Stormwater Plan

Washington State Fair – Gold Gate

Puyallup, WA

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March 04, 2024

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City of Puyallup
Development & Permitting Services
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Building	Planning
Engineering	Public Works
Fire	Traffic

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Stormwater Plan for the Gold Gate Remodel in Puyallup has been prepared by me or under my supervision and meets minimum standards of Washington State Department of Ecology, The City of Puyallup and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

Justin Jones, PE

03-04-24

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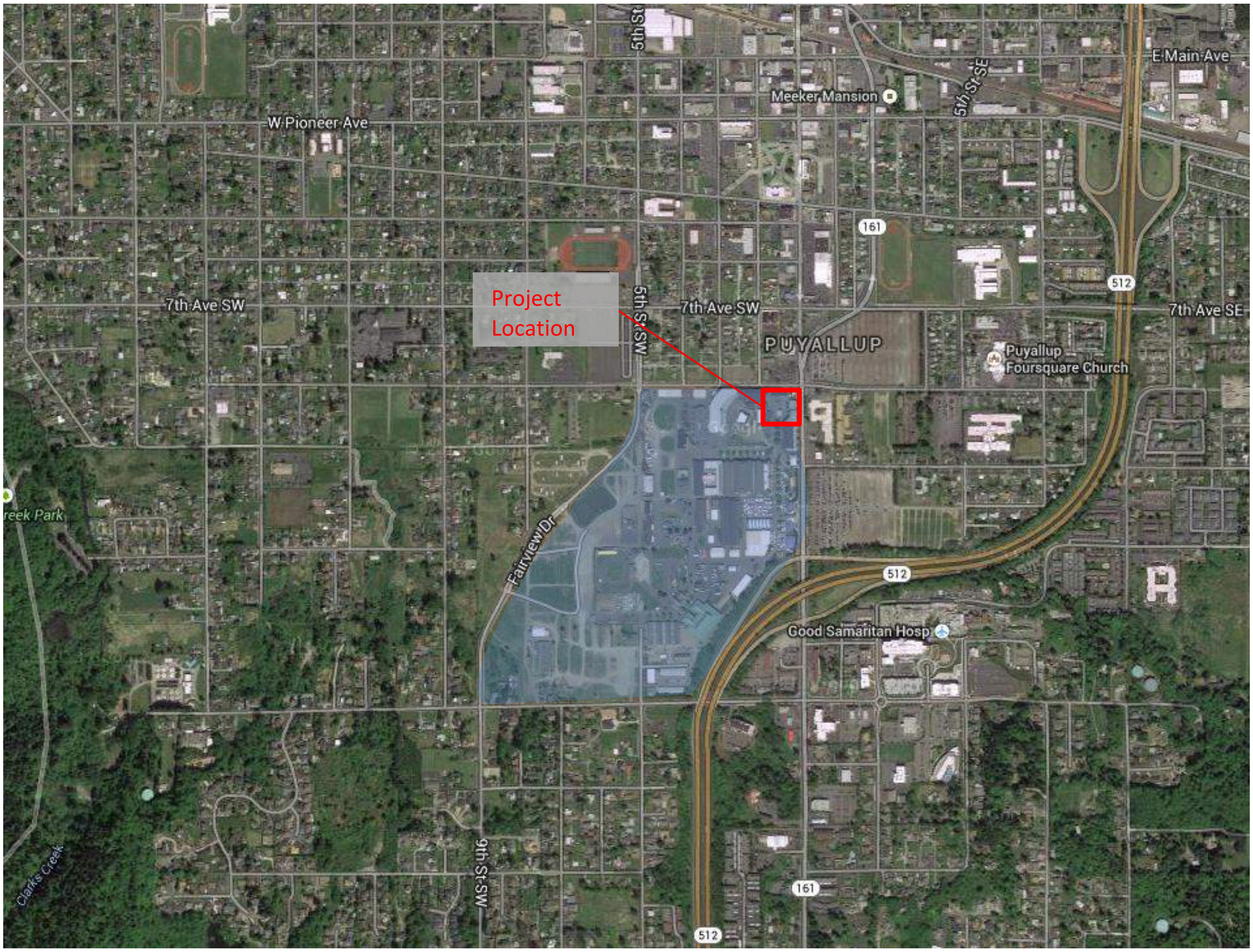
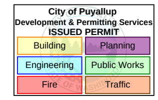
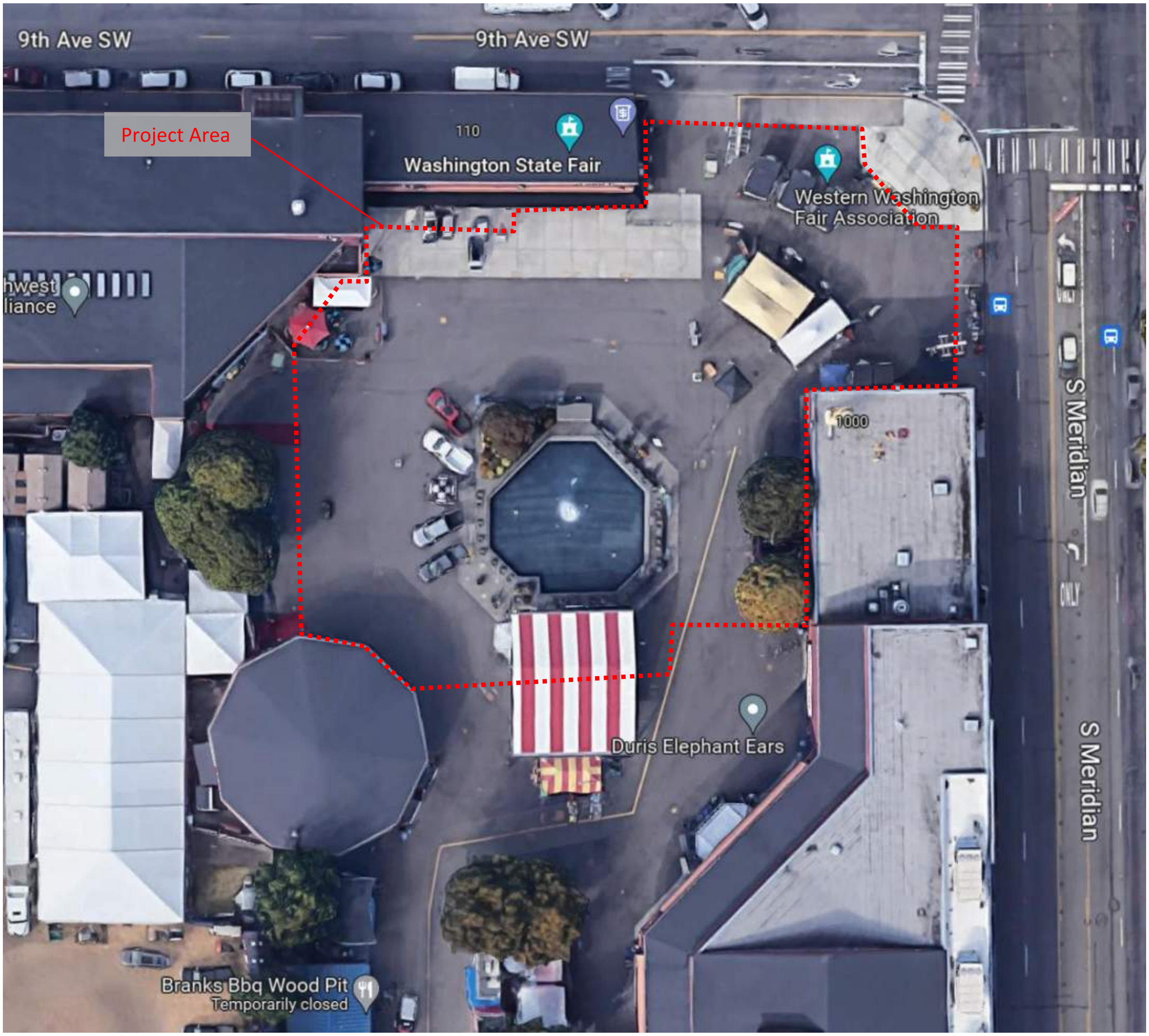
PROJECT OVERVIEW AND MAPS

The Washington State Fairgrounds (WSF) is a 98-acre site located between 15th Avenue SW to the South; Meridian Street to the East; 9th Avenue SW to the North; and Fairview Drive to the West. The surrounding area is comprised of residential and commercial buildings.





The Gold Gate project is a redevelopment project and includes the construction of a new canopy structure, fence/gate, concrete pavement, permeable asphalt, and a new water feature. Additionally, the development will include the construction of utility connections for vendor hookups. The stormwater approach is to fully infiltrate all stormwater onsite.



EXISTING CONDITIONS SUMMARY

The WSF is made up of two main parcels; a west parcel and an east parcel separated by former 5th Street. The WSF is considered a plan of common development and the site is substantially developed making both parcels redevelopment parcels. Therefore, the Gold Gate project is a redevelopment project. The site consists of asphalt, concrete, a gate/fence to the northeast, and a water fountain.

The project site is generally flat, sloping towards the center of existing asphalt pathways. Stormwater that falls within the existing site is collected in open-grate catch basins, which convey stormwater runoff to the City of Puyallup stormwater system to the north of the project site. The existing project site is 100% impervious.

PROPOSED CONDITIONS SUMMARY

The Gold Gate project proposes the construction of a new 4,600 SF canopy structure and fence/gate with site improvements.

The proposed development will result in 26,240 SF of replaced impervious surface within the project area and be 76.4% impervious.

Site improvements include the construction of 8,125 SF of permeable asphalt pavement, 10,504 SF of concrete pavement, 17,701 SF of colored concrete. The project site will also include the installation of utility service connections for sewer, water, gas, and communications for vendor hookups.

Stormwater from the Canopy will be collected with roof downspouts and conveyed to a proposed infiltration gallery, which will infiltrate 100% of stormwater up to the 100-year storm. Infiltration testing was performed on site to obtain a design infiltration rate for on-site soils in the vicinity of stormwater infiltration systems, see Civil Plan set submitted with drainage report.

The runoff from part of the colored concrete will sheet flow and be collected with a trench drain. This runoff will then be conveyed to the infiltration gallery, and 100% of the stormwater up to the 100-year storm will infiltrate onsite.

Runoff from the proposed pervious asphalt, standard concrete pavement, and part of the colored concrete within the site will infiltrate into native soils below the pavements. The pervious pavements are designed to infiltrate 100% of stormwater runoff from the permeable asphalt, standard concrete, and part of the colored concrete up to the 100-year storm event.

The infiltration system overflow will discharge storm events that exceed the 100-year storm to an existing manhole to the west of the infiltration gallery.

Stormwater runoff from the two existing Pavilion Building downspouts will be rerouted to a new 54” Manhole – Type 2 catch basin, to the west of the Pavilion Building. The roof runoff conveyed to the new 54” Manhole will then be conveyed to the existing Storm Drain manhole to the northwest of the site.

The Gold Gate project will have 34,365 SF of new and replaced hard surfaces upon project completion, and a total of 34,365 SF of land disturbing activity. The fully developed site will be 76.4% impervious in the final condition. Since the project exceeds 5,000 SF of new plus replaced hard surfaces, the project is subject to all minimum requirements. See tables below.

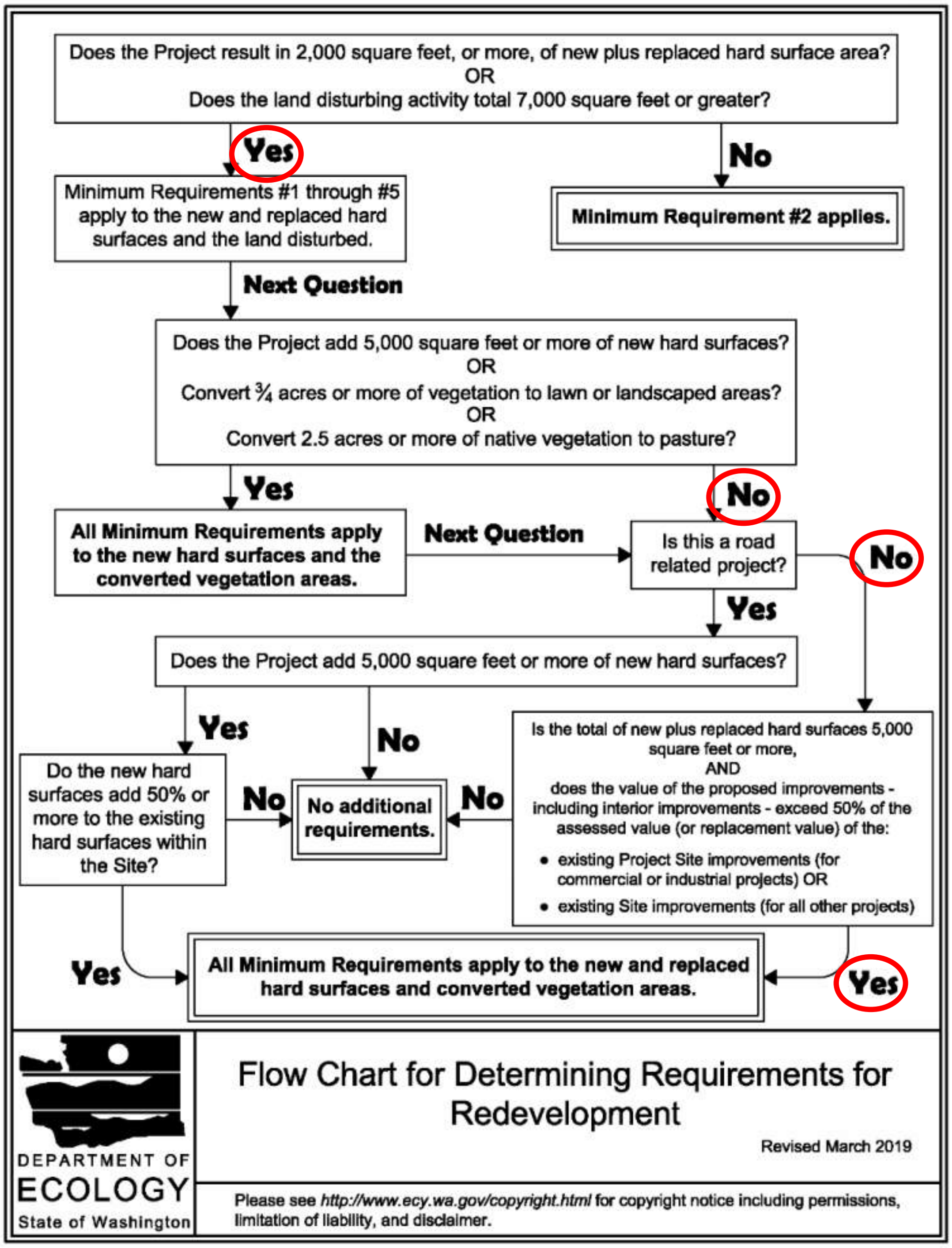
Description[a]	Onsite	Offsite	Total
Existing Conditions			
Total Project Area[b] (ft²)	34,840-0.80 ac	0-0 ac	34,840-0.80 ac
Existing hard surface (ft²)	34,840-0.80 ac	0-0 ac	34,840-0.80 ac
Existing vegetation area (ft²)	0-0 ac	0-0 ac	0-0 ac
Proposed Conditions			
Total Project Area[b] (ft²)	34,840-0.80 ac	0-0 ac	34,840-0.80 ac
Amount of new hard surface (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of new pollution generating hard surface (PGHS)[c] (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of replaced hard surface (ft²)	34,559-0.79 ac	0-0 ac	34,559-0.79 ac
Amount of replaced PGHS[d] (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of new plus replaced hard surface (ft²)	34,559-0.79 ac	0-0 ac	34,559-0.79 ac
Amount of new + replaced PGHS (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of existing hard surfaces converted to vegetation (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of Land Disturbed (ft²)	34,559-0.79 ac	0-0 ac	34,559-0.79 ac
Vegetation to Lawn/Landscaped (acres)	0-0 sf	0-0 sf	0-0 sf
Native Vegetation to Pasture (acres)	0-0 sf	0-0 sf	0-0 sf
Existing hard surface to remain unaltered (ft²)	278-0.01 ac	0-0 ac	278-0.01 ac
Existing vegetation area to remain unaltered (ft²)	0-0 ac	0-0 ac	0-0 ac

