ex A-3 (ab)	TDA 1	N/A	225		3		646	
Trail ex A-4	TDA 1	Bike	234	234	3	3	700	700
Trail ex A-5 4-foot	TDA 1	Bike	79	79	3	4	237	316
Trail ex A-6 (ab)	TDA 1	N/A	224		3		672	
Trail ex B (ab)	TDA 1	N/A	130		3		389	
Trail ex C-1 TDA 1	TDA 1	Hike & bike	562	562	5.5	5.5	2,967	2,967
Trail ex C-2 TDA 2-A	TDA 2-A	Hike & bike	912	912	6	6	5,379	5,379
Trail ex C-3 TDA 2-A	TDA 2-A	Hike & bike	45	45	6	6	194	194
Trail ex D-1	TDA 2-A	Bike	413	413	8	8	3,366	3,366
Trail ex D-2 (ab)	TDA 2-A	N/A	273		3		820	
Trail ex E	TDA 2-A	Hike & bike	573	573	12	12	6,877	6,877
Trail ex F-1	TDA 2-A	Bike	386	386	3	3	1,158	1,158
Trail ex F-2 (ab)	TDA 2-A	N/A	205		3		615	
Trail ex G (ab)	TDA 2-A	N/A	854		3		2,562	
Trail ex H	TDA 2-C	Hike	304	304	3	3	905	905
Trail ex I-1 maint	TDA 2-C	Hike	95	95	3	3	285	285
Trail ex I-2 (ab)	TDA 2-C	N/A	71		3		213	
Trail ex J - gravel TDA 2-D (Tum)	TDA 2-D	Hike	28	28	5	5	142	142
Trail 1 Connector	TDA 2-C	Hike & bike		46		4		207
Trail 1 TDA 2-A Up	TDA 2-A	Hike & bike		269		4		1,159
Trail 1 TDA 2-B Up	TDA 2-B	Hike & bike		70		4		280
Trail 1 TDA 2-C Up	TDA 2-C	Hike & bike		1364		4		5,864
Trail 2 down	TDA 2-C	Hike & bike		295		4		1,357
Trail 2 up	TDA 2-C	Hike & bike		244		4		1,062
Trail 3 TDA 2-A	TDA 2-A	Bike		1100		3		3,712
Trail 3 TDA 2-C	TDA 2-C	Bike		441		3		1,487
Trail 4	TDA 2-A	Bike		245		3		734
Trail 5	TDA 2-A	Bike		1203		3		4,045
Trail 6	TDA 2-A	Bike		453		3		1,597
Trail 7	TDA 2-A	Bike		602		3		1,947
Trail 8 up	TDA 2-A	Hike & bike		604		4		2,608
Trail 9 up	TDA 2-A	Hike & bike		1624		4		7,164
Trail 10	TDA 2-A	Bike		1571		3		5,318
Trail 11 connector	TDA 2-A	Hike		83		3		301
Trail 11 up	TDA 2-A	Hike & bike		690		4		2,944
Trail 12	TDA 2-A	Bike		168		3		498
Trail 13 Black	TDA 2-A	Bike		1440		3		4,802
Trail 14 Blue	TDA 2-A	Bike		739		3		2,476
Trail 15 TDA 1	TDA 1	Bike		322		4		1,292
Trail 15 TDA 2-A	TDA 2-A	Bike		283		4		1,158
Trail 16	TDA 1	Bike		1193		3		3,843
Trail 17 part 1	TDA 1	Bike		842		3		3,097
Trail 17 part 2	TDA 1	Bike		460		3		1,520
		Totals:	12,176	28,412			77,848	140,784



SCALE: 1"=80 FEET
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KAISER WOODS PARK
2549 BLACK LAKE BLVD SW

KAISER WOODS PARK DEVELOPMENT

OVERALL SITE PLAN

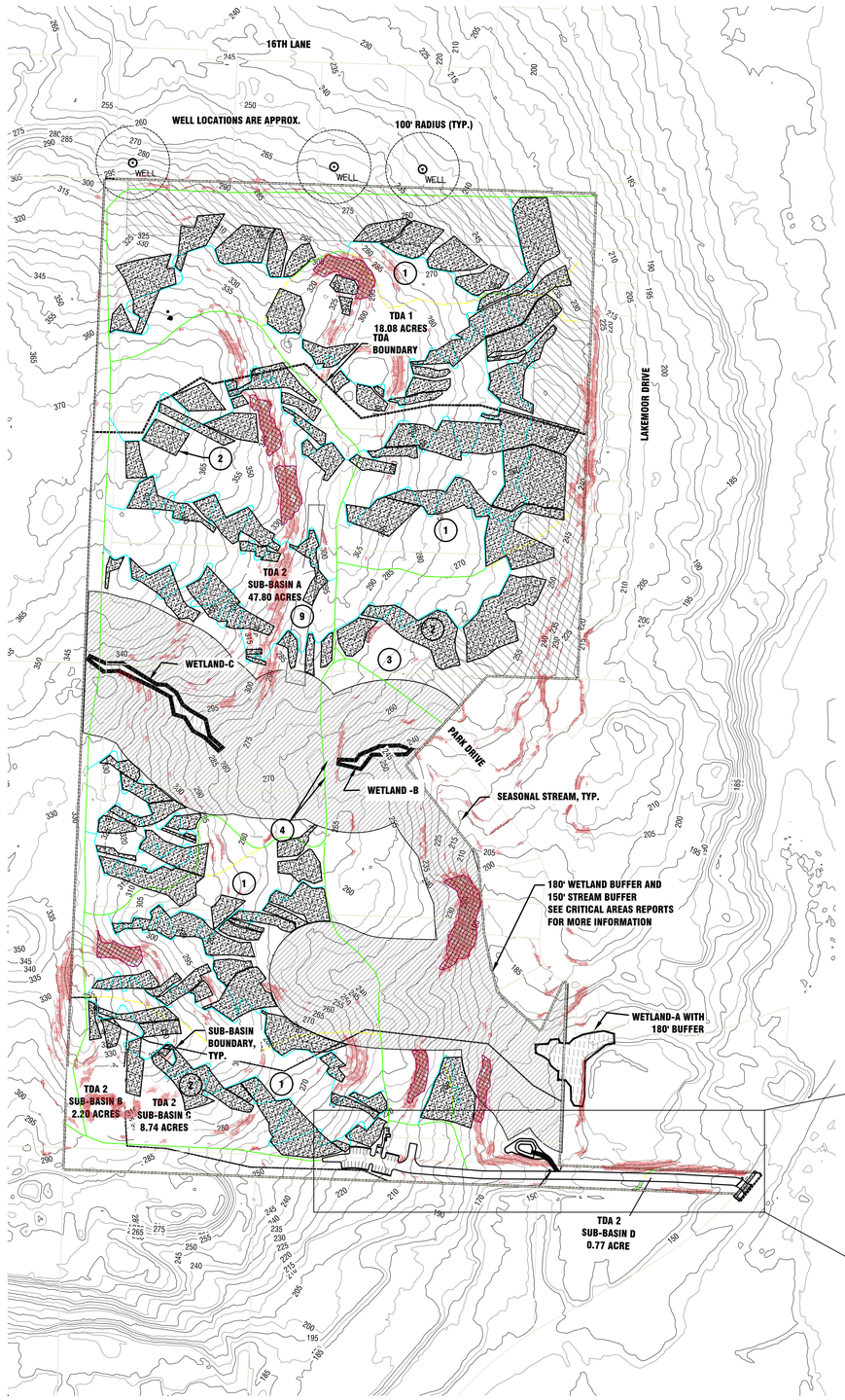
NO.	DATE	REVISION
1	11/26/2024	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
2	4/23/2025	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
3	3/31/2026	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS

DIANE MONTGOMERY PILOT OF WASHINGTON 46975 REGISTERED PROFESSIONAL ENGINEER

DATE: 6/6/2023
SCALE:
DESIGNED: DU/NG
DRAWN: DU/NG
CHECKED:
PROJECT #: 1857H

C0.2
SHEET 2 OF 20

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



SCALE: 1"=200 FEET
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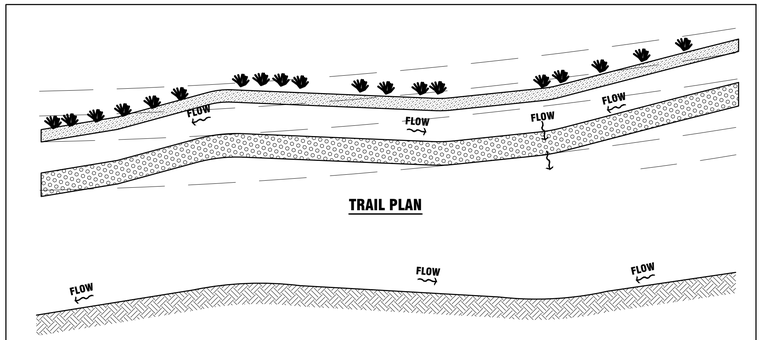
LEGEND

- WETLAND BOUNDARY
- POTENTIAL LANDSLIDE AREA
- SLOPES OVER 36%
- CRITICAL AREA BUFFER
- NEIGHBORHOOD BUFFER
- WELLHEAD PROTECTION AREA
- ORIGINAL BUFFER AREA
- PROPOSED CRITICAL BUFFER AREA AFTER BUFFER AVERAGING
- PROPOSED TRAILS
- EXISTING TRAILS
- TRAILS TO BE ABANDONED
- TDA, SUB-BASIN AND SITE BOUNDARY
- PARCEL BOUNDARY



TRAIL PLAN

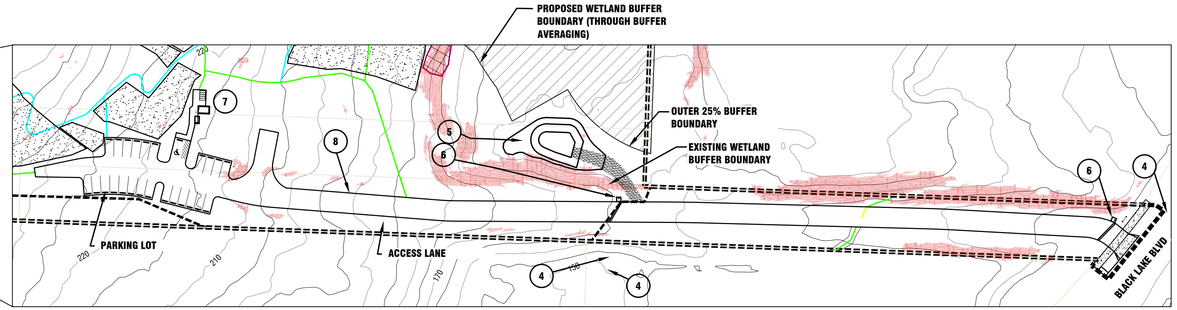
TRAIL PROFILE

NOTES:
1. VEER TRAIL UPSLOPE AROUND NATURAL ANCHOR POINT SUCH AS TREE, BOULDER OR LOG. WHERE POSSIBLE. TRAIL SHALL VEER UPSLOPE RATHER THAN UP A CONSTRUCTED MOUND.
2. ROLLING GRADE DIPS SHALL BE INCORPORATED INTO GRADE REVERSALS AT MID-SLOPE.
3. TRAIL GRADE REVERSALS SHALL BE SPACED 25' - 40' APART, AS DETERMINED IN THE FIELD.
4. TRAIL GRADE REVERSALS SHALL BE CONSTRUCTED OF COMPACTED NATIVE SOIL.