a. All terms are defined in the 2019 Ecology Manual glossary.
b. The total project area in the existing condition should typically match the total project area in the proposed condition.
c. The “amount of new PGHS” should be part of or all of “amount of new hard surfaces”
d. The “amount of replaced PGHS” should be part of or all of the “amount of replaced hard surfaces”.

SUMMARY OF MINIMUM REQUIREMENTS

The City of Puyallup utilizes the 2019 Department of Ecology Stormwater Manual for Western Washington (manual) for stormwater design. Volume 1 of this manual describes the Minimum Requirements for stormwater management for a redevelopment site. Using the flow chart below, all minimum requirements apply to the Gold Gate project site.

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment



2019 Stormwater Management Manual for Western Washington

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MINIMUM REQUIREMENT 1: PREPARATION OF STORMWATER SITE PLANS

Stormwater Site Plan drawings have been prepared per the City of Puyallup development codes and the 2019 DOE Manual.

MINIMUM REQUIREMENT 2: CONSTRUCTION STORMWATER POLLUTION PREVENTION

Temporary Erosion and Sediment Control Plans and a Construction Stormwater Pollution Prevention Plan have been prepared per the City of Puyallup development codes and the 2019 DOE Manual. Construction Stormwater Pollution Prevention measures may include: storm drain inlet protection; construction entrance; silt fence. See CSWPPP submitted with drainage report.

MINIMUM REQUIREMENT 3: SOURCE CONTROL OF POLLUTION

Source control BMPs will be implemented to minimize stormwater contamination and help comply with the Department of Ecology Stormwater Management Manual for Western Washington. BMP's for the project may include:

- *Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O & M Improvements.*
- *Clean catch basins when the depth of deposits reaches 60-percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin.*
- *Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.*

MINIMUM REQUIREMENT 4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

The existing site is comprised of asphalt, concrete, iron rod fence/gate, water feature, and trees. Stormwater currently sheet flows to catch basins in the asphalt and eventually is conveyed to the city of Puyallup stormwater system with 9th Ave SE. The project proposes to continue to send the existing downspout runoff to 9th Ave SE, and the emergency overflow runoff from the infiltration gallery will be conveyed to the existing city of Puyallup stormwater system.

MINIMUM REQUIREMENT 5: ONSITE STORMWATER MANAGEMENT

Minimum Requirement #5 states projects shall utilize either On-Site Stormwater Management BMP's from List #2 or demonstrate compliance with the LID Performance Standard. The LID performance standard requires the site to match predeveloped flows through flow control systems for 50% of the 2-year and 50-year storm events. The Gold Gate project selected to meet the LID performance standard since the stormwater approach is to infiltrate all hard surface runoff onsite.

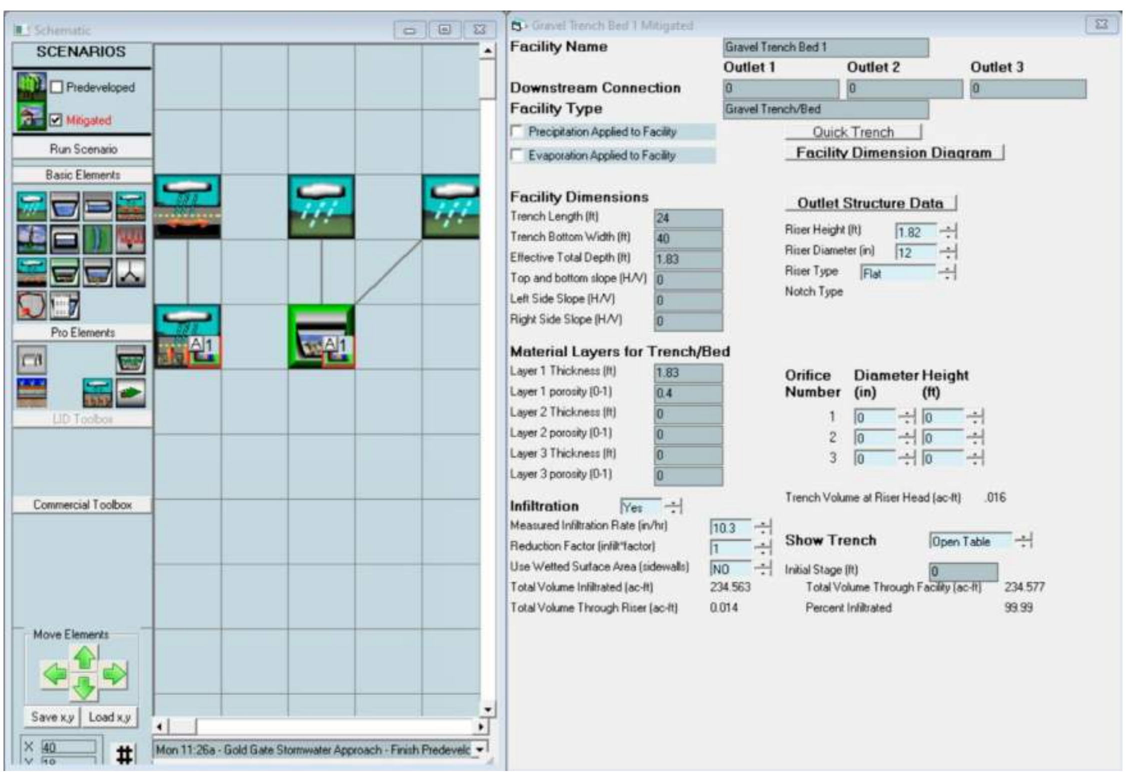
Each BMP requires varying separation between the bottom of the BMP and the seasonal high groundwater level. Therefore, testing of the stormwater infiltration rate and seasonal high groundwater level was conducted. Excavation was conducted to a depth of 4.0-feet. No mottling or groundwater was observed in the test locations. Two Pilot Infiltration Test (PIT) were conducted on site. The tests recorded infiltration rates of 23.1 and 22.9 inches per hour, and after applying factors of safety design infiltration rates are 10.4 and 10.3 inches per hour, see Appendix A for Infiltration Report. Groundwater was not encountered during soil inspections. Groundwater monitoring was conducted from December to March. An 8.5' deep groundwater monitoring well was installed on the Gold Gate project site. During the groundwater monitoring period, no groundwater was observed. Since the existing grade of the groundwater monitoring well was 40.4', the seasonal high groundwater level is 31.9'.

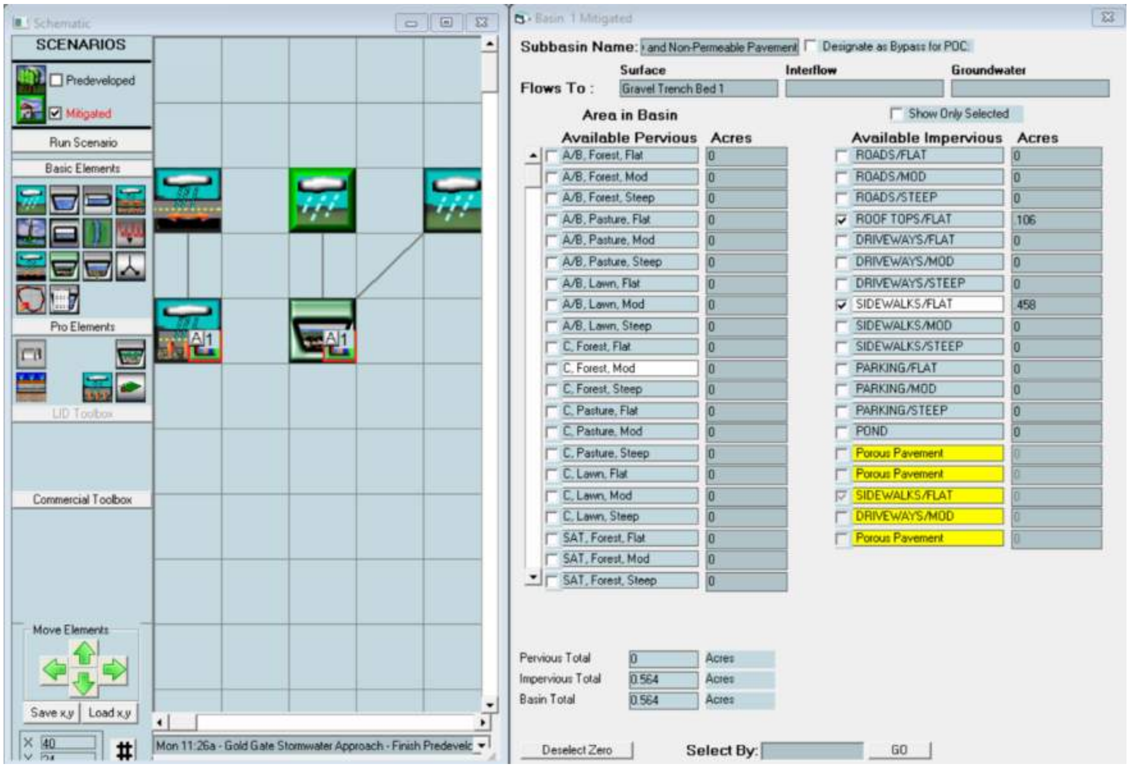
BMP's must maintain the required separation between the assumed groundwater level of 31.9'. The bottom of the proposed infiltration gallery is at an elevation of 37.8'. Since the infiltration Gallery is considered a UIC well a minimum of 5-feet of vertical separation is required between the seasonal high groundwater level and the bottom of the UIC well. The vertical separation is 5.9', so sufficient separation between the groundwater the bottom of the BMP is achieved.