TRAIL DRAINAGE DIP DETAIL (TO BE USED AT FREQUENT LOCATIONS IN TRAIL AREAS)

OVERALL STORMWATER NOTES

1. FULL DISPERSION, BMP T5.30 IN TRAILS AREAS IN TDA 1 AND TDA 2
2. FULL DISPERSION FLOW PATH IN TRAILS AND SKILLS AREAS (TYP.)
3. EXISTING GARAGE AND GRAVEL AREA
4. EXISTING CULVERT
5. PROPOSED DETENTION POND
6. PROPOSED FILTERRA STORMWATER TREATMENT DEVICE
7. IMPERVIOUS AREA NEAR RESTROOM WILL BE DISPERSED INTO VEGETATION AND EVENTUALLY TO THE POND, IF NEEDED. THE SURFACES ARE NON POLLUTION GENERATING SO TREATMENT IS NOT REQUIRED.
8. WEDGE CURB WILL DIRECT RUNOFF TO FILTERRA DEVICES.
9. APPROX. 500'x50' WET AREA IS NOT A WETLAND, PER SCJ REPORT, SECTION 2.2.



SCALE: 1"=80 FEET
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SEE SHEET C0.2 FOR TABLE OF TRAIL INFORMATION.

SEE SHEETS C4.1 THROUGH C4.4 FOR DETAILED TRAIL DESIGN.

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KAISER WOODS PARK DEVELOPMENT

DIANE MONTGOMERY — STATE OF WASHINGTON — 40970 — REGISTERED PROFESSIONAL ENGINEER

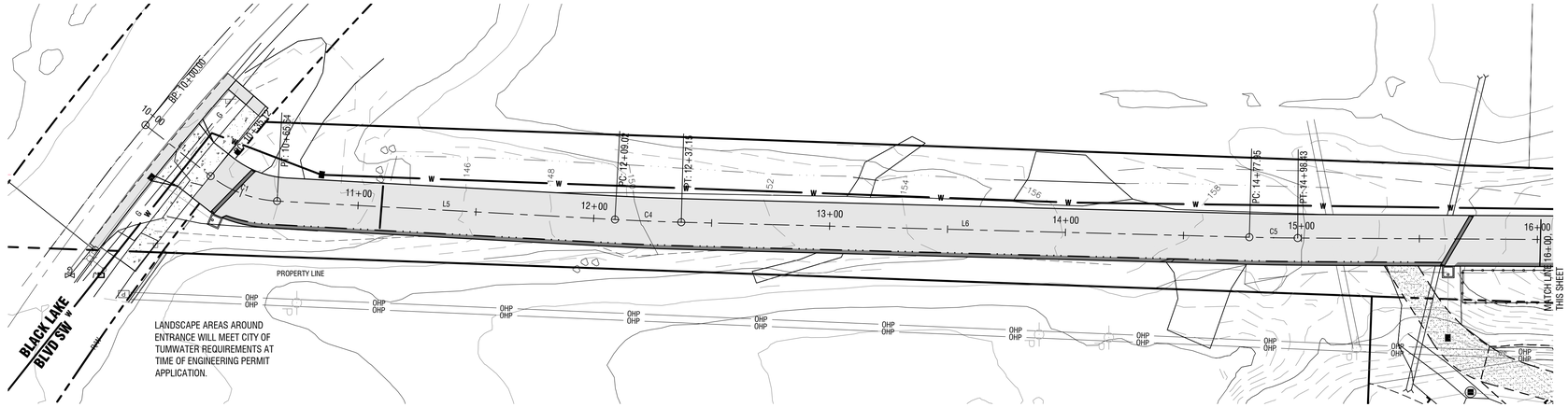
OVERALL STORMWATER PLAN

NO.	DATE	REVISION
1	11/26/2024	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
2	4/23/2025	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
3	3/31/2026	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS

DATE: 6/6/2023
SCALE: **VARIES**
DESIGNED: DU/NG
DRAWN: DU/NG
CHECKED:
PROJECT #: 1857H

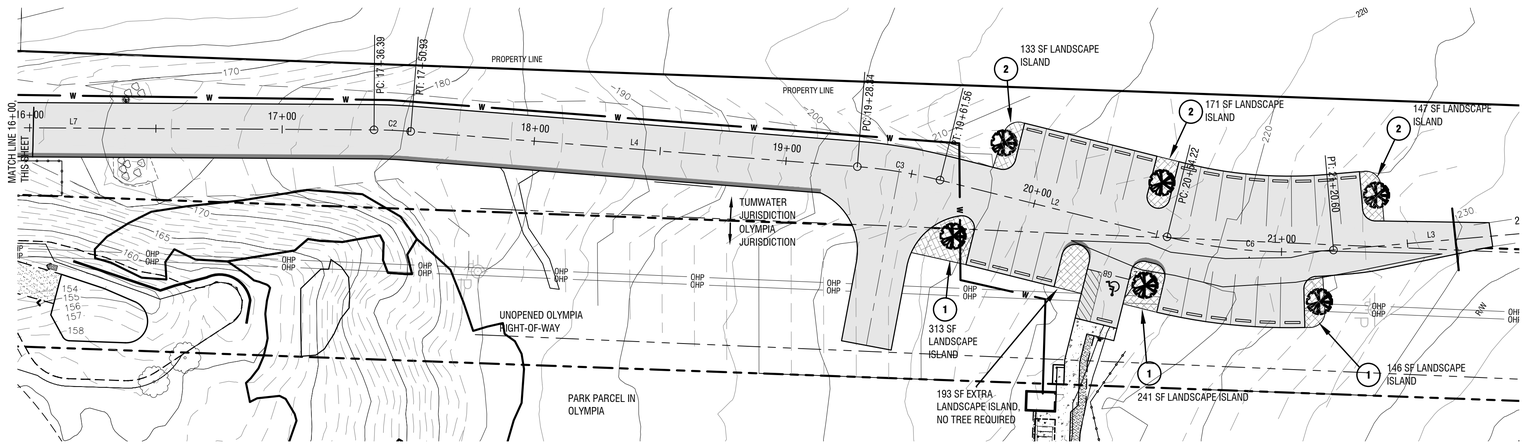
C0.3
SHEET **3** OF **20**

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION



GENERAL LANDSCAPE NOTES

1. ALL TREES SHALL BE PLANTED PER DETAIL ON THIS SHEET. TREES OVER 6' IN HEIGHT SHALL BE STAKED PER DECIDUOUS TREE PLANTING DETAIL.
2. ALL PLANT TYPES AND CONDITION MUST BE APPROVED BY THE CITY PARKS DEPARTMENT PRIOR TO INSTALLATION.
3. PLANT MATERIAL SHALL EXHIBIT NORMAL HABITS OF GROWTH FOR THE SPECIES, SHALL HAVE BUDS INTACT AND SHALL BE FREE OF DISEASE, INSECTS, SCARS, BRUISES, BREAKS, SEED AND WEED ROOTS.
4. ALL PLANTS SHALL BE WATERED IN THOROUGHLY AFTER PLANTING TO REMOVE AIR POCKETS.
5. ALL PLANTING MATERIALS SHALL BE GUARANTEED FOR THREE YEARS.
6. ALL WORK IS TO BE PERFORMED BY LICENSED CONTRACTORS AND EXPERIENCED WORKERS.
7. IN THE EVENT THAT PLANT MATERIALS ARE NOT AVAILABLE, CONTACT PROJECT ENGINEER FOR APPROVED SUBSTITUTIONS, NO SUBSTITUTION FOR PLANT MATERIAL WILL BE ALLOWED WITHOUT PRIOR WRITTEN APPROVAL OF THE PROJECT ENGINEER. IF SUBSTITUTIONS OCCUR, AN UPDATED PLANTING PLAN SHALL BE SUBMITTED TO THE APPLICABLE CITY.
8. TREE LOCATIONS MAY BE ADJUSTED IN THE FIELD TO SUIT SITE REQUIREMENTS AS DIRECTED BY THE PROJECT ENGINEER.
9. LOCATE ALL EXISTING UTILITIES WITHIN LIMIT OF WORK BEFORE CONSTRUCTION.
10. CITY FORESTER SHALL INSPECT AND APPROVE ALL TREES PRIOR TO PLANTING. TREE SUBSTITUTIONS MUST BE APPROVED BY THE CITY FORESTER THROUGH THE PROJECT ENGINEER.



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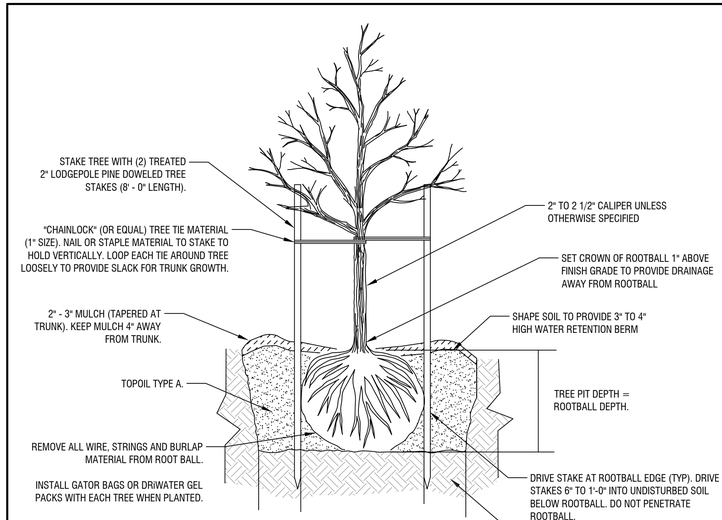


NOTES:
1. ALL TREES IN LAWN AREAS SHALL BE PLANTED WITH 3'-0" DIAMETER CIRCLE OF MULCH.

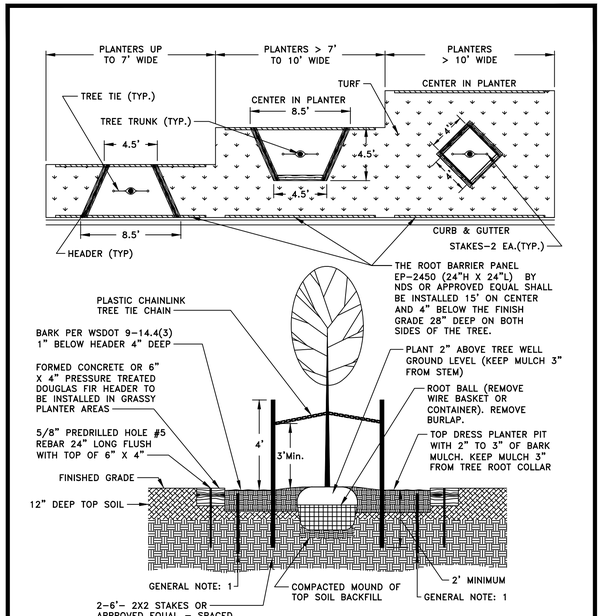
DECIDUOUS TREE PLANTING
CITY OF OLYMPIA N.T.S.

LANDSCAPE AREA: 133 + 171 + 147 + 313 +193 + 241 + 146 = 1,344 SF
(OLYMPIA MINIMUM REQUIREMENT: 27 SF PER STALL x 25 STALLS = 675 SF)
(TUMWATER MINIMUM REQUIREMENT: 17.5 SF PER STALL x 25 STALLS = 437.5 SF)

COMPLIANT WITH TUMWATER MUNICIPAL CODE SECTION 18.47
AND OLYMPIA MUNICIPAL CODE SECTION 18.36.