The following Stormwater BMP's were evaluated for feasibility with regards to the Gold Gate project:

- Roofs:
  - <u>Downspout Infiltration:</u> Downspout infiltration was evaluated for feasibility for the site, and infiltration was deemed feasible for the site. Proposed roof areas will be routed to the infiltration trench and infiltrate 100% on site into native soils based on WWHM modeling, see Appendix B. The infiltration trench has been sized utilizing the WWHM Model for a gravel trench bed based on the following criteria:
    - Infiltration rate of 10.3 in/hr
      - Field measured rates for infiltration are higher than the design infiltration rate, however the rate 10.3 in/hr has been used as a conservative design rate.
    - Drain Rock Basin with a porosity of 0.33
    - 1.83' Drainage/Storage Layer thickness
    - Minimum 1-foot of separation between the bottom of the infiltration trench and the seasonal high groundwater level

See screenshot below for infiltration trench WWHM Modelling:




Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
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Mon 11:26a - Gold Gate Stormwater Approach - Finish Predevelc
Basin 1 Mitigated
Subbasin Name: and Non-Permeable Pavement
Designate as Bypass for POC
Surface
Interflow
Groundwater
Flows To :
Gravel Trench Bed 1
Area in Basin
Show Only Selected
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Acres
Available Impervious
Acres
ROOF TOPS/FLAT .106
SIDEWALKS/FLAT .458
Pervious Total 0 Acres
Impervious Total 0.564 Acres
Basin Total 0.564 Acres
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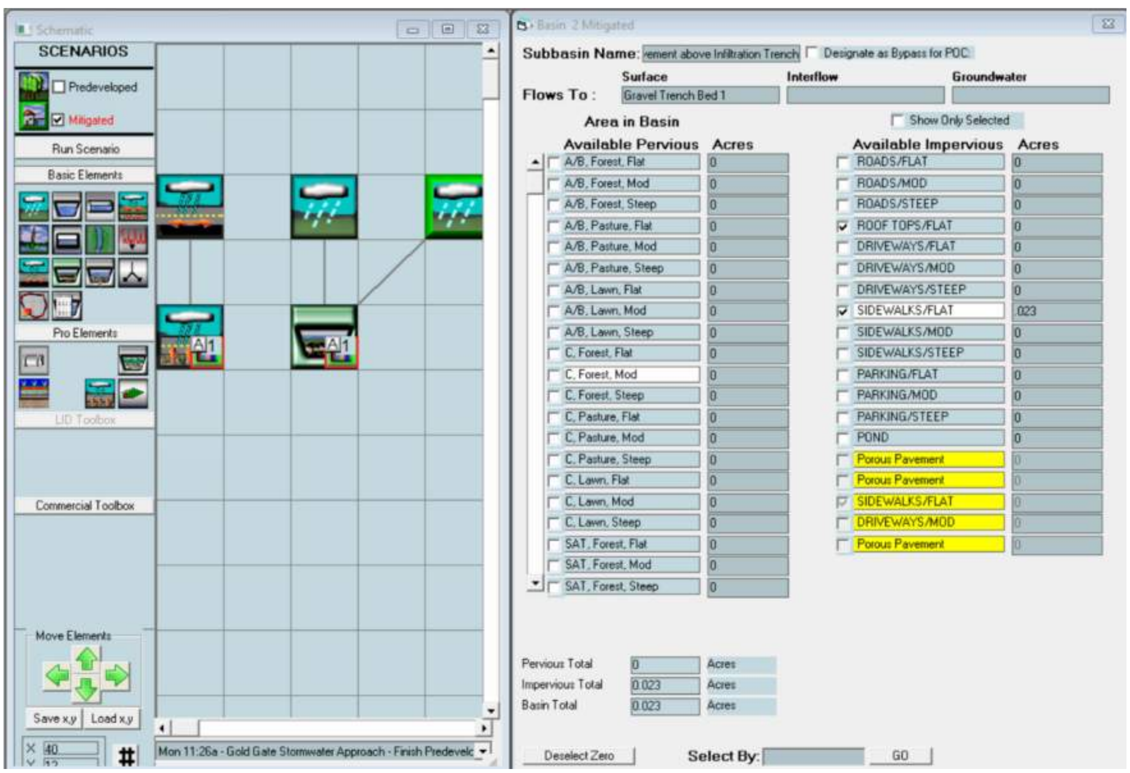
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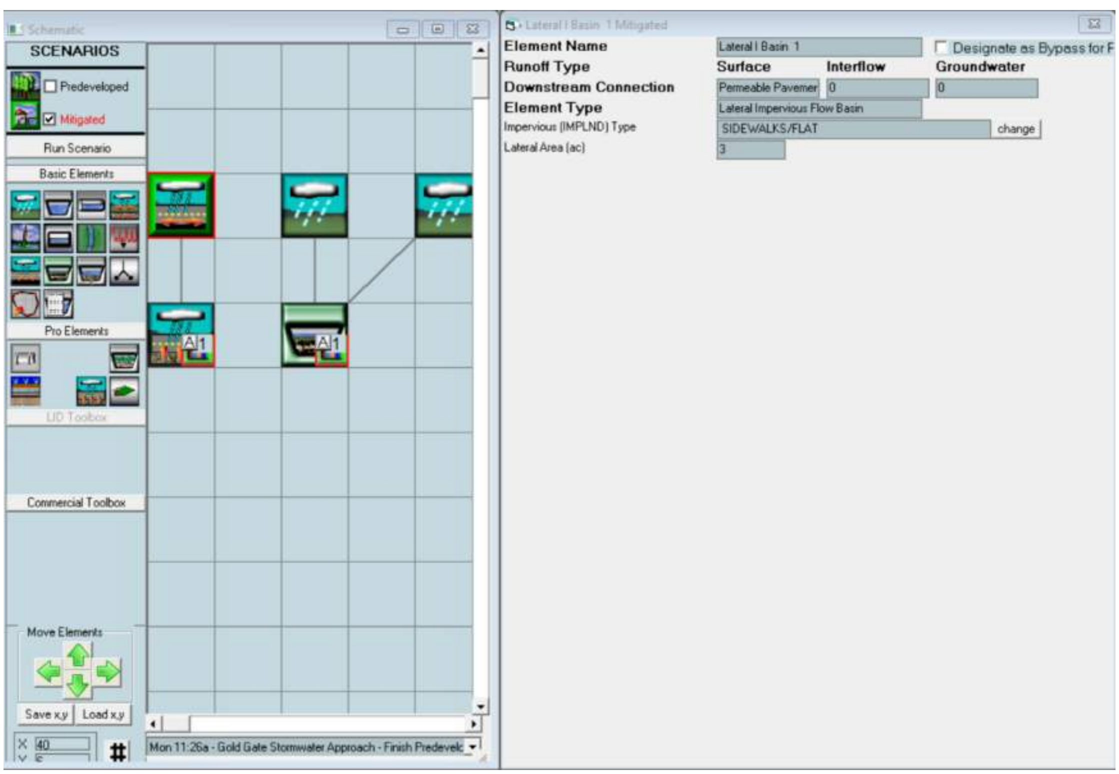
Mon 11:26a - Gold Gate Stormwater Approach - Finish Predevelc
Basin 2 Mitigated
Subbasin Name: ement above Infiltration Trench
Designate as Bypass for POC
Surface
Interflow
Groundwater
Flows To :
Gravel Trench Bed 1
Area in Basin
Show Only Selected
Available Pervious
Acres
Available Impervious
Acres
SIDEWALKS/FLAT .023
Pervious Total 0 Acres
Impervious Total 0.023 Acres
Basin Total 0.023 Acres
Deselect Zero
Select By:
GO

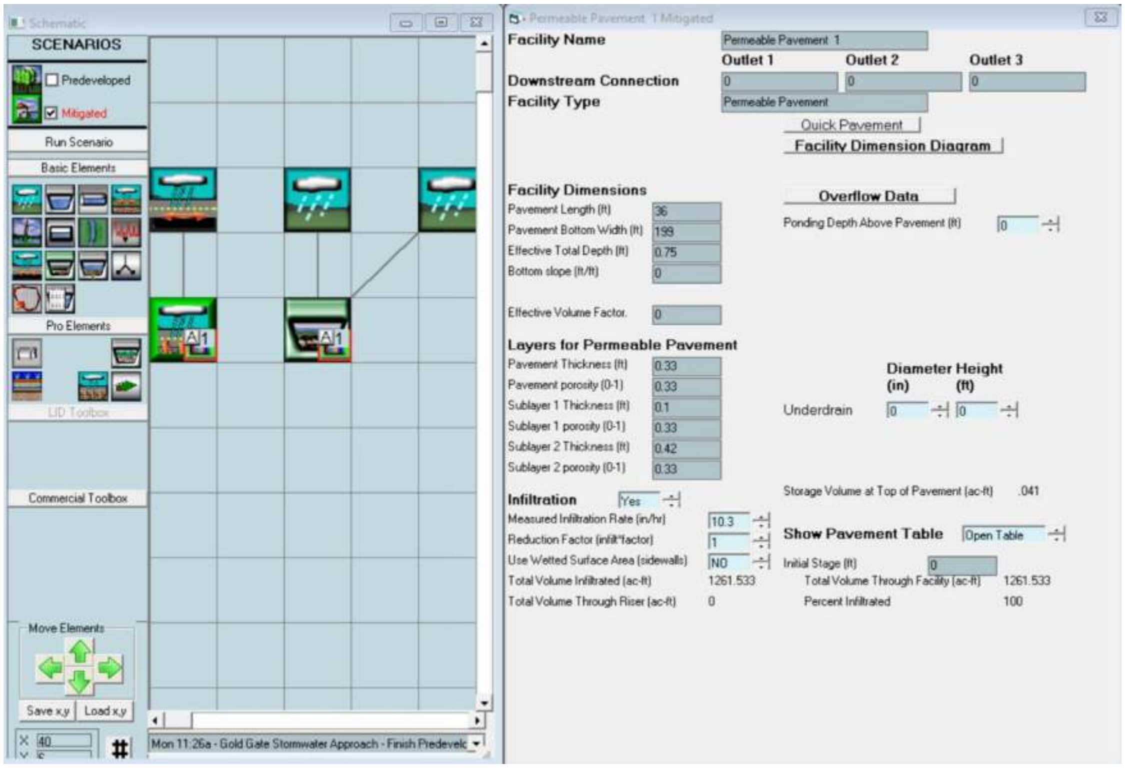
- Other Hard Surfaces:

  - Full Dispersion: Full dispersion is feasible if a site maintains 65% of its area in a native vegetated condition. The Gold Gate project does not maintain 65% of the site in a native condition and thus full dispersion was deemed infeasible for hard surface stormwater management.

  - Permeable Pavement: Permeable Pavements were evaluated for the Gold Gate site and were determined to be feasible for the project. Proposed permeable pavement areas will infiltrate at 100% on site into native soils based on WWHM modeling, see Appendix B for WWHM report. Permeable Pavements have been sized utilizing the WWHM Model for permeable pavement based on the following criteria:
    - Infiltration rate of 10.3 in/hr
      - Field measured rates for infiltration are higher than the design infiltration rate, however the rate of 10.3 in/hr has been used as a conservative design rate.
    - Drainage/Storage Layer with a porosity of 0.33
    - 5” Drainage/Storage Layer thickness
    - Minimum 1-foot of separation between the bottom of the permeable pavement and the seasonal high groundwater level
    - Runoff from the proposed concrete and a portion of the colored concrete will sheet flow onto the permeable pavement
    - Impermeable geotextile along transitions between other hard surfaces

See screenshot below for permeable pavement WWHM Modelling:

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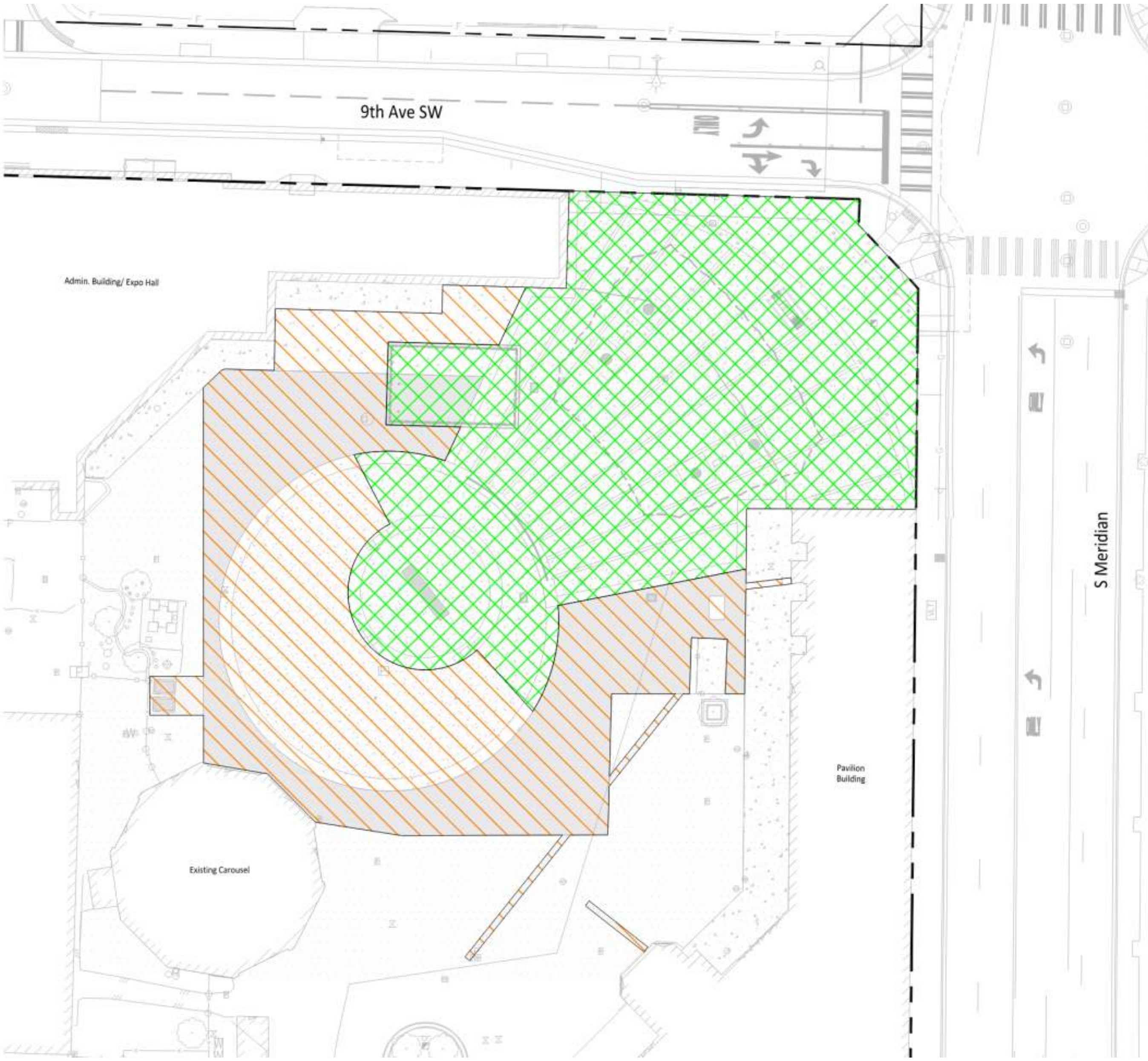
Save x,y
Load x,y
Mon 11:26a - Gold Gate Stormwater Approach - Finish Predevelc
Permeable Pavement 1 Mitigated
Facility Name
Permeable Pavement 1
Outlet 1
Outlet 2
Outlet 3
Downstream Connection
Facility Type
Permeable Pavement
Quick Pavement
Facility Dimension Diagram
Facility Dimensions
Pavement Length (ft) 36
Pavement Bottom Width (ft) 199
Effective Total Depth (ft) 0.75
Bottom slope (ft/ft) 0
Effective Volume Factor. 0
Overflow Data
Ponding Depth Above Pavement (ft) 0
Layers for Permeable Pavement
Pavement Thickness (ft) 0.33
Pavement porosity (0-1) 0.33
Sublayer 1 Thickness (ft) 0.1
Sublayer 1 porosity (0-1) 0.33
Sublayer 2 Thickness (ft) 0.42
Sublayer 2 porosity (0-1) 0.33
Diameter Height
(in) (ft)
Underdrain 0 0
Storage Volume at Top of Pavement (ac-ft) .041
Infiltration Yes
Measured Infiltration Rate (in/hr) 10.3
Reduction Factor (infilt*factor) 1
Use Wetted Surface Area (sidewalls) NO
Total Volume Infiltrated (ac-ft) 1261.533
Total Volume Through Riser (ac-ft) 0
Show Pavement Table Open Table
Initial Stage (ft) 0
Total Volume Through Facility (ac-ft) 1261.533
Percent Infiltrated 100

See Figure below for Basin Map.