LANDSCAPE NOTES

1. PLANT DROUGHT-TOLERANT, DECIDUOUS TREE, AT LEAST 6' FROM PAVEMENT, PER DETAIL, THIS SHEET (IN OLYMPIA).
2. PLANT DROUGHT-TOLERANT, DECIDUOUS TREE PER DETAIL, THIS SHEET (IN TUMWATER).



CITY OF TUMWATER
TRANSPORTATION & ENGINEERING DEPT.

TREE PLANTER AND BARRIER IN PLANTER STRIP

APPROVED BY:				DWG. NO.
CITY ENGINEER				ST-23
DES. PW	DWG. BY PW	CK'D BY MW	DATE JAN. 2015	NOT TO SCALE

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KAISER WOODS PARK
2549 BLACK LAKE BLVD SW

KAISER WOODS PARK DEVELOPMENT

DIANE MONTECUCCO UTTER
MAYOR
CITY OF TUMWATER
BOARD OF WASHINGTON
ABOVE AND BEYOND
PROFESSIONAL EXCELLENCE

LANDSCAPE PLAN & DETAILS

NO.	DATE	REVISION
1	11/26/2024	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
2	4/23/2025	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS
3	3/31/2026	REVISED PER CP&D SUBSTANTIVE REVIEW COMMENTS

DATE: 6/6/2023
SCALE:
DESIGNED: DU/NG
DRAWN: DU/NG
CHECKED:
PROJECT #: 1857H

L1.1
SHEET **14** OF **20**

APPENDIX B – SCHEDULE OF STORMWATER STRUCTURES

SCHEDULE OF STRUCTURES

Structure/ Pipe ID	*Existing or Proposed*	*Location (stationing or northing/easting)*	*Size, Material*	*Length or Height*	*Upstream invert*	*Downstream invert*	*Slope*	*Pipe Capacity* [1]	*Flow for 25-year storm*	*Velocity at 25-year storm*	*Depth at 25-year storm*
Culvert #1	Existing	626493 N, 1028779 E upstream 626524 N, 1028744 E downstream	12” PVC	47.1 LF	137.2	135.3	4.0%	11.0 cfs	0.40 cfs (from project)	6.3 ft/sec	1.6 in
EX. CB	Existing	10+14.78 55.0’ R	Type 2	4.6’, rim to sump	N/A	137.2	N/A	N/A	N/A	N/A	N/A
SD Pipe #1	Proposed	10+15.55 17.40’ R upstream 10+16.25 53.33’ R downstream	12” PVC	37.7 LF	138.6	137.2	3.7%	10.5 cfs	0.40 cfs	6.2 ft/sec	1.6 in
CB#1	Proposed	10+15.72 15.95’ R	Type 2		N/A	N/A	N/A	N/A	N/A	N/A	N/A
SD Pipe #2	Proposed	10+44.19 15.24’ R upstream 10+16.89 15.73’ R downstream	8” PVC	31.2 LF	139.8	138.6	3.8%	3.6 cfs	0.40 cfs	6.5 ft/sec	1.8 in
SWTS#1	Proposed	10+45.21 15.20’ R	4’x4’	2.5’, invert to top	N/A	139.8	N/A	treatment 1.42 cfs, max bypass	0.40 cfs	N/A	N/A
Culvert #2	Existing	13+08.67 9.43’ R upstream 12+97.88 7.83’ R downstream	6” HDPE	10.7 LF	152.4	152.2	1.9%	0.9 cfs	Replace in kind, no new flow	Replace in kind, no new flow	Replace in kind, no new flow
Culvert #3	Existing	13+20.27 19.85’ L upstream 13+09.46 20.96’ L downstream	6” HDPE	10.7 LF	153.4	153.3	0.9%	0.6 cfs	Outside project area	Outside project area	Outside project area
Culvert #4	Existing	14+27.34 19.87’ L upstream 13+75.14 18.42’ L downstream	12” HDPE	47.2 LF	156.1	155.2	1.9%	5.7 cfs	Outside project area	Outside project area	Outside project area
Culvert #5	Existing	15+44.76 64.09’ R upstream 15+75.18 68.54’ L downstream	30” CMP	135.3 LF	153.9	147.2	5.0%	58 cfs	1.7 cfs (from pond outlet)	5.0 ft/sec	3.7 in
Culvert #6	Existing	15+46.92 64.40’R upstream 15+77.67 69.07’ L downstream	30” CMP	136.1 LF	153.9	147.1	5.0%	58 cfs	1.7 cfs (from pond outlet)	5.0 ft/sec	3.7 in
SD Pipe #3	Proposed	15+70.70 64.96’ R upstream 15+54.83 68.10’ R downstream	12” PVC	17.5 LF	154.0	153.9	0.6%	4.2 cfs	3.4 cfs	5.7 ft/sec	8.5 in
SDMH #1	Proposed	15.72.12 64.75’ R	Type 2	4’, invert to top	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SD Pipe #4	Proposed	16+03.75 69.21’ R upstream 15+73.37 64.94’ R downstream	12” PVC	31.7 LF	154.0	153.8	0.6%	4.2 cfs	3.4 cfs	5.7 ft/sec	8.5 in
SD Pipe #5	Proposed	15+64.49 42.24’ R upstream 16+07.47 54.48’ R downstream	8” PVC	46.3 LF	157.5	154.0	7.6%	5.1 cfs	0.45 cfs	8.7 ft/sec	1.7 in
CB#2	Proposed	15+61.07 42.37’R	Type 2	2’, invert to top	157.5	157.5	N/A	N/A	N/A	N/A	N/A

SD Pipe #6	Proposed	15+62.36 16.59' R upstream 15+62.34 40.94' R downstream	8" PVC	26.5 LF	162.6	157.5	19.2%	8.2 cfs	0.45 cfs	12.2 ft/sec	1.4 in
SWTS#2	Proposed	15+62.29 13.49' R	4'x4'	2.42', invert to top	N/A	162.6	N/A	treatment 1.42 cfs, max bypass	0.45 cfs	N/A	N/A
Culvert #7	Existing	627597 N, 1027551 E upstream 627603 N, 1027589 E downstream	24" HDPE	39 LF	256.5 capped	255.0	3.8%	51 cfs (if opened)	Outside project area	Outside project area	Outside project area
Culvert #8	Existing	627642 N, 1027552 E upstream 627643 N, 1027587 E downstream	20" Concrete	35 LF	257.5	254.5	8.6%	47 cfs	Outside project area	Outside project area	Outside project area

[1] Pipe capacity calculated for 90% full pipe (maximum capacity), using Manning Pipe Flow equation (online calculator at https://www.hawsedc.com/engcalcs/Manning-Pipe-Flow.php). The Manning's roughness coefficient used was n= .009 for PVC, .012 for HDPE and concrete, and 0.022 for corrugated metal.

APPENDIX C –WWHM REPORTS FOR RUNOFF TREATMENT FOR TDA 2

KW Flow West Access Lane

KW Flow East Access Lane

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	KW Flow West Access Lane
Site Name:	
Site Address:	
City:	
Report Date:	4/9/2025
Gage:	Courthouse
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

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

Predeveloped

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Mod	0.479
Pervious Total	0.479
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.479

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Parking Lot - West Access Lane

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.479
Impervious Total	0.479
Basin Total	0.479

Element Flows To:

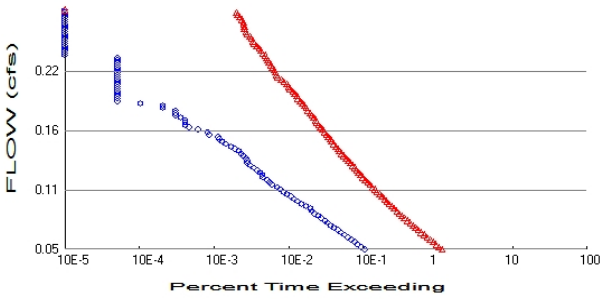
Surface	Interflow	Groundwater

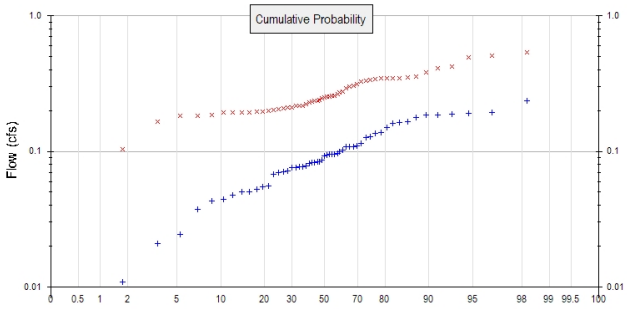
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.479
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.479

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.091707
5 year	0.164207
10 year	0.207461
25 year	0.253851
50 year	0.282456
100 year	0.306516

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.257653
5 year	0.340283
10 year	0.39107
25 year	0.451488
50 year	0.494139
100 year	0.53503

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.078	0.194
1957	0.166	0.348
1958	0.099	0.252
1959	0.067	0.306
1960	0.237	0.510
1961	0.087	0.195
1962	0.021	0.211
1963	0.185	0.408
1964	0.083	0.252
1965	0.137	0.270

1966	0.044	0.182
1967	0.189	0.346
1968	0.084	0.216
1969	0.055	0.182
1970	0.082	0.164
1971	0.075	0.192
1972	0.191	0.348
1973	0.093	0.230
1974	0.097	0.349
1975	0.077	0.222
1976	0.102	0.264
1977	0.050	0.357
1978	0.071	0.259
1979	0.081	0.291
1980	0.077	0.208
1981	0.139	0.337
1982	0.095	0.314
1983	0.094	0.534
1984	0.164	0.422
1985	0.052	0.341
1986	0.115	0.247
1987	0.126	0.202
1988	0.038	0.205
1989	0.024	0.184
1990	0.108	0.348
1991	0.185	0.328
1992	0.108	0.257
1993	0.084	0.300
1994	0.070	0.195
1995	0.076	0.196
1996	0.178	0.333
1997	0.011	0.090
1998	0.001	0.104
1999	0.096	0.215
2000	0.050	0.277
2001	0.055	0.200
2002	0.150	0.241
2003	0.070	0.235
2004	0.193	0.495
2005	0.095	0.196
2006	0.109	0.210
2007	0.160	0.249
2008	0.128	0.217
2009	0.043	0.382
2010	0.048	0.233
2011	0.109	0.237

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2372	0.5343
2	0.1935	0.5102
3	0.1910	0.4947
4	0.1893	0.4224
5	0.1854	0.4077
6	0.1848	0.3823
7	0.1780	0.3574
8	0.1661	0.3488

9	0.1643	0.3483
10	0.1604	0.3483
11	0.1504	0.3476
12	0.1387	0.3457
13	0.1366	0.3408
14	0.1284	0.3371
15	0.1258	0.3327
16	0.1148	0.3280
17	0.1091	0.3141
18	0.1088	0.3057
19	0.1084	0.2999
20	0.1081	0.2911
21	0.1023	0.2768
22	0.0990	0.2702
23	0.0969	0.2641
24	0.0957	0.2585
25	0.0951	0.2571
26	0.0948	0.2521
27	0.0944	0.2519
28	0.0926	0.2491
29	0.0867	0.2475
30	0.0837	0.2406
31	0.0835	0.2369
32	0.0829	0.2353
33	0.0824	0.2331
34	0.0810	0.2303
35	0.0777	0.2223
36	0.0773	0.2168
37	0.0770	0.2156
38	0.0757	0.2154
39	0.0755	0.2113
40	0.0712	0.2096
41	0.0702	0.2080
42	0.0701	0.2049
43	0.0675	0.2018
44	0.0552	0.2001
45	0.0547	0.1965
46	0.0523	0.1961
47	0.0504	0.1947
48	0.0501	0.1947
49	0.0478	0.1944
50	0.0441	0.1925
51	0.0428	0.1843
52	0.0376	0.1824
53	0.0243	0.1817
54	0.0210	0.1644
55	0.0109	0.1043
56	0.0009	0.0903

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0459	2066	22228	1075	Fail
0.0482	1843	20205	1096	Fail
0.0506	1631	18450	1131	Fail
0.0530	1491	16812	1127	Fail
0.0554	1346	15391	1143	Fail
0.0578	1216	14055	1155	Fail
0.0602	1101	12830	1165	Fail
0.0626	988	11699	1184	Fail
0.0650	888	10698	1204	Fail
0.0674	793	9849	1241	Fail
0.0698	711	9052	1273	Fail
0.0721	652	8335	1278	Fail
0.0745	601	7670	1276	Fail
0.0769	536	6983	1302	Fail
0.0793	486	6458	1328	Fail
0.0817	437	5914	1353	Fail
0.0841	403	5518	1369	Fail
0.0865	381	5074	1331	Fail
0.0889	333	4713	1415	Fail
0.0913	292	4349	1489	Fail
0.0937	258	4053	1570	Fail
0.0960	231	3770	1632	Fail
0.0984	207	3505	1693	Fail
0.1008	186	3248	1746	Fail
0.1032	167	2989	1789	Fail
0.1056	151	2798	1852	Fail
0.1080	139	2590	1863	Fail
0.1104	116	2413	2080	Fail
0.1128	108	2246	2079	Fail
0.1152	101	2085	2064	Fail
0.1176	89	1939	2178	Fail
0.1199	87	1813	2083	Fail
0.1223	81	1693	2090	Fail
0.1247	75	1596	2128	Fail
0.1271	67	1501	2240	Fail
0.1295	60	1412	2353	Fail
0.1319	55	1318	2396	Fail
0.1343	54	1238	2292	Fail
0.1367	52	1151	2213	Fail
0.1391	48	1081	2252	Fail
0.1415	45	1009	2242	Fail
0.1438	42	937	2230	Fail
0.1462	37	893	2413	Fail
0.1486	33	838	2539	Fail
0.1510	28	788	2814	Fail
0.1534	25	742	2968	Fail
0.1558	23	709	3082	Fail
0.1582	22	669	3040	Fail
0.1606	17	628	3694	Fail
0.1630	16	589	3681	Fail
0.1653	12	557	4641	Fail
0.1677	9	523	5811	Fail
0.1701	8	494	6175	Fail
0.1725	8	470	5875	Fail

0.1749	8	453	5662	Fail
0.1773	7	426	6085	Fail
0.1797	6	399	6650	Fail
0.1821	6	377	6283	Fail
0.1845	6	350	5833	Fail
0.1869	4	337	8425	Fail
0.1892	4	317	7925	Fail
0.1916	2	299	14950	Fail
0.1940	1	281	28100	Fail
0.1964	1	263	26300	Fail
0.1988	1	252	25200	Fail
0.2012	1	237	23700	Fail
0.2036	1	223	22300	Fail
0.2060	1	205	20500	Fail
0.2084	1	195	19500	Fail
0.2108	1	185	18500	Fail
0.2131	1	170	17000	Fail
0.2155	1	156	15600	Fail
0.2179	1	141	14100	Fail
0.2203	1	135	13500	Fail
0.2227	1	129	12900	Fail
0.2251	1	125	12500	Fail
0.2275	1	119	11900	Fail
0.2299	1	113	11300	Fail
0.2323	1	107	10700	Fail
0.2347	1	103	10300	Fail
0.2370	1	98	9800	Fail
0.2394	0	95	n/a	Fail
0.2418	0	88	n/a	Fail
0.2442	0	83	n/a	Fail
0.2466	0	79	n/a	Fail
0.2490	0	73	n/a	Fail
0.2514	0	68	n/a	Fail
0.2538	0	66	n/a	Fail
0.2562	0	62	n/a	Fail
0.2586	0	59	n/a	Fail
0.2609	0	54	n/a	Fail
0.2633	0	52	n/a	Fail
0.2657	0	50	n/a	Fail
0.2681	0	50	n/a	Fail
0.2705	0	49	n/a	Fail
0.2729	0	49	n/a	Fail
0.2753	0	46	n/a	Fail
0.2777	0	43	n/a	Fail
0.2801	0	40	n/a	Fail
0.2825	0	39	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.0796 acre-feet
On-line facility target flow:	0.1028 cfs.
Adjusted for 15 min:	0.1028 cfs.
Off-line facility target flow:	0.058 cfs.
Adjusted for 15 min:	0.058 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
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

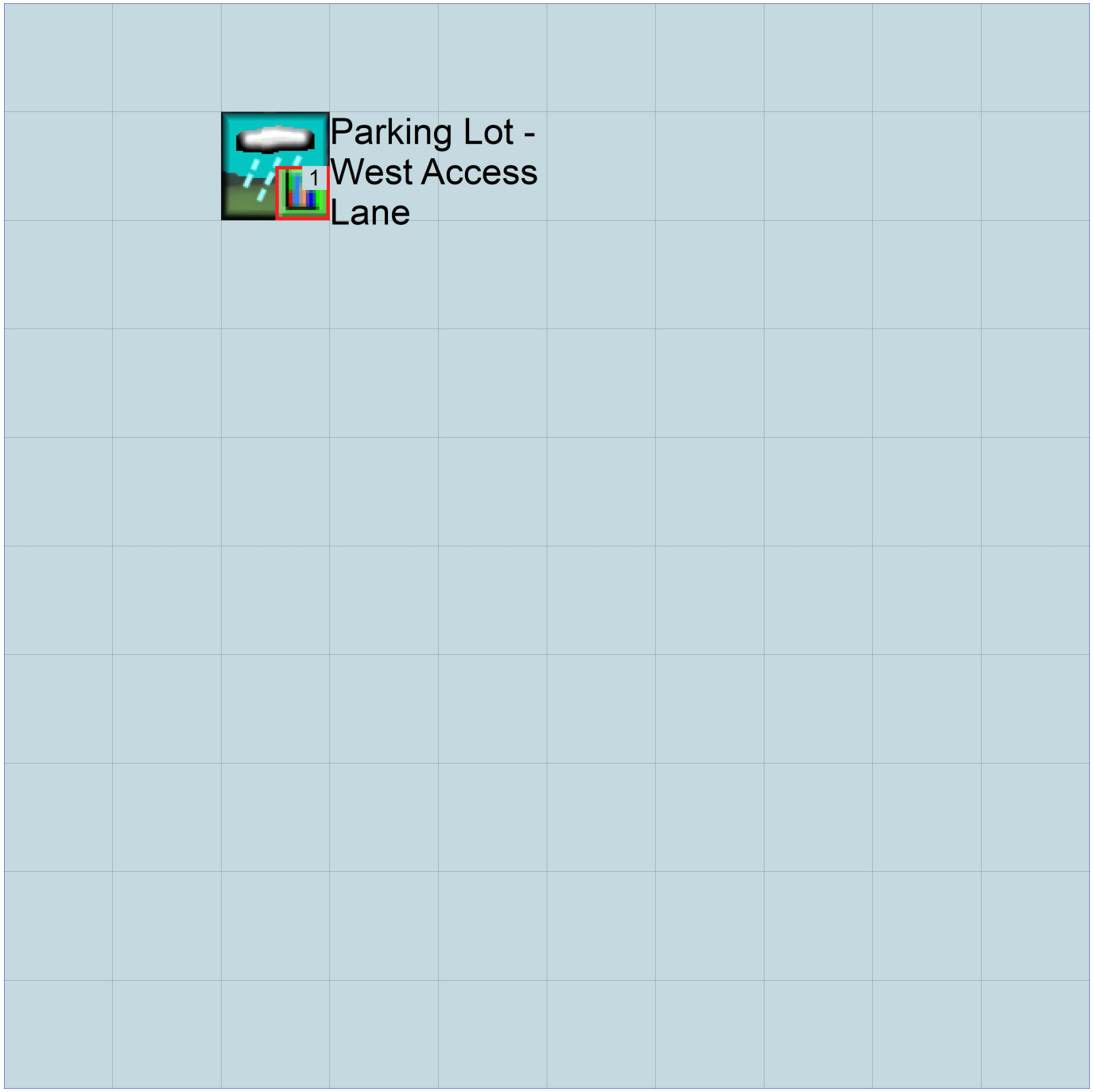
IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2011 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   KW Flow West Access Lane.wdm
MESSU       25   PreKW Flow West Access Lane.MES
            27   PreKW Flow West Access Lane.L61
            28   PreKW Flow West Access Lane.L62
            30   POCKW Flow West Access Lane1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      20
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Predeveloped               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           ***
   20     SAT, 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 ***
   20         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  *********
   20         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 ***
   20         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
   20              0         4         2       100      0.01       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   20             0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                            ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   20          0.2         3       0.5         1       0.7       0.8
  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
   20             0         0         0         0       4.2         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#   ***
Predeveloped***
PERLND  20                      0.479     COPY   501     12
PERLND  20                      0.479     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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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       1955 10 01        END    2011 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   KW Flow West Access Lane.wdm
MESSU       25   MitKW Flow West Access Lane.MES
            27   MitKW Flow West Access Lane.L61
            28   MitKW Flow West Access Lane.L62
            30   POCKW Flow West Access Lane1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Parking Lot - West Access   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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