Based upon the evaluation of the above BMP's, runoff from canopy roof will be collected from the downspout locations and routed through 8-inch DI pipes connect into the proposed infiltration gallery. In addition to the canopy runoff, runoff from a portion of the colored concrete and concrete bands will sheetflow to a trench drain, where the runoff will be conveyed to the same infiltration gallery. Stormwater entering the infiltration gallery will infiltrate 100% of the runoff up to the 100-year storm event. The top of the infiltration gallery will be located at the bottom of the storage course of the proposed permeable pavement, and the runoff from the permeable pavement above will infiltrate into the infiltration gallery.

Permeable pavements located within the Gold Gate project area have been sized to infiltrate 100% of stormwater runoff up to the 100-year storm event. Stormwater runoff in these areas will infiltrate through the pavement surface, through the storage layer, and into native soils below. Permeable pavements at the Gold Gate project will abut other hard surfaces and could introduce risk of water pooling under hard surfaces. To mitigate this risk, permeable pavements shall be lined with an impermeable geotextile along hardscape transition to convey any stormwater that may pool away from the other hard surfaces.

Both the infiltration gallery and permeable pavement have been designed to infiltrate 100% of the 100-year peak discharge. If the 100-year peak discharge is exceeded, an overflow pipe will convey the overflow runoff from the infiltration gallery to an existing storm drain manhole to the west of the infiltration gallery with a 6" PVC pipe. This runoff will subsequently be conveyed to the existing 12" DI storm line to the north, which conveys runoff to the City of Puyallup storm system.

Standard concrete pavement will be installed in certain areas of the project site (such as adjacent to the Admin building) for the replaced portions of existing concrete and will maintain existing surface runoff flow characteristics and sheet flow to the permeable pavement.

A portion of the runoff from the new colored concrete and concrete bands will sheetflow onto the permeable pavement. The permeable pavement has been sized to assume the runoff from a portion of the colored concrete and concrete bands will infiltrate through the permeable pavement. In addition, the permeable asphalt will receive some runoff from adjacent impermeable asphalt areas. The permeable asphalt has been modelled utilizing a 10.3 in/hr infiltration rate, and has capacity to receive these additional areas without any increase to the reservoir course section.

MINIMUM REQUIREMENT 6: WATER QUALITY

The Department of Ecology Stormwater Management Manual states that any project with a pollution generating threshold discharge area greater than 5,000 SF shall be required to utilize runoff treatment BMPs. The project does not propose any PGIS and is therefore not subject to runoff treatment for pollution generating areas.

MINIMUM REQUIREMENT 7: FLOW CONTROL

The Gold Gate project site uses infiltration to meet the requirement of Minimum Requirement 7 Flow Control.

The Department of Ecology Stormwater Management Manual code requires the infiltration trench to be sized using WWHM and to achieve 100 percent infiltration. Stormwater will have an opportunity to infiltrate into native soils, permeable pavements and the infiltration trench were modeled to infiltrate 100% of the flows that they receive.

Per the department of Ecology Stormwater Management Manual, developed discharge durations shall match the predeveloped rates from 50% of the 2-year peak flow up to the full 50-year peak flow. However, the project is choosing to meet the LID Performance standard so developed discharge durations shall match the predeveloped rates from 8% of the 2-year peak flow up to the full 50-year peak flow, per the DOE SWMM.

WWHM modeling was conducted to confirm that the infiltration trench and permeable pavements infiltrated met the lid performance standard, see Appendix B for WWHM report.

The predeveloped project area 2-year peak flow, 8% of the 2-year peak flow, and 50-year peak flow are 1.3145 cfs, 0.1052 CFS, and 2.8985 cfs, respectively. The mitigated project area 2-year peak flow and 50-year peak flow are both 0.0000 cfs.

Since the developed condition 2-year peak flow and 50-year peak flow are less than those of the developed condition, the project meets the Flow Control and LID performance standard.

MINIMUM REQUIREMENT 8: WETLANDS PROTECTION

Any threshold discharge area that discharges stormwater through a conveyance system into a wetland is required to meet the Ecology Manual standards for protecting the wetland. The Gold Gate project will not discharge stormwater into a wetland, and thus is not subject to the wetlands protection standards outlined in Minimum Requirement #8.

MINIMUM REQUIREMENT 9: OPERATION AND MAINTENANCE

See Appendix C for Operations & Maintenance Manual for all new stormwater BMP's installed with the project.

APPENDIX A

Infiltration Testing Report

Washington State Fair – Gold Gate

Puyallup, WA

Prepared for

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Prepared by

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206.596.2020
Justin Jones, PE

April 18, 2024

JMJTEAM

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Infiltration Testing Report for the Gold Gate Development has been prepared by me or under my supervision and meets minimum standards of the Department of Ecology Stormwater Management Manual for Western Washington.

____

Justin Jones, PE

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER

04-18-2024

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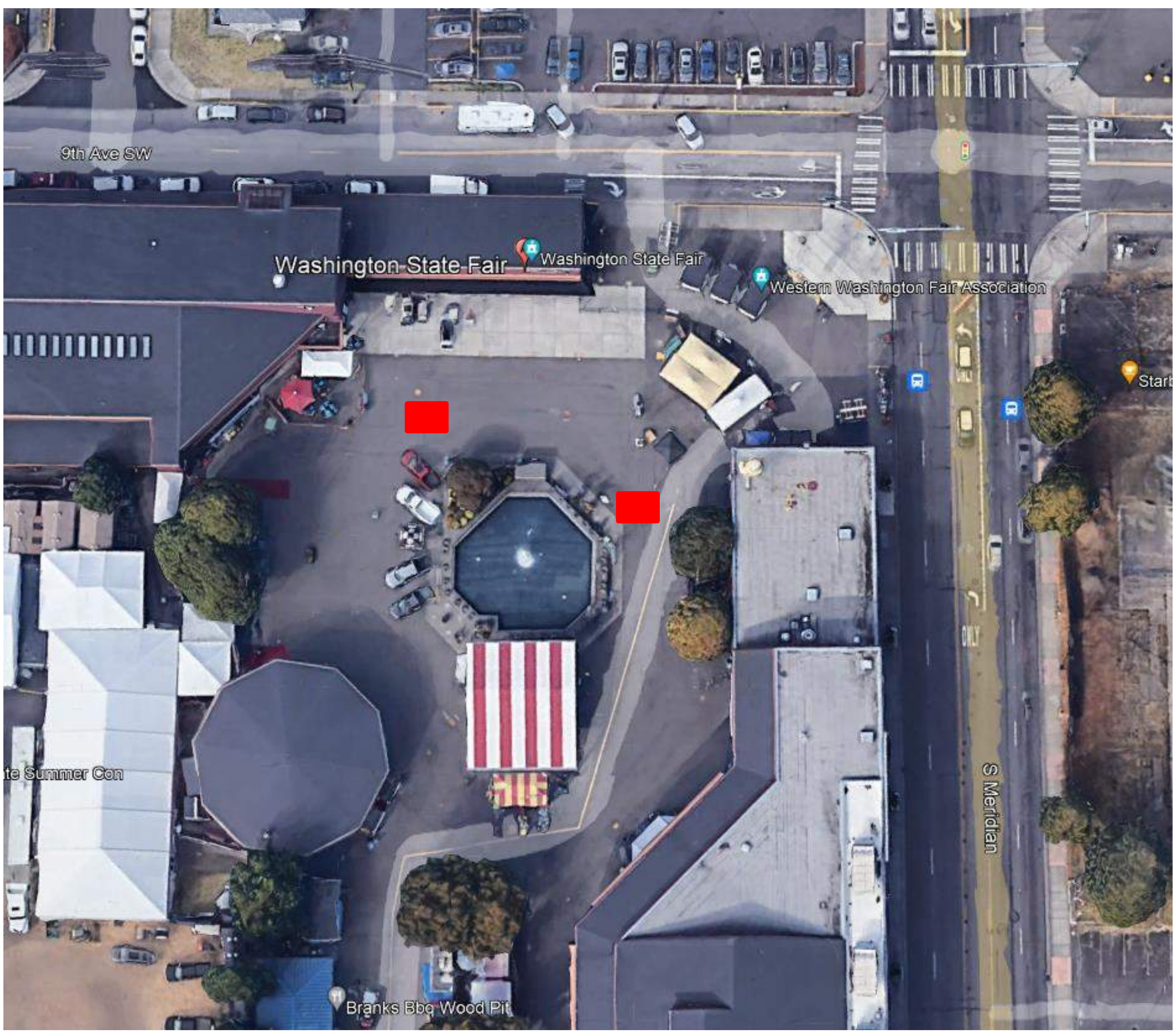
SUMMARY

This report details the results of infiltration testing for use in the stormwater system design of the Gold Gate Development located within Puyallup, WA. Two Pilot Infiltration Test (PIT) were conducted on site to determine the onsite stormwater infiltration rate. The test hole was excavated and backfilled by a licensed contractor and the PIT was completed in accordance with the Department of Ecology (ECY) Stormwater Management Manual for Western Washington (Stormwater Manual).

The PIT process evaluates the infiltration within a 12 SF area by first measuring the rate of water required to maintain a constant water elevation of approximately 12-inches in the test pit, and second by measuring the drawdown rate of the water within the test pit. The drawdown is done using a data logger.

The field data is then analyzed, and a factor of safety applied to determine the stormwater design infiltration rate. Below is a summary of the results.

Test Pit Location



Summary of Results

Per the PIT, the site soils are suitable for stormwater infiltration. A soil sample was taken from each PIT, the soil sample has been submitted and is pending results.

Testing	Test PIT	Results	ECY Threshold
Ground Water	Pit Depth	4.0-feet	N/A
	Test Hole 1 Groundwater Level	Ground Water not Observed	N/A
	Test Hole 2 Groundwater Level	Ground Water not Observed	N/A
Infiltration Rate	Infiltration Rate Factor of Safety	0.45	N/A
	Test Hole 1 Infiltration Rates	Uncorrected: 23.1 inches per hour	≥ 0.3 inches per hour
		Design: 10.4 Inches per hour	
	Test Hole 2 Infiltration Rates	Uncorrected: 22.9 inches per hour	≥ 0.3 inches per hour
		Design: 10.3 inches per hour	

INFILTRATION TEST PROCEDURES

Below is the process taken for the PIT:

- ◻ Identify PIT locations based on the site survey of existing buildings and utilities as well as the potential locations of infiltration facilities based on the preliminary site plan.
- ◻ Obtain public and private utility locates. Prior to the PIT utility locates will be called to ensure there are no utilities present in the PIT locations.
- ◻ Excavation of PIT holes (approximately 3-feet x 4-feet 4-feet deep). A 3-feet x 4-feet x2-feet tall wood box is inserted into the test hole to ensures that the bottom surface area is exactly 12 SF. The box is backfilled to the top edge to ensure stability and infiltration only through the bottom of the test hole for the duration of the PIT.
- ◻ A soil sample is collected from the bottom of the hole to test treatment capability. A lab tests the cation exchange rate and organic matter content of soils. Lab results confirm if the soil is suitable for treatment based on Stormwater Manual criteria.
- ◻ A float system with a water hose connection is set into the center of the test hole. The float system is equipped with a leveling plate, a measuring ruler for visual inspection of water levels and a perforated pipe housing for the data collector.
- ◻ Using water transfer tanks or hose spigot as available, the test hole is filled to a 12-inch water depth that is maintained. The presoak period ensures that the soils have been fully saturated before conducting the PIT. A 1-hour stabilization test is performed after the presoak period to confirm soil stabilization. If the test yields 4 constant gallon per minute (GPM) readings that are conducted every 15-minutes, the stabilization of the soil is confirmed.
- ◻ A 1-hour GPM test is conducted per the Stormwater Manual. Using a water meter accurate to the nearest tenth of a gallon, a GPM flow rate is recorded every 15-minutes while the water level is maintained at a 12-inch depth. An infiltration rate (in/hr) can be determined using the GPM flow rate and the 12 SF bottom surface area of the hole.
- ◻ A drawdown test is performed per Stormwater Manual to determine the drawdown infiltration capability of the soil. A CRS451V (Pressure Transducer) is placed into the test hole and set to take pressure (PSI) readings every 5-minutes. The water source is shutoff, and the pressure transducer will measure water drawdown for a 2-hour period. At the end of the period the sensors are removed from the test hole, the data is collected using a PC interface module and the HydroSci program to communicate with the sensor to retrieve the data.
- ◻ The wood box and the float system are removed from the test hole.
- ◻ Over excavate test hole to confirm there is no ground water mounding.
- ◻ The test pit is then backfilled and restored to prior state of excavation.

FINDINGS AND RECOMMENDATIONS

Groundwater Conditions

The Stormwater Manual specifies minimum separations between the seasonal high groundwater elevation and the bottom of the infiltration facility based on different best management practices (BMP):

- **Downspout Infiltration:** 1-foot
- **Permeable Pavement:** 1-foot
- **Infiltration Facility:** 3-foot
- **UIC Well:** 5-foot

An 8.5' deep groundwater monitoring well was installed to conduct groundwater monitoring for the Gold Gate project site during the wet season. No groundwater was observed during multiple attempts to measure the seasonal high groundwater.

The known seasonal high groundwater level is 8.5' below the existing grade of 40.4'. Therefore, the known seasonal high groundwater level is 31.9'

With known groundwater conditions for each test hole, there is adequate spacing between groundwater and BMPs. An overflow should be installed with BMP in case of large storm events.

Field Measured Infiltration Rate

The infiltration rate was collected using two methods in during the PIT. The first method is to measure the gallons per minute flowrate required to maintain a constant water level in the test pit. The average of the flowrate measurements taken over an hour timeframe.

The second method is to measure the drawdown rate of the test pit. Measurements were taken both visually and with a data logger. The test was terminated because the water level in the test pit could not be maintained long enough for the sensors to take readings every 5 minutes.

Design Infiltration Rate

Per the Stormwater Manual a minimum design infiltration rate of 0.3 inches per hour is required for onsite infiltration. The design infiltration rate takes the field measured infiltration rate and applies a factor of safety based on three correction factors. The three corrections are based on site variability, test method, and degree of influent control (See Appendix D).

Issue	Partial Correction Factor
Site variability and number of locations tested	CF_v = 0.33 to 1.0
Test Method	
• Large-scale PIT • Small-scale PIT • Other small-scale (e.g. Double ring, falling head) • Grain Size Method	CF_t = 0.75 = 0.50 = 0.40 = 0.40
Degree of influent control to prevent siltation and bio-buildup	CF_m = 0.9

Total Correction Factor, $CF_T = CF_v \times CF_t \times CF_m$

Based on multiple geotechnical reports from nearby projects, soils are known to be consistent in this area. Per the Stormwater Manual, a site variability correction of 1 is used. A correction of 0.5 for the small-scale PIT and 0.9 for the degree of influent are also used. A total correction factor of 0.45 is applied to the measured infiltration rate yielding a recommended design infiltration rates as follows:

- Test Hole 1: 10.4 inches per hour
- Test Hole 2: 10.3 inches per hour

TEST PIT PHOTO DOCUMENTATION – TEST HOLE 1

3-feet x 4-feet x 18-inches

Test Pit Pre-soak at 12-inches

1-hour GPM Test


Pressure Transducer Drawdown Test


Over Excavation to observe if Groundwater is Mounding


Backfill Test Hole

JMJTEAM

APPENDIX A

APPENDIX B

PRODUCT

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

CRS451V

Stainless-Steel Vented Stand-Alone Pressure Transducer

Pressure Transducer Combined with a Recorder

High resolution and accuracy

Overview

The CRS451V consists of a submersible water-level and water-temperature sensor with its own time clock and memory to store the collected data—in a compact stainless-steel case. This data logging capability frees users to place the sensor in remote sites and let it collect data for long periods. HydroSci software is included and elegantly supports test setup, data retrieval, and data display. Long battery life and rugged construction mean you can trust the CRS451V to collect important data. Low cost and ease of use make it a good choice in a variety of applications. The CRS456V is the same as this, but with a titanium case.

Benefits and Features

- Sensors and data-collection features in one instrument case
- Rugged stainless-steel case protects piezoresistive sensor
- Quality construction ensures product reliability
- Fully temperature-compensated
- Fast scan rate
- Large data-storage capacity
- Long battery life
- Easy-to-use software

Detailed Description

The CRS451V has several pressure range options.

HydroSci software is available for download. This software simplifies the process of configuring the CRS451V. Users can configure the CRS451V to monitor surface water, ground water, or a standard pump test.

HydroSci software will display the data in tabular or graphical formats.

Specifications

Venting	Vented	Measurement Time	< 1.0 s

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APPENDIX C

INFILTRATION TEST

The Washington State Department of Ecology Stormwater Manual provides testing procedures and best practices, which are described below.

- Testing should occur between December 1 and April 1.
- The horizontal and vertical locations of the PIT shall be surveyed by a licensed land surveyor and accurately shown on the design drawings.
- Excavate the test pit to the estimated elevation of the proposed infiltration into the native soil. Note that for some proposed BMPs, such as and BMP T5.15: Per- meable Pavements, this will be below the proposed finished grade. If the native soils will have to meet a minimum subgrade compaction requirement (for example, the road subgrade if using BMP T5.15: Permeable Pavements), compact the native soil to that requirement prior to testing. Lay back the slopes sufficiently to avoid caving and erosion during the test. Altern- atively, consider shoring the sides of the test pit.
- The horizontal surface area of the bottom of the test pit should be approximately 100 square feet. Document the size and geometry of the test pit.
- Install a vertical measuring rod (long enough to measure the ponded water depth, minimum 5- ft. long) marked in half-inch increments in the center of the pit bottom.
- Use a rigid 6-inch diameter pipe with a splash plate on the bottom to convey water to the test pit and reduce side-wall erosion or excessive disturbance of the test pit bottom. Excessive erosion and bottom disturbance will result in clogging of the infiltration receptor and yield lower than actual infiltration rates.
- Add water to the pit at a rate that will maintain a water level between 6 and 12 inches above the bottom of the pit. A rotameter can be used to measure the flow rate into the pit.

The depth should not exceed the proposed maximum depth of water expected in the completed BMP. For infiltration BMPs serving large drainage areas, designs with multiple feet of standing water can have infiltration tests with greater than 1 foot of standing water.

- Every 15-30 min, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point on the measuring rod.
- Keep adding water to the pit until one hour after the flow rate into the pit has stabilized (constant flow rate; a goal of 5% or less variation in the total flow) while maintaining the same pond water level. The total of the pre-soak time plus one hour after the flow rate has stabilized should be no less than 6 hours.
- After the flow rate has stabilized for at least one hour, turn off the water and record the rate of infiltration (the drop rate of the standing water) in inches per hour from the measuring rod data, until the pit is empty. Consider running this falling head phase of the test several times to estimate the

dependency of the infiltration rate with head.

- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to the hydraulic restricting layer, and is determined by the engineer or certified soils professional. Mounding is an indication that a mounding analysis is necessary.

DATA ANALYSIS

Calculate and record the initial K_{sat} rate in inches per hour in 30 minutes or one-hour increments until one hour after the flow has stabilized.

Use statistical/trend analysis to obtain the hourly flow rate when the flow stabilizes. This would be the lowest hourly flow rate. *Example:*

The area of the bottom of the test pit is 8.5-ft. by 11.5-ft. (97.75 sq. ft.).

Water flow rate was measured and recorded at intervals ranging from 15 to 30 minutes throughout the test. Between 400 minutes and 1,000 minutes the flow rate stabilized between 10 and 12.5 gal- lons per minute or 600 to 750 gallons per hour, or 80.2 to 100 ft^3 per hour. Dividing this rate by the surface area gives an initial K_{sat} of 9.8 to 12.3 inches per hour.

K_{sat} Determination Option 2: Small Scale Pilot Infiltration Test (PIT)

A small-scale PIT can be substituted for Ksat Determination Option 1: Large Scale Pilot Infiltration Test (PIT) in any of the following instances:

- The drainage area to the infiltration BMP is less than 1 acre.
- The testing is for BMP T7.30: Bioretention or BMP T5.15: Permeable Pavements that either serve small drainage areas and/or are widely dispersed throughout a project site.
- The site has a high infiltration rate (>4 in/hr), making a large scale PIT difficult, and the site geo- technical investigation suggests uniform subsurface characteristics.

INFILTRATION TEST

Use the same procedures described above in Ksat Determination Option 1: Large Scale Pilot Infiltra-tion Test (PIT), with the following changes:

- The horizontal surface area of the bottom of the test pit should be 12 to 32 square feet. It may be circular or rectangular. Document the size and geometry of the test pit.
- The rigid pipe with a splash plate used to convey water to the pit may be a 3-inch diameter pipe for

pits on the smaller end of the recommended surface area, or a 4-inch pipe for pits on the larger end of the recommended surface area.

- Pre-soak period: Add water to the pit so that there is standing water for at least 6 hours. Maintain the pre-soak water level at least 12 inches above the bottom of the pit.
- At the end of the pre-soak period, add water to the pit at a rate that will maintain a 6-12 inch water level above the bottom of the pit over a full hour. The depth should not exceed the pro- posed maximum depth of water expected in the completed facility.
- Every 15 minutes, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point (between 6 inches and 1 foot) on the measuring rod. The specific depth should be the same as the maximum designed pond- ing depth (usually 6 – 12 inches).

After one hour, turn off the water and record the rate of infiltration (the drop rate of the standing water) in inches per hour from the measuring rod data, until the pit is empty.

- A self-logging pressure sensor may also be used to determine water depth and drain-down.
- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to the hydraulic restricting layer, and is determined by the engineer or certified soils professional. The soils professional should judge whether a mounding analysis is necessary.

APPENDIX D

CALCULATED DESIGN INFILTRATION RATE:

Site variability and number of locations tested (CF_v) - The number of locations tested must be capable of producing a picture of the subsurface conditions that fully rep- resents the conditions throughout the proposed location of the infiltration BMP. The partial correction factor used for this issue depends on the level of uncertainty that adverse subsurface conditions may occur. If the range of uncertainty is low - for example, conditions are known to be uniform through previous exploration and site geological factors

- one pilot infiltration test (or grain size analysis location) may be adequate to justify a partial correction factor at the high end of the range.

If the level of uncertainty is high, a partial correction factor near the low end of the range may be appropriate. This might be the case where the site conditions are highly variable due to conditions such as a deposit of ancient landslide debris, or buried stream channels. In these cases, even with many explorations and several pilot infiltration tests (or several grain size test locations), the level of uncertainty may still be high.

A partial correction factor near the low end of the range could be assigned where conditions have a more typical variability, but few explorations and only one pilot infiltration test (or one grain size analysis location) is conducted. That is, the number of explorations and tests conducted do not match the degree of site variability anticipated.

- **Uncertainty of test method (CF_t)** accounts for uncertainties in the testing methods. For the full scale PIT method, CF_t = 0.75; for the small-scale PIT method, CF_t = 0.50; for smaller-scale infiltration tests such as the double-ring infiltrometer test, CF_t = 0.40; for grain size analysis, CF_t = 0.40. These values are intended to represent the difference in each test's ability to estimate the actual saturated hydraulic conductivity. The assumption is the larger the scale of the test, the more reliable the result.
- **Degree of influent control to prevent siltation and bio-buildup (CF_m)** Even with a pre-settling basin or a basic treatment BMP for pre-treatment, the soil's initial infiltration rate will gradually decline as more and more stormwater, with some amount of suspended material, passes through the soil profile. The maintenance schedule calls for removing sediment when the BMP is infiltrating at only 90% of its design capacity. Therefore, a correction factor, CF_m, of 0.9 is called for.

Table V-5.1: Correction Factors to be Used With In-Situ Saturated Hydraulic Conductivity Measurements to Estimate Design Rates

Issue	Partial Correction Factor
Site variability and number of locations tested	CF_v = 0.33 to 1.0
Test Method	
• Large-scale PIT • Small-scale PIT • Other small-scale (e.g. Double ring, falling head) • Grain Size Method	CF_t = 0.75 = 0.50 = 0.40 = 0.40
Degree of influent control to prevent siltation and bio-buildup	CF_m = 0.9

Total Correction Factor, $CF_T = CF_v \times CF_t \times CF_m$

Total Correction Factor, $CF_T = 1.0 \times 0.5 \times 0.9$

$CF_T = 0.45$

APPENDIX B

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Gold Gate Stormwater Modeling

Site Name:

Site Address:

City:

Report Date:	3/4/2024
Gage:	38 IN CENTRAL
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2023/01/27
Version:	4.2.19

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
SIDEWALKS FLAT	3.751
Impervious Total	3.751
Basin Total	3.751

Mitigated Land Use

Canopy and Non-Permeable Pavement

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.106
SIDEWALKS FLAT	0.458
Impervious Total	0.564
Basin Total	0.564

Lateral I Basin 1

Bypass:	No
Impervious Land Use	acre
SIDEWALKS FLAT	3

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
SIDEWALKS FLAT	0.023
Impervious Total	0.023
Basin Total	0.023

Routing Elements
Predeveloped Routing

Mitigated Routing

Gravel Trench Bed 1

Bottom Length: 24.00 ft.
Bottom Width: 40.00 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 1.83
Pour Space of material for first layer: 0.4
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 10.3
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 234.563
Total Volume Through Riser (ac-ft.): 0.014
Total Volume Through Facility (ac-ft.): 234.577
Percent Infiltrated: 99.99
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 1.82 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.022	0.000	0.000	0.000
0.0203	0.022	0.000	0.000	0.228
0.0407	0.022	0.000	0.000	0.228
0.0610	0.022	0.000	0.000	0.228
0.0813	0.022	0.000	0.000	0.228
0.1017	0.022	0.000	0.000	0.228
0.1220	0.022	0.001	0.000	0.228
0.1423	0.022	0.001	0.000	0.228
0.1627	0.022	0.001	0.000	0.228
0.1830	0.022	0.001	0.000	0.228
0.2033	0.022	0.001	0.000	0.228
0.2237	0.022	0.002	0.000	0.228
0.2440	0.022	0.002	0.000	0.228
0.2643	0.022	0.002	0.000	0.228
0.2847	0.022	0.002	0.000	0.228
0.3050	0.022	0.002	0.000	0.228
0.3253	0.022	0.002	0.000	0.228
0.3457	0.022	0.003	0.000	0.228
0.3660	0.022	0.003	0.000	0.228
0.3863	0.022	0.003	0.000	0.228
0.4067	0.022	0.003	0.000	0.228
0.4270	0.022	0.003	0.000	0.228
0.4473	0.022	0.003	0.000	0.228
0.4677	0.022	0.004	0.000	0.228