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

```
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                            ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2      ROADS/MOD              1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         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     ***
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

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

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

END IMPLND
```

```
SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Parking Lot - West Access Lane***
IMPLND   2                       0.479     COPY   501     15

******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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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WWHM2012

PROJECT REPORT

General Model Information

Project Name:	KW Flow East Access Lane
Site Name:	
Site Address:	
City:	
Report Date:	4/9/2025
Gage:	Courthouse
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

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
SAT, Forest, Mod	0.422
Pervious Total	0.422
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.422

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.422
Impervious Total	0.422
Basin Total	0.422

Element Flows To:

Surface	Interflow	Groundwater

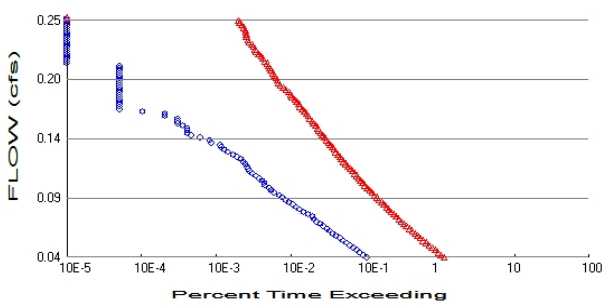
Routing Elements

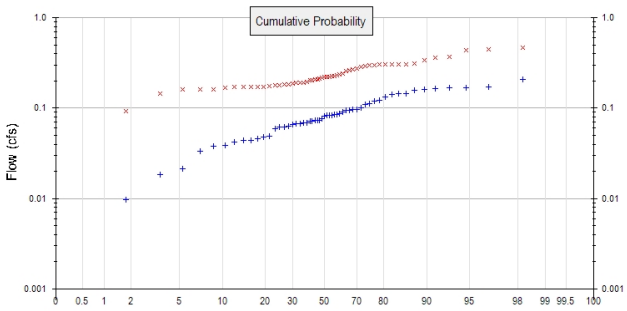
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.422
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.422

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.080794
5 year	0.144666
10 year	0.182774
25 year	0.223644
50 year	0.248844
100 year	0.270041

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.226993
5 year	0.29979
10 year	0.344533
25 year	0.397761
50 year	0.435337
100 year	0.471362

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.068	0.171
1957	0.146	0.307
1958	0.087	0.222
1959	0.059	0.269
1960	0.209	0.449
1961	0.076	0.172
1962	0.018	0.186
1963	0.163	0.359
1964	0.073	0.222
1965	0.120	0.238

1966	0.039	0.161
1967	0.167	0.305
1968	0.074	0.190
1969	0.048	0.160
1970	0.073	0.145
1971	0.066	0.170
1972	0.168	0.307
1973	0.082	0.203
1974	0.085	0.307
1975	0.068	0.196
1976	0.090	0.233
1977	0.044	0.315
1978	0.063	0.228
1979	0.071	0.256
1980	0.068	0.183
1981	0.122	0.297
1982	0.083	0.277
1983	0.083	0.471
1984	0.145	0.372
1985	0.046	0.300
1986	0.101	0.218
1987	0.111	0.178
1988	0.033	0.181
1989	0.021	0.162
1990	0.095	0.306
1991	0.163	0.289
1992	0.096	0.226
1993	0.074	0.264
1994	0.062	0.172
1995	0.067	0.173
1996	0.157	0.293
1997	0.010	0.080
1998	0.001	0.092
1999	0.084	0.190
2000	0.044	0.244
2001	0.049	0.176
2002	0.133	0.212
2003	0.062	0.207
2004	0.170	0.436
2005	0.084	0.173
2006	0.096	0.185
2007	0.141	0.219
2008	0.113	0.191
2009	0.038	0.337
2010	0.042	0.205
2011	0.096	0.209

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2089	0.4707
2	0.1704	0.4495
3	0.1683	0.4358
4	0.1667	0.3721
5	0.1633	0.3592
6	0.1628	0.3368
7	0.1568	0.3149
8	0.1464	0.3073

9	0.1448	0.3068
10	0.1413	0.3068
11	0.1325	0.3063
12	0.1222	0.3045
13	0.1204	0.3003
14	0.1131	0.2970
15	0.1108	0.2931
16	0.1012	0.2890
17	0.0961	0.2768
18	0.0959	0.2694
19	0.0955	0.2642
20	0.0952	0.2565
21	0.0901	0.2439
22	0.0873	0.2381
23	0.0854	0.2326
24	0.0843	0.2277
25	0.0838	0.2265
26	0.0835	0.2221
27	0.0831	0.2219
28	0.0816	0.2195
29	0.0764	0.2180
30	0.0737	0.2120
31	0.0736	0.2087
32	0.0731	0.2073
33	0.0726	0.2053
34	0.0714	0.2029
35	0.0684	0.1958
36	0.0681	0.1910
37	0.0679	0.1899
38	0.0667	0.1898
39	0.0665	0.1861
40	0.0628	0.1847
41	0.0619	0.1832
42	0.0617	0.1805
43	0.0595	0.1778
44	0.0486	0.1763
45	0.0482	0.1731
46	0.0461	0.1728
47	0.0444	0.1716
48	0.0441	0.1715
49	0.0421	0.1712
50	0.0388	0.1696
51	0.0377	0.1624
52	0.0331	0.1607
53	0.0214	0.1601
54	0.0185	0.1449
55	0.0096	0.0919
56	0.0008	0.0795

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0404	2066	22228	1075	Fail
0.0425	1843	20205	1096	Fail
0.0446	1631	18454	1131	Fail
0.0467	1491	16812	1127	Fail
0.0488	1346	15396	1143	Fail
0.0509	1216	14057	1156	Fail
0.0530	1101	12828	1165	Fail
0.0551	988	11701	1184	Fail
0.0572	887	10696	1205	Fail
0.0593	794	9851	1240	Fail
0.0615	711	9052	1273	Fail
0.0636	652	8337	1278	Fail
0.0657	601	7670	1276	Fail
0.0678	536	6984	1302	Fail
0.0699	486	6460	1329	Fail
0.0720	437	5918	1354	Fail
0.0741	403	5518	1369	Fail
0.0762	381	5074	1331	Fail
0.0783	333	4713	1415	Fail
0.0804	292	4349	1489	Fail
0.0825	258	4053	1570	Fail
0.0846	231	3770	1632	Fail
0.0867	207	3505	1693	Fail
0.0888	186	3248	1746	Fail
0.0909	167	2989	1789	Fail
0.0930	151	2798	1852	Fail
0.0951	137	2582	1884	Fail
0.0972	116	2405	2073	Fail
0.0994	107	2242	2095	Fail
0.1015	101	2085	2064	Fail
0.1036	89	1940	2179	Fail
0.1057	87	1813	2083	Fail
0.1078	81	1694	2091	Fail
0.1099	75	1597	2129	Fail
0.1120	67	1506	2247	Fail
0.1141	60	1413	2355	Fail
0.1162	55	1318	2396	Fail
0.1183	53	1236	2332	Fail
0.1204	51	1148	2250	Fail
0.1225	48	1080	2250	Fail
0.1246	45	1008	2240	Fail
0.1267	42	936	2228	Fail
0.1288	37	893	2413	Fail
0.1309	33	839	2542	Fail
0.1330	28	790	2821	Fail
0.1351	25	744	2976	Fail
0.1373	23	709	3082	Fail
0.1394	22	669	3040	Fail
0.1415	17	628	3694	Fail
0.1436	16	589	3681	Fail
0.1457	12	559	4658	Fail
0.1478	9	523	5811	Fail
0.1499	8	495	6187	Fail
0.1520	8	471	5887	Fail

0.1541	8	454	5675	Fail
0.1562	7	425	6071	Fail
0.1583	6	398	6633	Fail
0.1604	6	377	6283	Fail
0.1625	6	350	5833	Fail
0.1646	4	337	8425	Fail
0.1667	4	317	7925	Fail
0.1688	2	299	14950	Fail
0.1709	1	281	28100	Fail
0.1730	1	263	26300	Fail
0.1752	1	252	25200	Fail
0.1773	1	237	23700	Fail
0.1794	1	223	22300	Fail
0.1815	1	205	20500	Fail
0.1836	1	195	19500	Fail
0.1857	1	185	18500	Fail
0.1878	1	170	17000	Fail
0.1899	1	156	15600	Fail
0.1920	1	142	14200	Fail
0.1941	1	135	13500	Fail
0.1962	1	129	12900	Fail
0.1983	1	124	12400	Fail
0.2004	1	119	11900	Fail
0.2025	1	113	11300	Fail
0.2046	1	107	10700	Fail
0.2067	1	103	10300	Fail
0.2088	1	98	9800	Fail
0.2109	0	95	n/a	Fail
0.2131	0	88	n/a	Fail
0.2152	0	83	n/a	Fail
0.2173	0	79	n/a	Fail
0.2194	0	73	n/a	Fail
0.2215	0	68	n/a	Fail
0.2236	0	66	n/a	Fail
0.2257	0	62	n/a	Fail
0.2278	0	59	n/a	Fail
0.2299	0	54	n/a	Fail
0.2320	0	52	n/a	Fail
0.2341	0	50	n/a	Fail
0.2362	0	50	n/a	Fail
0.2383	0	49	n/a	Fail
0.2404	0	49	n/a	Fail
0.2425	0	46	n/a	Fail
0.2446	0	43	n/a	Fail
0.2467	0	40	n/a	Fail
0.2488	0	39	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.0701 acre-feet
On-line facility target flow:	0.0905 cfs.
Adjusted for 15 min:	0.0905 cfs.
Off-line facility target flow:	0.0511 cfs.
Adjusted for 15 min:	0.0511 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
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

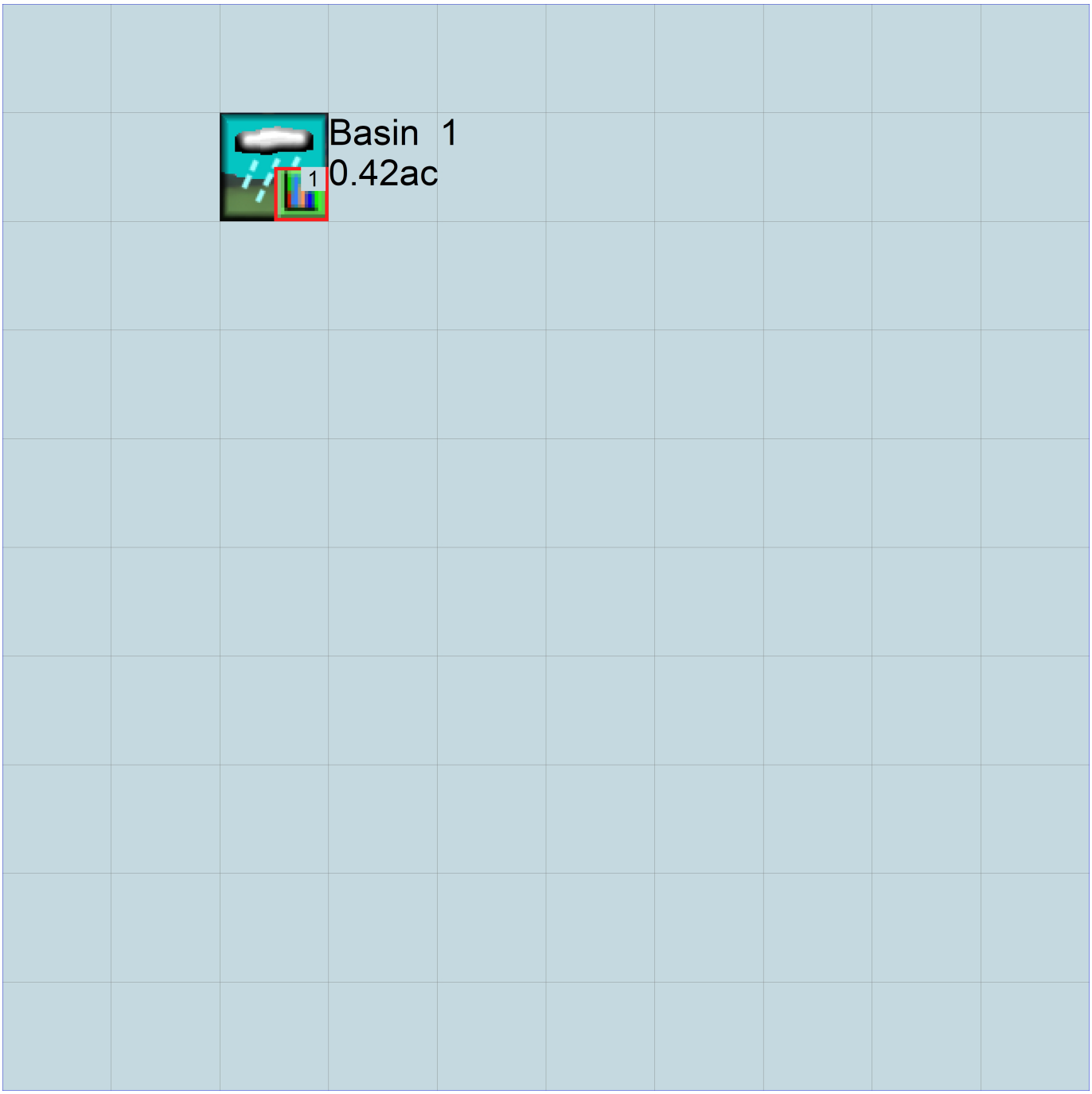
No PERLND changes have been made.

IMPLND Changes

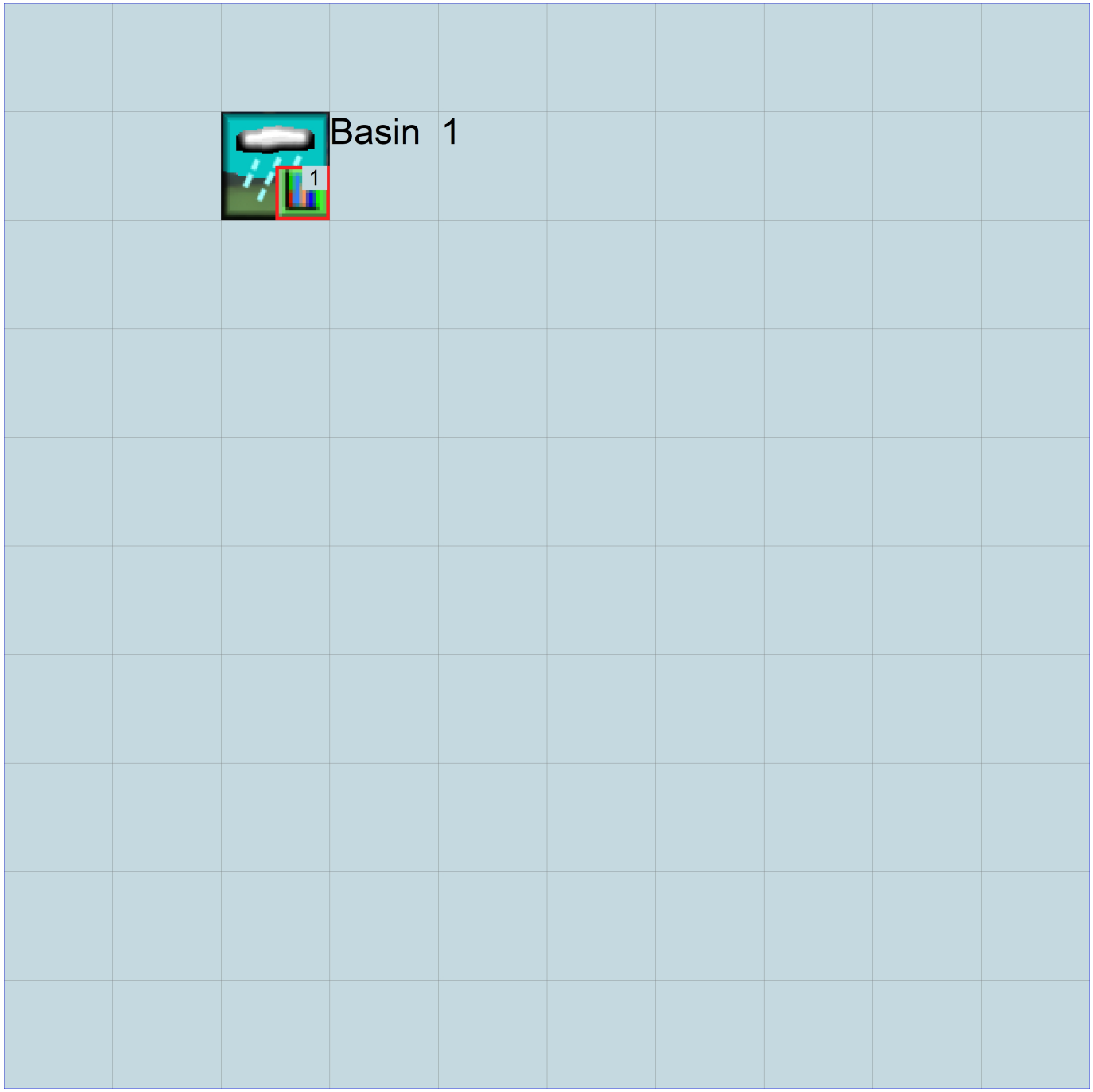
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2011 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   KW Flow East Access Lane.wdm
MESSU       25   PreKW Flow East Access Lane.MES
            27   PreKW Flow East Access Lane.L61
            28   PreKW Flow East Access Lane.L62
            30   POCKW Flow East Access Lane1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      20
      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           ***
   20     SAT, 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 ***
   20         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  *********
   20         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 ***
   20         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
   20              0         4         2       100      0.01       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   20             0         0        10         2         0         0       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                            ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   20          0.2         3       0.5         1       0.7       0.8
  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
   20             0         0         0         0       4.2         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  20                       0.422     COPY   501     12
PERLND  20                       0.422     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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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       1955 10 01        END    2011 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   KW Flow East Access Lane.wdm
MESSU       25   MitKW Flow East Access Lane.MES
            27   MitKW Flow East Access Lane.L61
            28   MitKW Flow East Access Lane.L62
            30   POCKW Flow East Access Lane1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       2
      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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

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