0.4880	0.022	0.004	0.000	0.228
0.5083	0.022	0.004	0.000	0.228
0.5287	0.022	0.004	0.000	0.228
0.5490	0.022	0.004	0.000	0.228
0.5693	0.022	0.005	0.000	0.228
0.5897	0.022	0.005	0.000	0.228
0.6100	0.022	0.005	0.000	0.228
0.6303	0.022	0.005	0.000	0.228
0.6507	0.022	0.005	0.000	0.228
0.6710	0.022	0.005	0.000	0.228
0.6913	0.022	0.006	0.000	0.228
0.7117	0.022	0.006	0.000	0.228
0.7320	0.022	0.006	0.000	0.228
0.7523	0.022	0.006	0.000	0.228
0.7727	0.022	0.006	0.000	0.228
0.7930	0.022	0.007	0.000	0.228
0.8133	0.022	0.007	0.000	0.228
0.8337	0.022	0.007	0.000	0.228
0.8540	0.022	0.007	0.000	0.228
0.8743	0.022	0.007	0.000	0.228
0.8947	0.022	0.007	0.000	0.228
0.9150	0.022	0.008	0.000	0.228
0.9353	0.022	0.008	0.000	0.228
0.9557	0.022	0.008	0.000	0.228
0.9760	0.022	0.008	0.000	0.228
0.9963	0.022	0.008	0.000	0.228
1.0167	0.022	0.009	0.000	0.228
1.0370	0.022	0.009	0.000	0.228
1.0573	0.022	0.009	0.000	0.228
1.0777	0.022	0.009	0.000	0.228
1.0980	0.022	0.009	0.000	0.228
1.1183	0.022	0.009	0.000	0.228
1.1387	0.022	0.010	0.000	0.228
1.1590	0.022	0.010	0.000	0.228
1.1793	0.022	0.010	0.000	0.228
1.1997	0.022	0.010	0.000	0.228
1.2200	0.022	0.010	0.000	0.228
1.2403	0.022	0.010	0.000	0.228
1.2607	0.022	0.011	0.000	0.228
1.2810	0.022	0.011	0.000	0.228
1.3013	0.022	0.011	0.000	0.228
1.3217	0.022	0.011	0.000	0.228
1.3420	0.022	0.011	0.000	0.228
1.3623	0.022	0.012	0.000	0.228
1.3827	0.022	0.012	0.000	0.228
1.4030	0.022	0.012	0.000	0.228
1.4233	0.022	0.012	0.000	0.228
1.4437	0.022	0.012	0.000	0.228
1.4640	0.022	0.012	0.000	0.228
1.4843	0.022	0.013	0.000	0.228
1.5047	0.022	0.013	0.000	0.228
1.5250	0.022	0.013	0.000	0.228
1.5453	0.022	0.013	0.000	0.228
1.5657	0.022	0.013	0.000	0.228
1.5860	0.022	0.014	0.000	0.228
1.6063	0.022	0.014	0.000	0.228
1.6267	0.022	0.014	0.000	0.228
1.6470	0.022	0.014	0.000	0.228

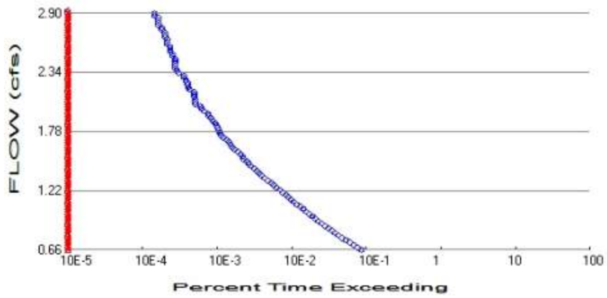
1.6673	0.022	0.014	0.000	0.228
1.6877	0.022	0.014	0.000	0.228
1.7080	0.022	0.015	0.000	0.228
1.7283	0.022	0.015	0.000	0.228
1.7487	0.022	0.015	0.000	0.228
1.7690	0.022	0.015	0.000	0.228
1.7893	0.022	0.015	0.000	0.228
1.8097	0.022	0.016	0.000	0.228
1.8300	0.022	0.016	0.010	0.228

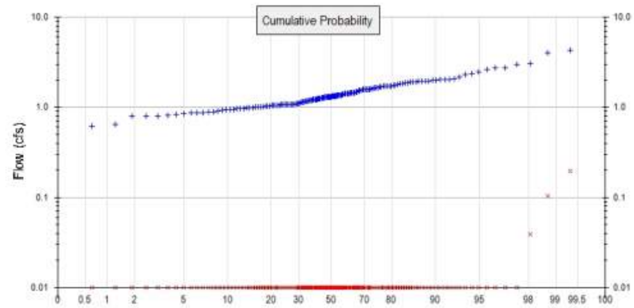
Permeable Pavement 1

Pavement Area:0.1645 acre.Pavement Length:36.00 ft.
Pavement Width: 199.00 ft.
Pavement slope 1:0 To 1
Pavement thickness: 0.33
Pour Space of Pavement: 0.33
Material thickness of second layer: 0.1
Pour Space of material for second layer: 0.33
Material thickness of third layer: 0.42
Pour Space of material for third layer: 0.33
Infiltration On
Infiltration rate: 10.3
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1261.533
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1261.533
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 8.988

Analysis Results

POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 3.751

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 3.751463

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.314541
5 year	1.764542
10 year	2.091606
25 year	2.539238
50 year	2.898492
100 year	3.280563

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	1.554	0.000
1903	1.723	0.000
1904	1.950	0.000
1905	0.874	0.000
1906	0.978	0.000
1907	1.308	0.000
1908	1.075	0.000
1909	1.327	0.000
1910	1.268	0.000
1911	1.423	0.000

1912	2.358	0.000
1913	1.027	0.000
1914	4.313	0.104
1915	0.885	0.000
1916	1.655	0.000
1917	0.625	0.000
1918	1.325	0.000
1919	0.811	0.000
1920	1.079	0.000
1921	0.925	0.000
1922	1.451	0.000
1923	1.011	0.000
1924	1.914	0.000
1925	0.799	0.000
1926	1.559	0.000
1927	1.270	0.000
1928	0.942	0.000
1929	1.880	0.000
1930	1.968	0.000
1931	0.948	0.000
1932	1.024	0.000
1933	1.015	0.000
1934	1.649	0.000
1935	0.874	0.000
1936	1.224	0.000
1937	1.820	0.000
1938	0.889	0.000
1939	1.119	0.000
1940	1.974	0.000
1941	1.950	0.000
1942	1.467	0.000
1943	1.452	0.000
1944	2.088	0.000
1945	1.583	0.000
1946	1.228	0.000
1947	0.958	0.000
1948	1.318	0.000
1949	2.035	0.000
1950	1.151	0.000
1951	1.742	0.000
1952	1.952	0.000
1953	1.807	0.000
1954	1.070	0.000
1955	0.995	0.000
1956	0.981	0.000
1957	1.061	0.000
1958	1.316	0.000
1959	1.318	0.000
1960	1.047	0.000
1961	2.987	0.000
1962	1.284	0.000
1963	0.954	0.000
1964	2.765	0.000
1965	1.241	0.000
1966	1.038	0.000
1967	1.454	0.000
1968	1.226	0.000
1969	1.105	0.000

1970	1.257	0.000
1971	1.218	0.000
1972	4.027	0.197
1973	2.339	0.000
1974	1.693	0.000
1975	1.747	0.000
1976	1.863	0.000
1977	0.800	0.000
1978	1.349	0.000
1979	1.418	0.000
1980	1.398	0.000
1981	1.316	0.000
1982	1.072	0.000
1983	1.454	0.000
1984	1.446	0.000
1985	1.645	0.000
1986	0.835	0.000
1987	1.467	0.000
1988	0.875	0.000
1989	0.800	0.000
1990	1.057	0.000
1991	1.580	0.000
1992	1.502	0.000
1993	1.716	0.000
1994	1.174	0.000
1995	0.913	0.000
1996	1.223	0.000
1997	1.096	0.000
1998	1.303	0.000
1999	1.416	0.000
2000	1.245	0.000
2001	0.998	0.000
2002	1.812	0.000
2003	1.058	0.000
2004	1.586	0.000
2005	3.031	0.000
2006	1.422	0.000
2007	1.591	0.000
2008	1.311	0.000
2009	1.000	0.000
2010	1.284	0.000
2011	1.351	0.000
2012	1.254	0.000
2013	1.183	0.000
2014	1.144	0.000
2015	1.923	0.000
2016	1.202	0.000
2017	1.929	0.000
2018	1.155	0.000
2019	1.710	0.000
2020	1.400	0.000
2021	1.180	0.000
2022	2.007	0.000
2023	2.479	0.000
2024	2.651	0.039
2025	1.291	0.000
2026	1.417	0.000
2027	1.581	0.000

2028	0.619	0.000
2029	1.016	0.000
2030	2.037	0.000
2031	0.640	0.000
2032	1.084	0.000
2033	1.362	0.000
2034	1.066	0.000
2035	1.312	0.000
2036	1.064	0.000
2037	1.432	0.000
2038	1.359	0.000
2039	2.731	0.000
2040	1.069	0.000
2041	1.356	0.000
2042	1.565	0.000
2043	1.730	0.000
2044	1.189	0.000
2045	0.962	0.000
2046	1.067	0.000
2047	1.317	0.000
2048	1.086	0.000
2049	1.611	0.000
2050	1.200	0.000
2051	1.691	0.000
2052	1.292	0.000
2053	1.098	0.000
2054	2.179	0.000
2055	1.334	0.000
2056	1.721	0.000
2057	0.846	0.000
2058	1.620	0.000
2059	2.021	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	4.3135	0.1973
2	4.0265	0.1043
3	3.0312	0.0392
4	2.9866	0.0000
5	2.7654	0.0000
6	2.7307	0.0000
7	2.6511	0.0000
8	2.4794	0.0000
9	2.3581	0.0000
10	2.3388	0.0000
11	2.1790	0.0000
12	2.0881	0.0000
13	2.0365	0.0000
14	2.0349	0.0000
15	2.0207	0.0000
16	2.0068	0.0000
17	1.9736	0.0000
18	1.9681	0.0000
19	1.9521	0.0000
20	1.9502	0.0000
21	1.9500	0.0000
22	1.9286	0.0000

23	1.9231	0.0000
24	1.9138	0.0000
25	1.8801	0.0000
26	1.8630	0.0000
27	1.8196	0.0000
28	1.8122	0.0000
29	1.8068	0.0000
30	1.7467	0.0000
31	1.7418	0.0000
32	1.7304	0.0000
33	1.7230	0.0000
34	1.7214	0.0000
35	1.7163	0.0000
36	1.7100	0.0000
37	1.6926	0.0000
38	1.6913	0.0000
39	1.6549	0.0000
40	1.6492	0.0000
41	1.6445	0.0000
42	1.6204	0.0000
43	1.6113	0.0000
44	1.5910	0.0000
45	1.5865	0.0000
46	1.5825	0.0000
47	1.5812	0.0000
48	1.5796	0.0000
49	1.5647	0.0000
50	1.5591	0.0000
51	1.5544	0.0000
52	1.5020	0.0000
53	1.4667	0.0000
54	1.4666	0.0000
55	1.4544	0.0000
56	1.4541	0.0000
57	1.4524	0.0000
58	1.4514	0.0000
59	1.4456	0.0000
60	1.4319	0.0000
61	1.4229	0.0000
62	1.4221	0.0000
63	1.4182	0.0000
64	1.4174	0.0000
65	1.4159	0.0000
66	1.3998	0.0000
67	1.3984	0.0000
68	1.3617	0.0000
69	1.3587	0.0000
70	1.3561	0.0000
71	1.3513	0.0000
72	1.3490	0.0000
73	1.3343	0.0000
74	1.3269	0.0000
75	1.3251	0.0000
76	1.3184	0.0000
77	1.3175	0.0000
78	1.3171	0.0000
79	1.3160	0.0000
80	1.3159	0.0000

81	1.3120	0.0000
82	1.3110	0.0000
83	1.3079	0.0000
84	1.3028	0.0000
85	1.2920	0.0000
86	1.2907	0.0000
87	1.2843	0.0000
88	1.2842	0.0000
89	1.2702	0.0000
90	1.2680	0.0000
91	1.2566	0.0000
92	1.2542	0.0000
93	1.2446	0.0000
94	1.2406	0.0000
95	1.2281	0.0000
96	1.2259	0.0000
97	1.2235	0.0000
98	1.2230	0.0000
99	1.2175	0.0000
100	1.2016	0.0000
101	1.2002	0.0000
102	1.1888	0.0000
103	1.1830	0.0000
104	1.1803	0.0000
105	1.1739	0.0000
106	1.1554	0.0000
107	1.1513	0.0000
108	1.1442	0.0000
109	1.1185	0.0000
110	1.1054	0.0000
111	1.0979	0.0000
112	1.0965	0.0000
113	1.0859	0.0000
114	1.0840	0.0000
115	1.0787	0.0000
116	1.0754	0.0000
117	1.0723	0.0000
118	1.0700	0.0000
119	1.0688	0.0000
120	1.0671	0.0000
121	1.0661	0.0000
122	1.0644	0.0000
123	1.0606	0.0000
124	1.0576	0.0000
125	1.0570	0.0000
126	1.0467	0.0000
127	1.0379	0.0000
128	1.0275	0.0000
129	1.0238	0.0000
130	1.0159	0.0000
131	1.0152	0.0000
132	1.0113	0.0000
133	1.0004	0.0000
134	0.9982	0.0000
135	0.9948	0.0000
136	0.9811	0.0000
137	0.9777	0.0000
138	0.9622	0.0000