```
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2      ROADS/MOD              1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         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     ***
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            400      0.05       0.1      0.08
  END IWAT-PARM2

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

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

END IMPLND
```

```
SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   2                      0.422     COPY   501     15

******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              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              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
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX D –WWHM REPORT FOR FLOW CONTROL FOR TDA 2

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	KW Flow Control TDA 2 3_24-2026
Site Name:	Kaiser Woods Park
Site Address:	
City:	
Report Date:	3/24/2026
Gage:	Courthouse
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

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
SAT, Forest, Mod	9.29
Pervious Total	9.29
Impervious Land Use	acre
Impervious Total	0
Basin Total	9.29

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Parking lot-west access land-pond

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS MOD	0.479
POND	0.067
Impervious Total	0.546
Basin Total	0.546

Element Flows To:

Surface	Interflow	Groundwater
Pond	Pond	

Forest area

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT, Forest, Mod	7.974
Pervious Total	7.974
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.974

Element Flows To:

Surface	Interflow	Groundwater
Pond	Pond	

East Access Lane

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
SAT, Forest, Mod	0.44
Pervious Total	0.44

Impervious Land Use	acre
ROADS MOD	0.33
Impervious Total	0.33
Basin Total	0.77

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Pond

Bottom Length: 34.40 ft.
Bottom Width: 34.40 ft.
Depth: 4 ft.
Volume at riser head: 0.1281 acre-feet.
Side slope 1: 2 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 3 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 4 in. Elevation:0 ft.
Orifice 2 Diameter: 5 in. Elevation:2 ft.
Element Flows To:
Outlet 1 Outlet 2

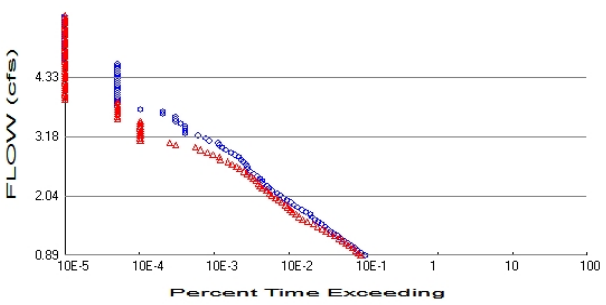
Pond Hydraulic Table

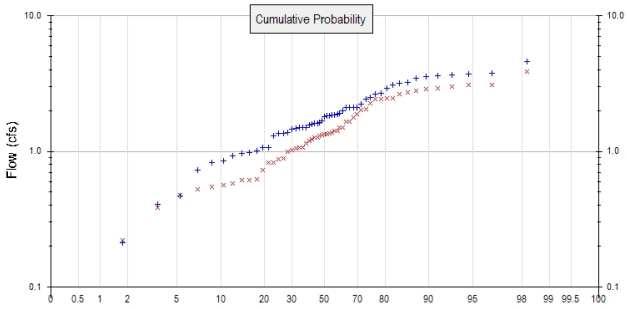
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)	
154.00	0.027	0.000	0.000	0.000	POND BOTTOM/ORIFICE #1
154.04	0.027	0.001	0.091	0.000	
154.09	0.027	0.002	0.129	0.000	
154.13	0.028	0.003	0.158	0.000	
154.18	0.028	0.005	0.183	0.000	
154.22	0.029	0.006	0.204	0.000	
154.27	0.029	0.007	0.224	0.000	
154.31	0.029	0.008	0.242	0.000	
154.36	0.030	0.010	0.258	0.000	
154.40	0.030	0.011	0.274	0.000	
154.44	0.031	0.013	0.289	0.000	
154.49	0.031	0.014	0.303	0.000	
154.53	0.032	0.015	0.317	0.000	
154.58	0.032	0.017	0.330	0.000	
154.62	0.032	0.018	0.342	0.000	
154.67	0.033	0.020	0.354	0.000	
154.71	0.033	0.021	0.366	0.000	
154.76	0.034	0.023	0.377	0.000	
154.80	0.034	0.024	0.388	0.000	
154.84	0.035	0.026	0.399	0.000	
154.89	0.035	0.027	0.409	0.000	
154.93	0.035	0.029	0.419	0.000	
154.98	0.036	0.030	0.429	0.000	
155.02	0.036	0.032	0.439	0.000	
155.07	0.037	0.034	0.448	0.000	
155.11	0.037	0.035	0.457	0.000	
155.16	0.038	0.037	0.466	0.000	
155.20	0.038	0.039	0.475	0.000	
155.24	0.039	0.041	0.484	0.000	
155.29	0.039	0.042	0.492	0.000	
155.33	0.040	0.044	0.501	0.000	
155.38	0.040	0.046	0.509	0.000	
155.42	0.040	0.048	0.517	0.000	
155.47	0.041	0.049	0.525	0.000	

155.51	0.041	0.051	0.533	0.000	
155.56	0.042	0.053	0.541	0.000	
155.60	0.042	0.055	0.549	0.000	
155.64	0.043	0.057	0.556	0.000	
155.69	0.043	0.059	0.564	0.000	
155.73	0.044	0.061	0.571	0.000	
155.78	0.044	0.063	0.578	0.000	
155.82	0.045	0.065	0.586	0.000	
155.87	0.045	0.067	0.593	0.000	
155.91	0.046	0.069	0.600	0.000	
155.96	0.046	0.071	0.607	0.000	
156.00	0.047	0.073	0.614	0.000	ORIFICE #2
156.04	0.047	0.075	0.763	0.000	
156.09	0.048	0.077	0.829	0.000	
156.13	0.048	0.080	0.881	0.000	
156.18	0.049	0.082	0.926	0.000	
156.22	0.049	0.084	0.967	0.000	
156.27	0.050	0.086	1.004	0.000	
156.31	0.050	0.088	1.038	0.000	
156.36	0.051	0.091	1.070	0.000	
156.40	0.052	0.093	1.101	0.000	
156.44	0.052	0.095	1.131	0.000	
156.49	0.053	0.098	1.159	0.000	
156.53	0.053	0.100	1.186	0.000	
156.58	0.054	0.102	1.212	0.000	
156.62	0.054	0.105	1.238	0.000	
156.67	0.055	0.107	1.263	0.000	
156.71	0.055	0.110	1.287	0.000	
156.76	0.056	0.112	1.310	0.000	
156.80	0.056	0.115	1.333	0.000	2-YEAR STORM
156.84	0.057	0.117	1.355	0.000	
156.89	0.058	0.120	1.377	0.000	
156.93	0.058	0.122	1.399	0.000	
156.98	0.059	0.125	1.420	0.000	
157.02	0.059	0.128	1.475	0.000	RISER ELEVATION
157.07	0.060	0.130	1.643	0.000	
157.11	0.060	0.133	1.870	0.000	
157.16	0.061	0.136	2.137	0.000	5-YEAR STORM
157.20	0.062	0.138	2.427	0.000	
157.24	0.062	0.141	2.722	0.000	10-YEAR STORM
157.29	0.063	0.144	3.005	0.000	
157.33	0.063	0.147	3.259	0.000	25-YEAR STORM
157.38	0.064	0.150	3.473	0.000	
157.42	0.065	0.153	3.641	0.000	
157.47	0.065	0.155	3.768	0.000	50-YEAR STORM
157.51	0.066	0.158	3.899	0.000	
157.56	0.066	0.161	4.012	0.000	
157.60	0.067	0.164	4.121	0.000	
157.64	0.068	0.167	4.227	0.000	
157.69	0.068	0.170	4.329	0.000	
157.73	0.069	0.173	4.429	0.000	
157.78	0.069	0.177	4.526	0.000	
157.82	0.070	0.180	4.620	0.000	
157.87	0.071	0.183	4.712	0.000	
157.91	0.071	0.186	4.802	0.000	
157.96	0.072	0.189	4.891	0.000	EMERGENCY SPILLWAY
158.00	0.072	0.192	4.977	0.000	BASE
158.04	0.073	0.196	5.062	0.000	