139	0.9576	0.0000
140	0.9538	0.0000
141	0.9483	0.0000
142	0.9420	0.0000
143	0.9252	0.0000
144	0.9125	0.0000
145	0.8895	0.0000
146	0.8846	0.0000
147	0.8746	0.0000
148	0.8743	0.0000
149	0.8741	0.0000
150	0.8463	0.0000
151	0.8352	0.0000
152	0.8107	0.0000
153	0.8002	0.0000
154	0.7999	0.0000
155	0.7988	0.0000
156	0.6398	0.0000
157	0.6250	0.0000
158	0.6189	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.6573	4775	0	0	Pass
0.6799	4253	0	0	Pass
0.7025	3736	0	0	Pass
0.7252	3283	0	0	Pass
0.7478	2938	0	0	Pass
0.7705	2625	0	0	Pass
0.7931	2371	0	0	Pass
0.8157	2119	0	0	Pass
0.8384	1920	0	0	Pass
0.8610	1713	0	0	Pass
0.8837	1541	0	0	Pass
0.9063	1396	0	0	Pass
0.9289	1273	0	0	Pass
0.9516	1143	0	0	Pass
0.9742	1045	0	0	Pass
0.9968	960	0	0	Pass
1.0195	867	0	0	Pass
1.0421	794	0	0	Pass
1.0648	728	0	0	Pass
1.0874	645	0	0	Pass
1.1100	594	0	0	Pass
1.1327	544	0	0	Pass
1.1553	498	0	0	Pass
1.1780	467	0	0	Pass
1.2006	420	0	0	Pass
1.2232	389	0	0	Pass
1.2459	347	0	0	Pass
1.2685	320	0	0	Pass
1.2912	294	0	0	Pass
1.3138	268	0	0	Pass
1.3364	243	0	0	Pass
1.3591	217	0	0	Pass
1.3817	201	0	0	Pass
1.4043	188	0	0	Pass
1.4270	174	0	0	Pass
1.4496	160	0	0	Pass
1.4723	146	0	0	Pass
1.4949	137	0	0	Pass
1.5175	126	0	0	Pass
1.5402	122	0	0	Pass
1.5628	114	0	0	Pass
1.5855	105	0	0	Pass
1.6081	95	0	0	Pass
1.6307	89	0	0	Pass
1.6534	84	0	0	Pass
1.6760	79	0	0	Pass
1.6986	75	0	0	Pass
1.7213	67	0	0	Pass
1.7439	62	0	0	Pass
1.7666	61	0	0	Pass
1.7892	58	0	0	Pass
1.8118	57	0	0	Pass
1.8345	55	0	0	Pass

1.8571	53	0	0	Pass
1.8798	48	0	0	Pass
1.9024	46	0	0	Pass
1.9250	43	0	0	Pass
1.9477	42	0	0	Pass
1.9703	37	0	0	Pass
1.9929	34	0	0	Pass
2.0156	33	0	0	Pass
2.0382	28	0	0	Pass
2.0609	28	0	0	Pass
2.0835	28	0	0	Pass
2.1061	27	0	0	Pass
2.1288	27	0	0	Pass
2.1514	27	0	0	Pass
2.1741	24	0	0	Pass
2.1967	23	0	0	Pass
2.2193	22	0	0	Pass
2.2420	22	0	0	Pass
2.2646	21	0	0	Pass
2.2872	20	0	0	Pass
2.3099	20	0	0	Pass
2.3325	17	0	0	Pass
2.3552	16	0	0	Pass
2.3778	15	0	0	Pass
2.4004	15	0	0	Pass
2.4231	15	0	0	Pass
2.4457	15	0	0	Pass
2.4684	15	0	0	Pass
2.4910	14	0	0	Pass
2.5136	14	0	0	Pass
2.5363	13	0	0	Pass
2.5589	13	0	0	Pass
2.5816	13	0	0	Pass
2.6042	12	0	0	Pass
2.6268	12	0	0	Pass
2.6495	12	0	0	Pass
2.6721	11	0	0	Pass
2.6947	11	0	0	Pass
2.7174	11	0	0	Pass
2.7400	10	0	0	Pass
2.7627	10	0	0	Pass
2.7853	9	0	0	Pass
2.8079	9	0	0	Pass
2.8306	9	0	0	Pass
2.8532	9	0	0	Pass
2.8759	8	0	0	Pass
2.8985	8	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
Gravel Trench Bed 1 POC	☐	213.47			☐	99.99			
Permeable Pavement 1 POC	☐	1148.00			☐	100.00			
Total Volume Infiltrated		1361.46	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

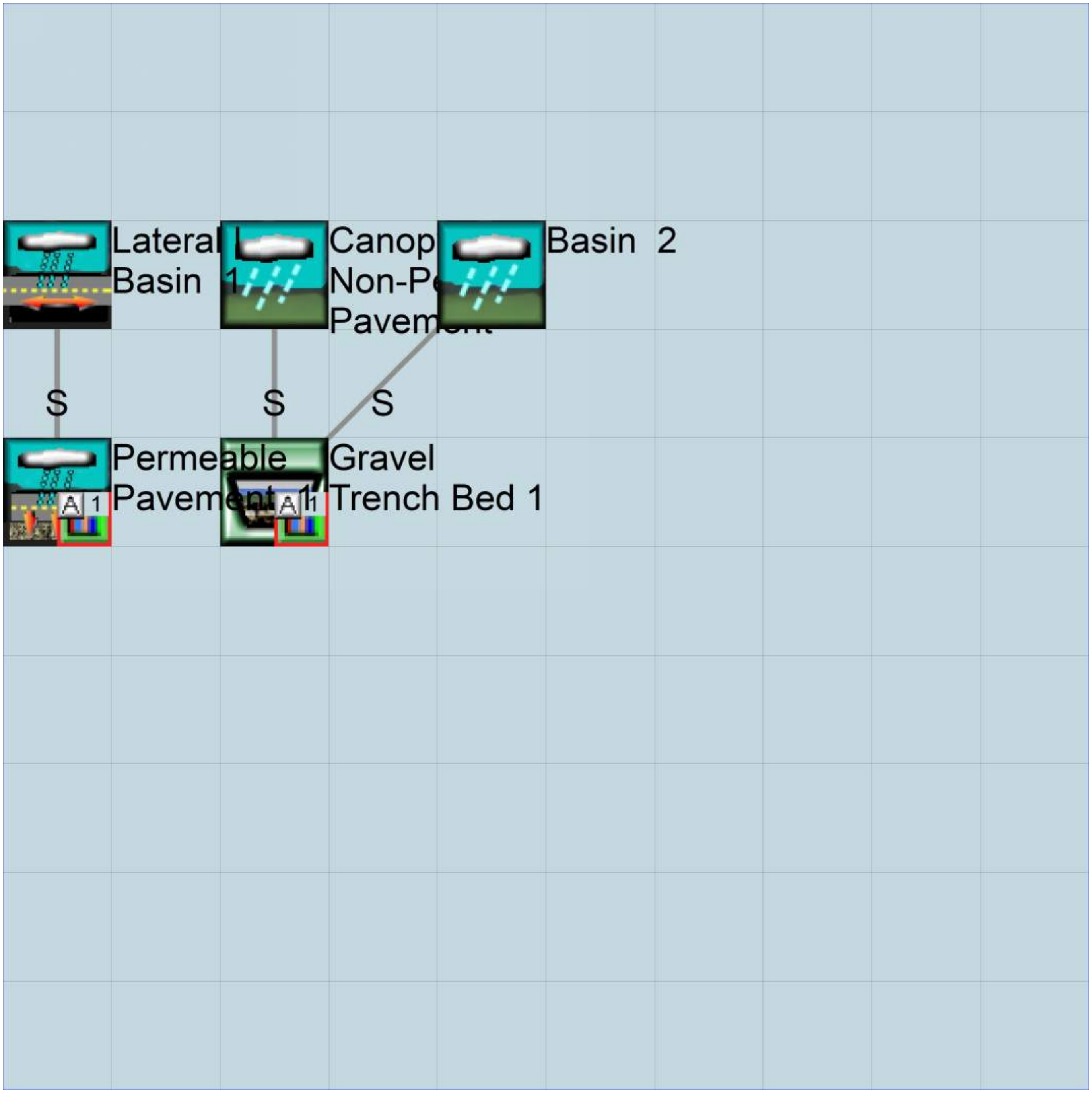
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 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   Gold Gate Stormwater Modeling.wdm
MESSU      25   PreGold Gate Stormwater Modeling.MES
           27   PreGold Gate Stormwater Modeling.L61
           28   PreGold Gate Stormwater Modeling.L62
           30   POCGold Gate Stormwater Modeling1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       8
      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           ***
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

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

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    8         0    0    0    0    0
  END IWAT-PARM1

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

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

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

END IMPLND
```

```
SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
IMPLND   8                       3.751     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    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              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       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

City of Puyallup Development & Permitting Services ISSUED PERMIT Building Planning Engineering Public Works Fire Traffic

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 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   Gold Gate Stormwater Modeling.wdm
MESSU      25   MitGold Gate Stormwater Modeling.MES
           27   MitGold Gate Stormwater Modeling.L61
           28   MitGold Gate Stormwater Modeling.L62
           30   POCGold Gate Stormwater Modeling1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       4
      IMPLND       8
      IMPLND      17
      IMPLND      16
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Permeable Pavement  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           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   17      SIDEWALKS/FLAT         1    1    1   27    0
   16      Porous Pavement        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   17         0    0    1    0    0    0
   16         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    4    1    9
    8         0    0    4    0    0    0    1    9
   17         0    0    4    0    0    0    1    9
   16         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     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   17         0    0    0    0    0
   16         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
```

```
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   17            400      0.01       0.1       0.1
   16            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    8              0         0
   17              0         0
   16              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    8              0         0
   17              0         0
   16              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Canopy and Non-Permeable Pavement***
IMPLND   4                       0.106     RCHRES   2      5
IMPLND   8                       0.458     RCHRES   2      5
Lateral I Basin  1***
IMPLND  17                     18.2412     IMPLND  16     53
Basin  2***
IMPLND   8                       0.023     RCHRES   2      5
IMPLND  16                      0.1645     RCHRES   1      5

******Routing******
IMPLND   4                       0.106     COPY     1     15
IMPLND   8                       0.458     COPY     1     15
IMPLND  17                           3     COPY     1     15
IMPLND   8                       0.023     COPY     1     15
RCHRES   2                           1     COPY   501     17
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     Permeable Paveme-009    2    1    1    1   28    0    1
    2     Gravel Trench Be-008    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***
```

```
    ACTIVITY
      <PLS > ************* Active Sections *****************************
      # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
      1         1    0    0    0    0    0    0    0    0    0
      2         1    0    0    0    0    0    0    0    0    0
    END ACTIVITY

    PRINT-INFO
      <PLS > ***************** Print-flags ******************* PIVL  PYR
      # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
      1         4    0    0    0    0    0    0    0    0    0    1    9
      2         4    0    0    0    0    0    0    0    0    0    1    9
    END PRINT-INFO

    HYDR-PARM1
      RCHRES  Flags for each HYDR Section                                         ***
      # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
              FG FG FG FG  possible  exit  *** possible  exit      possible  exit
               *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
      1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
      2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    END HYDR-PARM1

    HYDR-PARM2
      # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
    <------><--------><--------><--------><--------><--------><-------->        ***
      1             1      0.01       0.0       0.0       0.5       0.0
      2             2      0.01       0.0       0.0       0.5       0.0
    END HYDR-PARM2
    HYDR-INIT
      RCHRES  Initial conditions for each HYDR section                            ***
      # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit       for each possible exit
    <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
      1           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
      2           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    END HYDR-INIT
  END RCHRES

  SPEC-ACTIONS
  END SPEC-ACTIONS
  FTABLES
    FTABLE      2
     92    5
       Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
        (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
    0.000000  0.022039  0.000000  0.000000  0.000000
    0.020333  0.022039  0.000179  0.000000  0.228889
    0.040667  0.022039  0.000358  0.000000  0.228889
    0.061000  0.022039  0.000538  0.000000  0.228889
    0.081333  0.022039  0.000717  0.000000  0.228889
    0.101667  0.022039  0.000896  0.000000  0.228889
    0.122000  0.022039  0.001075  0.000000  0.228889
    0.142333  0.022039  0.001255  0.000000  0.228889
    0.162667  0.022039  0.001434  0.000000  0.228889
    0.183000  0.022039  0.001613  0.000000  0.228889
    0.203333  0.022039  0.001792  0.000000  0.228889
    0.223667  0.022039  0.001972  0.000000  0.228889
    0.244000  0.022039  0.002151  0.000000  0.228889
    0.264333  0.022039  0.002330  0.000000  0.228889
    0.284667  0.022039  0.002509  0.000000  0.228889
    0.305000  0.022039  0.002689  0.000000  0.228889
    0.325333  0.022039  0.002868  0.000000  0.228889
    0.345667  0.022039  0.003047  0.000000  0.228889
    0.366000  0.022039  0.003226  0.000000  0.228889
    0.386333  0.022039  0.003406  0.000000  0.228889
    0.406667  0.022039  0.003585  0.000000  0.228889
    0.427000  0.022039  0.003764  0.000000  0.228889
    0.447333  0.022039  0.003943  0.000000  0.228889
    0.467667  0.022039  0.004123  0.000000  0.228889
```