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 9.29
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 8.414
Total Impervious Area: 0.876

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.778623
5 year	3.184719
10 year	4.02362
25 year	4.923338
50 year	5.478108
100 year	5.94475

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.350209
5 year	2.228157
10 year	2.778118
25 year	3.414113
50 year	3.842008
100 year	4.231698

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	1.506	1.340
1957	3.222	2.908
1958	1.921	0.996
1959	1.309	1.017
1960	4.600	2.868
1961	1.681	1.062
1962	0.407	0.385
1963	3.596	2.435
1964	1.609	1.310
1965	2.650	2.471

1966	0.854	0.564
1967	3.671	2.799
1968	1.623	1.055
1969	1.060	0.616
1970	1.597	1.195
1971	1.463	1.264
1972	3.705	2.434
1973	1.796	1.062
1974	1.880	1.153
1975	1.494	0.831
1976	1.984	1.492
1977	0.972	0.615
1978	1.382	1.324
1979	1.572	1.420
1980	1.499	1.237
1981	2.689	1.652
1982	1.838	1.492
1983	1.830	1.646
1984	3.187	1.345
1985	1.015	0.576
1986	2.227	2.259
1987	2.439	2.461
1988	0.729	0.547
1989	0.471	0.472
1990	2.097	1.886
1991	3.583	3.106
1992	2.103	1.409
1993	1.620	0.884
1994	1.359	0.725
1995	1.469	1.374
1996	3.452	3.008
1997	0.212	0.222
1998	0.017	0.151
1999	1.857	1.771
2000	0.977	0.877
2001	1.070	0.623
2002	2.917	2.722
2003	1.362	1.262
2004	3.752	3.862
2005	1.844	1.353
2006	2.115	2.042
2007	3.111	3.098
2008	2.490	2.628
2009	0.831	0.823
2010	0.926	0.526
2011	2.110	2.028

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	4.5997	3.8620
2	3.7520	3.1056
3	3.7049	3.0979
4	3.6706	3.0084
5	3.5959	2.9078
6	3.5834	2.8683
7	3.4516	2.7989
8	3.2220	2.7225

9	3.1873	2.6282
10	3.1105	2.4708
11	2.9172	2.4609
12	2.6891	2.4354
13	2.6500	2.4339
14	2.4904	2.2588
15	2.4390	2.0416
16	2.2273	2.0278
17	2.1151	1.8858
18	2.1102	1.7712
19	2.1025	1.6519
20	2.0967	1.6458
21	1.9835	1.4923
22	1.9209	1.4917
23	1.8802	1.4201
24	1.8566	1.4092
25	1.8440	1.3737
26	1.8378	1.3528
27	1.8300	1.3453
28	1.7961	1.3398
29	1.6808	1.3242
30	1.6228	1.3095
31	1.6197	1.2636
32	1.6087	1.2622
33	1.5974	1.2372
34	1.5717	1.1949
35	1.5062	1.1531
36	1.4995	1.0624
37	1.4938	1.0621
38	1.4686	1.0552
39	1.4635	1.0174
40	1.3815	0.9962
41	1.3619	0.8844
42	1.3591	0.8772
43	1.3089	0.8306
44	1.0697	0.8231
45	1.0601	0.7248
46	1.0150	0.6229
47	0.9768	0.6159
48	0.9716	0.6146
49	0.9264	0.5758
50	0.8545	0.5643
51	0.8307	0.5473
52	0.7285	0.5263
53	0.4710	0.4725
54	0.4072	0.3847
55	0.2117	0.2215
56	0.0168	0.1515

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8893	2068	1803	87	Pass
0.9357	1847	1668	90	Pass
0.9820	1631	1541	94	Pass
1.0284	1491	1400	93	Pass
1.0747	1349	1252	92	Pass
1.1211	1216	1144	94	Pass
1.1674	1104	1025	92	Pass
1.2138	989	932	94	Pass
1.2601	888	820	92	Pass
1.3065	794	715	90	Pass
1.3528	712	611	85	Pass
1.3992	652	552	84	Pass
1.4455	601	479	79	Pass
1.4919	538	418	77	Pass
1.5382	486	351	72	Pass
1.5846	438	299	68	Pass
1.6309	404	272	67	Pass
1.6773	381	243	63	Pass
1.7236	333	221	66	Pass
1.7700	293	205	69	Pass
1.8163	258	192	74	Pass
1.8627	233	180	77	Pass
1.9090	207	158	76	Pass
1.9554	186	142	76	Pass
2.0017	167	129	77	Pass
2.0481	151	116	76	Pass
2.0944	139	108	77	Pass
2.1408	116	98	84	Pass
2.1872	107	87	81	Pass
2.2335	101	81	80	Pass
2.2799	89	77	86	Pass
2.3262	87	71	81	Pass
2.3726	81	66	81	Pass
2.4189	75	61	81	Pass
2.4653	67	54	80	Pass
2.5116	60	50	83	Pass
2.5580	55	43	78	Pass
2.6043	54	39	72	Pass
2.6507	52	34	65	Pass
2.6970	48	30	62	Pass
2.7434	45	24	53	Pass
2.7897	42	23	54	Pass
2.8361	37	19	51	Pass
2.8824	33	16	48	Pass
2.9288	28	13	46	Pass
2.9751	25	11	44	Pass
3.0215	23	6	26	Pass
3.0678	22	5	22	Pass
3.1142	17	2	11	Pass
3.1605	15	2	13	Pass
3.2069	12	2	16	Pass
3.2532	8	2	25	Pass
3.2996	8	2	25	Pass

3.3459	8	2	25	Pass
3.3923	8	2	25	Pass
3.4386	7	2	28	Pass
3.4850	6	2	33	Pass
3.5313	6	1	16	Pass
3.5777	6	1	16	Pass
3.6240	4	1	25	Pass
3.6704	4	1	25	Pass
3.7168	2	1	50	Pass
3.7631	1	1	100	Pass
3.8095	1	1	100	Pass
3.8558	1	1	100	Pass
3.9022	1	0	0	Pass
3.9485	1	0	0	Pass
3.9949	1	0	0	Pass
4.0412	1	0	0	Pass
4.0876	1	0	0	Pass
4.1339	1	0	0	Pass
4.1803	1	0	0	Pass
4.2266	1	0	0	Pass
4.2730	1	0	0	Pass
4.3193	1	0	0	Pass
4.3657	1	0	0	Pass
4.4120	1	0	0	Pass
4.4584	1	0	0	Pass
4.5047	1	0	0	Pass
4.5511	1	0	0	Pass
4.5974	1	0	0	Pass
4.6438	0	0	0	Pass
4.6901	0	0	0	Pass
4.7365	0	0	0	Pass
4.7828	0	0	0	Pass
4.8292	0	0	0	Pass
4.8755	0	0	0	Pass
4.9219	0	0	0	Pass
4.9682	0	0	0	Pass
5.0146	0	0	0	Pass
5.0609	0	0	0	Pass
5.1073	0	0	0	Pass
5.1536	0	0	0	Pass
5.2000	0	0	0	Pass
5.2464	0	0	0	Pass
5.2927	0	0	0	Pass
5.3391	0	0	0	Pass
5.3854	0	0	0	Pass
5.4318	0	0	0	Pass
5.4781	0	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Pond POC	☐	473.52			☐	0.00			
Total Volume Infiltrated		473.52	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

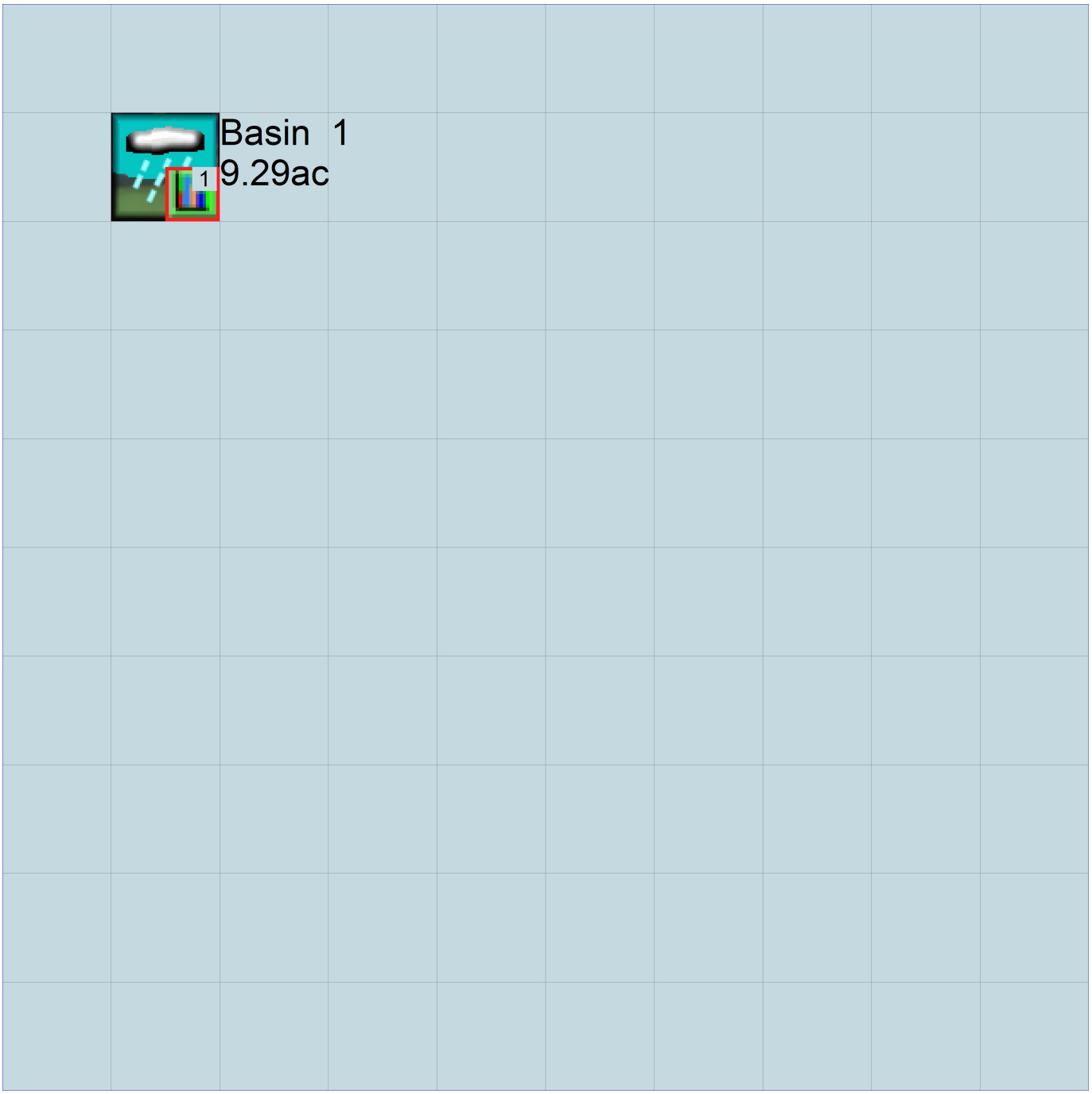
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

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Local (360)943-0304

www.clearcreeksolutions.com

APPENDIX E – FEMA FIRM PANEL

FLOOD HAZARD INFORMATION

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

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTPS://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*
- Area with Flood Risk due to Levee *Zone D*

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

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

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

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available effective flood hazard information for your community, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Mapping and Insurance Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be downloaded from the website. Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be acquired directly from the Flood Map Service Center at the website listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery. Last refreshed October, 2020.

Note: Some Special Flood Hazard Areas with elevations may not appear with elevation labels if the Base Flood Elevation or Cross-section line which communicates the elevation for the location appears on the adjacent panel. Please see the Panel Locator Diagram on this map panel to determine the adjacent panel and find the elevation feature there, or alternatively use the Flood Insurance Study report for detailed elevations by flood source.

PROJECT SITE

SCALE

1 inch = 500 feet 1:6,000

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

0 50 100 200 300 400 meters

Map Projection:
NAD 1983 StatePlane Washington South FIPS 4602 Feet
Vertical Datum: NAVD88

PANEL LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

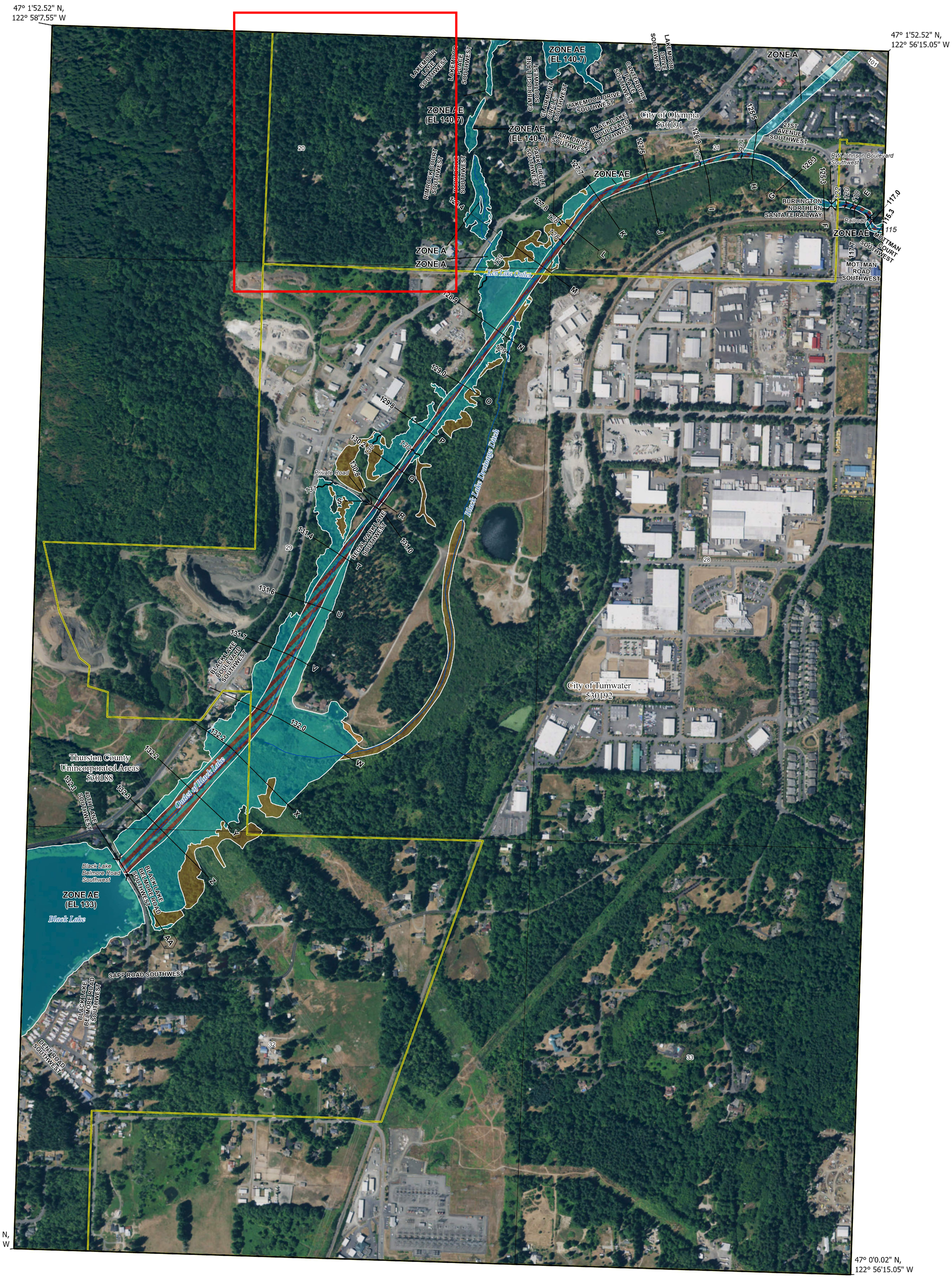
FLOOD INSURANCE RATE MAP

THURSTON COUNTY WASHINGTON AND INCORPORATED AREAS

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY OF OLYMPIA	530191	0162	F
THURSTON COUNTY UNINCORPORATED AREAS	530188	0162	F

MAP NUMBER
53067C0162F
EFFECTIVE DATE
May 08, 2024



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- 17.5 Water Surface Elevation
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

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Basemap information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery. Last refreshed October, 2020.

Note: Some Special Flood Hazard Areas with elevations may not appear with elevation labels if the Base Flood Elevation or Cross-section line which communicates the elevation for the location appears on the adjacent panel. Please see the Panel Locator Diagram on this map panel to determine the adjacent panel and find the elevation feature there, or alternatively use the Flood Insurance Study report for detailed elevations by flood source.

SCALE

N

1 inch = 500 feet 1:6,000

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

0 50 100 200 300 400 meters

Map Projection:
NAD 1983 StatePlane Washington South FIPS 4602 Feet
Vertical Datum: NAVD88

PANEL LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

THURSTON COUNTY WASHINGTON AND INCORPORATED AREAS

FEMA

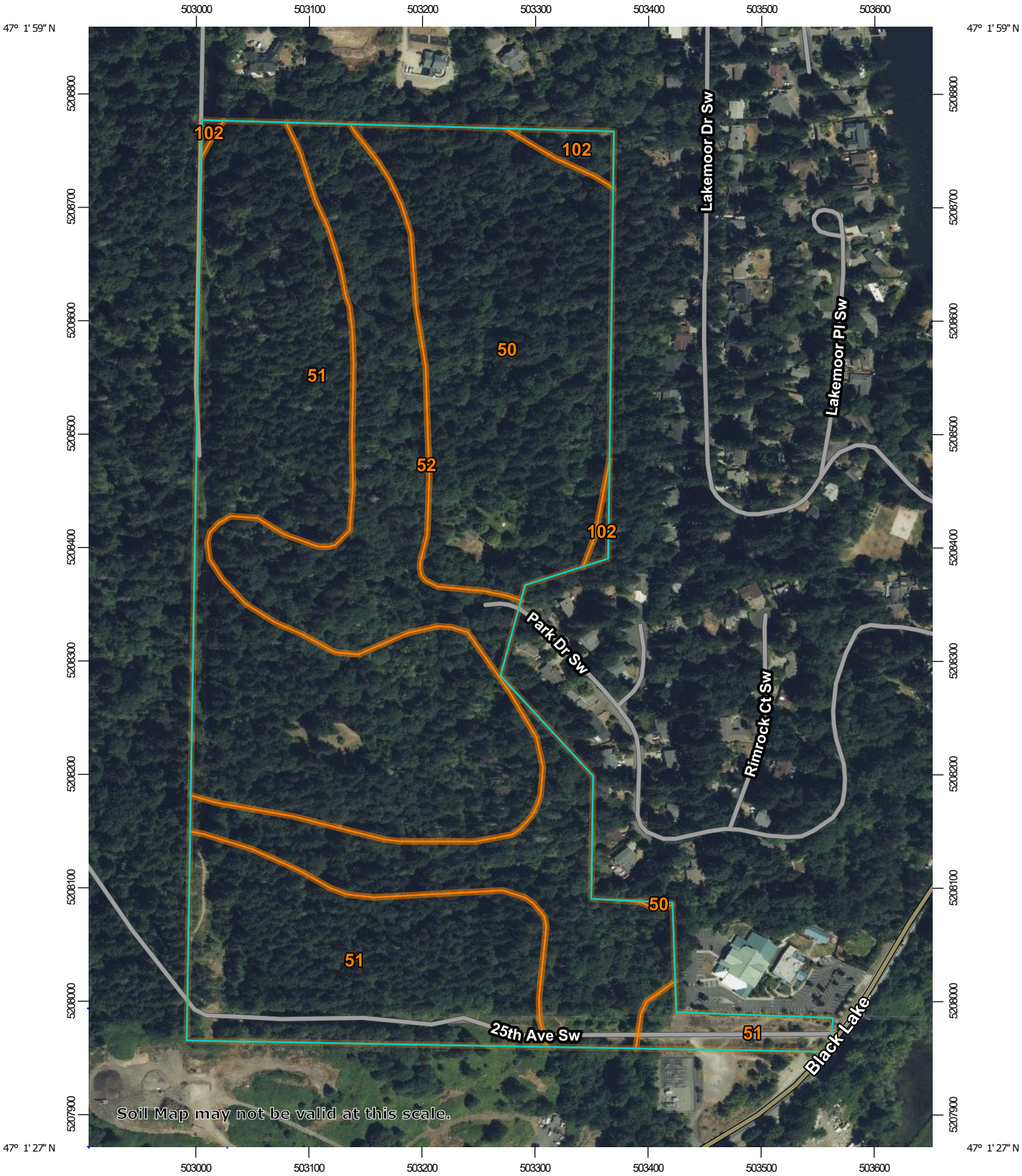
Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY OF OLYMPIA	530191	0164	F
THURSTON COUNTY UNINCORPORATED AREAS	530188	0164	F
CITY OF TUMWATER	530192	0164	F

MAP NUMBER
53067C0164F
EFFECTIVE DATE
May 08, 2024

APPENDIX F – NRCS/SCS SOIL MAPPING

Soil Map—Thurston County Area, Washington
(Kaiser Woods Park Development)



Map Scale: 1:4,810 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Soil Map—Thurston County Area, Washington
(Kaiser Woods Park Development)

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: Thurston County Area, Washington
Survey Area Data: Version 16, Sep 8, 2022

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

Date(s) aerial images were photographed: Jul 31, 2022—Aug 29, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI	Hydro group
50	Kapowsin silt loam, 0 to 3 percent slopes	16.5	22.5%	D
51	Kapowsin silt loam, 3 to 15 percent slopes	36.6	49.9%	D
52	Kapowsin silt loam, 15 to 30 percent slopes	19.4	26.4%	D
102	Schneider very gravelly loam, 20 to 40 percent slopes	0.9	1.2%	B
Totals for Area of Interest		**73.3**	**100.0%**	