```
 0.488000  0.022039  0.004302  0.000000  0.228889
 0.508333  0.022039  0.004481  0.000000  0.228889
 0.528667  0.022039  0.004660  0.000000  0.228889
 0.549000  0.022039  0.004840  0.000000  0.228889
 0.569333  0.022039  0.005019  0.000000  0.228889
 0.589667  0.022039  0.005198  0.000000  0.228889
 0.610000  0.022039  0.005377  0.000000  0.228889
 0.630333  0.022039  0.005557  0.000000  0.228889
 0.650667  0.022039  0.005736  0.000000  0.228889
 0.671000  0.022039  0.005915  0.000000  0.228889
 0.691333  0.022039  0.006094  0.000000  0.228889
 0.711667  0.022039  0.006274  0.000000  0.228889
 0.732000  0.022039  0.006453  0.000000  0.228889
 0.752333  0.022039  0.006632  0.000000  0.228889
 0.772667  0.022039  0.006811  0.000000  0.228889
 0.793000  0.022039  0.006991  0.000000  0.228889
 0.813333  0.022039  0.007170  0.000000  0.228889
 0.833667  0.022039  0.007349  0.000000  0.228889
 0.854000  0.022039  0.007528  0.000000  0.228889
 0.874333  0.022039  0.007708  0.000000  0.228889
 0.894667  0.022039  0.007887  0.000000  0.228889
 0.915000  0.022039  0.008066  0.000000  0.228889
 0.935333  0.022039  0.008245  0.000000  0.228889
 0.955667  0.022039  0.008425  0.000000  0.228889
 0.976000  0.022039  0.008604  0.000000  0.228889
 0.996333  0.022039  0.008783  0.000000  0.228889
 1.016667  0.022039  0.008962  0.000000  0.228889
 1.037000  0.022039  0.009142  0.000000  0.228889
 1.057333  0.022039  0.009321  0.000000  0.228889
 1.077667  0.022039  0.009500  0.000000  0.228889
 1.098000  0.022039  0.009679  0.000000  0.228889
 1.118333  0.022039  0.009859  0.000000  0.228889
 1.138667  0.022039  0.010038  0.000000  0.228889
 1.159000  0.022039  0.010217  0.000000  0.228889
 1.179333  0.022039  0.010396  0.000000  0.228889
 1.199667  0.022039  0.010576  0.000000  0.228889
 1.220000  0.022039  0.010755  0.000000  0.228889
 1.240333  0.022039  0.010934  0.000000  0.228889
 1.260667  0.022039  0.011113  0.000000  0.228889
 1.281000  0.022039  0.011293  0.000000  0.228889
 1.301333  0.022039  0.011472  0.000000  0.228889
 1.321667  0.022039  0.011651  0.000000  0.228889
 1.342000  0.022039  0.011830  0.000000  0.228889
 1.362333  0.022039  0.012010  0.000000  0.228889
 1.382667  0.022039  0.012189  0.000000  0.228889
 1.403000  0.022039  0.012368  0.000000  0.228889
 1.423333  0.022039  0.012547  0.000000  0.228889
 1.443667  0.022039  0.012727  0.000000  0.228889
 1.464000  0.022039  0.012906  0.000000  0.228889
 1.484333  0.022039  0.013085  0.000000  0.228889
 1.504667  0.022039  0.013264  0.000000  0.228889
 1.525000  0.022039  0.013444  0.000000  0.228889
 1.545333  0.022039  0.013623  0.000000  0.228889
 1.565667  0.022039  0.013802  0.000000  0.228889
 1.586000  0.022039  0.013981  0.000000  0.228889
 1.606333  0.022039  0.014161  0.000000  0.228889
 1.626667  0.022039  0.014340  0.000000  0.228889
 1.647000  0.022039  0.014519  0.000000  0.228889
 1.667333  0.022039  0.014698  0.000000  0.228889
 1.687667  0.022039  0.014878  0.000000  0.228889
 1.708000  0.022039  0.015057  0.000000  0.228889
 1.728333  0.022039  0.015236  0.000000  0.228889
 1.748667  0.022039  0.015415  0.000000  0.228889
 1.769000  0.022039  0.015594  0.000000  0.228889
 1.789333  0.022039  0.015774  0.000000  0.228889
 1.809667  0.022039  0.015953  0.000000  0.228889
 1.830000  0.022039  0.016132  0.010616  0.228889
 1.850333  0.022039  0.016580  0.056033  0.228889
 END FTABLE  2
 FTABLE      1
```

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Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Outflow2 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.164463	0.000000	0.000000	0.000000		
0.008333	0.164463	0.000452	0.000000	1.708083		
0.016667	0.164463	0.000905	0.000000	1.708083		
0.025000	0.164463	0.001357	0.000000	1.708083		
0.033333	0.164463	0.001809	0.000000	1.708083		
0.041667	0.164463	0.002261	0.000000	1.708083		
0.050000	0.164463	0.002714	0.000000	1.708083		
0.058333	0.164463	0.003166	0.000000	1.708083		
0.066667	0.164463	0.003618	0.000000	1.708083		
0.075000	0.164463	0.004070	0.000000	1.708083		
0.083333	0.164463	0.004523	0.000000	1.708083		
0.091667	0.164463	0.004975	0.000000	1.708083		
0.100000	0.164463	0.005427	0.000000	1.708083		
0.108333	0.164463	0.005880	0.000000	1.708083		
0.116667	0.164463	0.006332	0.000000	1.708083		
0.125000	0.164463	0.006784	0.000000	1.708083		
0.133333	0.164463	0.007236	0.000000	1.708083		
0.141667	0.164463	0.007689	0.000000	1.708083		
0.150000	0.164463	0.008141	0.000000	1.708083		
0.158333	0.164463	0.008593	0.000000	1.708083		
0.166667	0.164463	0.009045	0.000000	1.708083		
0.175000	0.164463	0.009498	0.000000	1.708083		
0.183333	0.164463	0.009950	0.000000	1.708083		
0.191667	0.164463	0.010402	0.000000	1.708083		
0.200000	0.164463	0.010855	0.000000	1.708083		
0.208333	0.164463	0.011307	0.000000	1.708083		
0.216667	0.164463	0.011759	0.000000	1.708083		
0.225000	0.164463	0.012211	0.000000	1.708083		
0.233333	0.164463	0.012664	0.000000	1.708083		
0.241667	0.164463	0.013116	0.000000	1.708083		
0.250000	0.164463	0.013568	0.000000	1.708083		
0.258333	0.164463	0.014020	0.000000	1.708083		
0.266667	0.164463	0.014473	0.000000	1.708083		
0.275000	0.164463	0.014925	0.000000	1.708083		
0.283333	0.164463	0.015377	0.000000	1.708083		
0.291667	0.164463	0.015830	0.000000	1.708083		
0.300000	0.164463	0.016282	0.000000	1.708083		
0.308333	0.164463	0.016734	0.000000	1.708083		
0.316667	0.164463	0.017186	0.000000	1.708083		
0.325000	0.164463	0.017639	0.000000	1.708083		
0.333333	0.164463	0.018091	0.000000	1.708083		
0.341667	0.164463	0.018543	0.000000	1.708083		
0.350000	0.164463	0.018995	0.000000	1.708083		
0.358333	0.164463	0.019448	0.000000	1.708083		
0.366667	0.164463	0.019900	0.000000	1.708083		
0.375000	0.164463	0.020352	0.000000	1.708083		
0.383333	0.164463	0.020805	0.000000	1.708083		
0.391667	0.164463	0.021257	0.000000	1.708083		
0.400000	0.164463	0.021709	0.000000	1.708083		
0.408333	0.164463	0.022161	0.000000	1.708083		
0.416667	0.164463	0.022614	0.000000	1.708083		
0.425000	0.164463	0.023066	0.000000	1.708083		
0.433333	0.164463	0.023518	0.000000	1.708083		
0.441667	0.164463	0.023970	0.000000	1.708083		
0.450000	0.164463	0.024423	0.000000	1.708083		
0.458333	0.164463	0.024875	0.000000	1.708083		
0.466667	0.164463	0.025327	0.000000	1.708083		
0.475000	0.164463	0.025780	0.000000	1.708083		
0.483333	0.164463	0.026232	0.000000	1.708083		
0.491667	0.164463	0.026684	0.000000	1.708083		
0.500000	0.164463	0.027136	0.000000	1.708083		
0.508333	0.164463	0.027589	0.000000	1.708083		
0.516667	0.164463	0.028041	0.000000	1.708083		
0.525000	0.164463	0.028493	0.000000	1.708083		
0.533333	0.164463	0.028945	0.000000	1.708083		
0.541667	0.164463	0.029398	0.000000	1.708083		
0.550000	0.164463	0.029850	0.000000	1.708083		

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  0.558333  0.164463  0.030302  0.000000  1.708083
  0.566667  0.164463  0.030755  0.000000  1.708083
  0.575000  0.164463  0.031207  0.000000  1.708083
  0.583333  0.164463  0.031659  0.000000  1.708083
  0.591667  0.164463  0.032111  0.000000  1.708083
  0.600000  0.164463  0.032564  0.000000  1.708083
  0.608333  0.164463  0.033016  0.000000  1.708083
  0.616667  0.164463  0.033468  0.000000  1.708083
  0.625000  0.164463  0.033920  0.000000  1.708083
  0.633333  0.164463  0.034373  0.000000  1.708083
  0.641667  0.164463  0.034825  0.000000  1.708083
  0.650000  0.164463  0.035277  0.000000  1.708083
  0.658333  0.164463  0.035730  0.000000  1.708083
  0.666667  0.164463  0.036182  0.000000  1.708083
  0.675000  0.164463  0.036634  0.000000  1.708083
  0.683333  0.164463  0.037086  0.000000  1.708083
  0.691667  0.164463  0.037539  0.000000  1.708083
  0.700000  0.164463  0.037991  0.000000  1.708083
  0.708333  0.164463  0.038443  0.000000  1.708083
  0.716667  0.164463  0.038895  0.000000  1.708083
  0.725000  0.164463  0.039348  0.000000  1.708083
  0.733333  0.164463  0.039800  0.000000  1.708083
  0.741667  0.164463  0.040252  0.000000  1.708083
  0.750000  0.164463  0.040705  0.000000  1.708083
  END FTABLE  1
END FTABLES

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

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1         1     WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1         1     WDM   1005 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1         1     WDM   1006 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1         1     WDM   1007 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1      48.4     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1      48.4     WDM    801 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1         1     WDM   1008 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1         1     WDM   1009 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1         1     WDM   1010 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1         1     WDM   1011 STAG     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17

  MASS-LINK       53
IMPLND     IWATER SURO                     IMPLND         EXTNL  SURLI
```

```
  END MASS-LINK   53

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 16:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
91	1753.4	1773.1	2692.6

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 16:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1.4328E+04	-6.820E+05	47.597	47.597	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 17: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
91	1753.4	1773.1	3069.2

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 17: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1.4328E+04	-9.555E+05	66.685	66.685	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 17:15

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS V1 V2 VOL
91 1753.4 1773.1 2767.8

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 17:15

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A B C RDEP1 RDEP2 COUNT
0.0000E+00 1.4328E+04 -7.366E+05 51.409 51.409 2

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 17:30

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS V1 V2 VOL
91 1753.4 1773.1 2415.3

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 17:30

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A B C RDEP1 RDEP2 COUNT
0.0000E+00 1.4328E+04 -4.807E+05 33.547 3.3547E+01 2

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 16:45

RCHRES: 2

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS V1 V2 VOL
92 7.0271E+02 722.22 740.18

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 16:45

RCHRES: 2

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1920.0	-3.687E+03	1.9200	1.9200E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1914/ 6/30 17: 0

RCHRES: 2

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	7.0271E+02	722.22	745.77

ERROR/WARNING ID: 341 5

DATE/TIME: 1914/ 6/30 17: 0

RCHRES: 2

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1920.0	-4.236E+03	2.2065	2.2065E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1972/ 6/10 17:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
91	1.7534E+03	1773.1	2398.1

ERROR/WARNING ID: 341 5

DATE/TIME: 1972/ 6/10 17:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0).

Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1.4328E+04	-4.681E+05	32.670	3.2670E+01	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/ 6/10 18: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	1.7534E+03	1773.1	3572.5

ERROR/WARNING ID: 341   5

DATE/TIME: 1972/ 6/10 18: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1.4328E+04	-1.321E+06	92.190	92.190	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/ 6/10 18:15

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	1753.4	1773.1	3879.6

ERROR/WARNING ID: 341   5

DATE/TIME: 1972/ 6/10 18:15

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1.4328E+04	-1.544E+06	107.75	107.75	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/ 6/10 18:30

```
RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 1753.4     1773.1     3620.7
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1972/ 6/10 18:30

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 1.4328E+04 -1.356E+06   94.630     94.630        2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1972/ 6/10 18:45

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 1753.4     1773.1     3157.3
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1972/ 6/10 18:45

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 1.4328E+04 -1.019E+06   71.146     71.146        2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1972/ 6/10 19: 0

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:
```

```
NROWS         V1          V2         VOL
91 1753.4     1773.1      2596.0
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1972/ 6/10 19: 0

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 1.4328E+04 -6.119E+05   42.704   4.2704E+01      2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1972/ 6/10 18: 0

RCHRES:     2

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1          V2         VOL
92 7.0271E+02  722.22      822.13
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1972/ 6/10 18: 0

RCHRES:     2

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 1920.0     -1.175E+04    6.1196  6.1196E+00      2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1972/ 6/10 18:15

RCHRES:     2

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1          V2         VOL
92 7.0271E+02  722.22      743.71
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1972/ 6/10 18:15

RCHRES:     2
```

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1920.0	-4.034E+03	2.1008	2.1008E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 2024/ 2/ 4 2: 0

RCHRES: 2

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	7.0271E+02	722.22	726.02

ERROR/WARNING ID: 341 5

DATE/TIME: 2024/ 2/ 4 2: 0

RCHRES: 2

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	1920.0	-2.293E+03	1.1942	1.1942E+00	2

Disclaimer

Legal Notice

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APPENDIX C

Washington State Fair - Gold Gate
Operation and Maintenance Manual

Stormwater from the Gold Gate development project area is collected and infiltrated using permeable pavement and a new infiltration gallery. Roof downspouts will collect stormwater and be routed to an infiltration gallery on the north side of the site. Hardscape areas are either collected through surface flow to a trench drain with conveyance to a new infiltration gallery, or surface flow to new permeable asphalt pavements on site which infiltrate stormwater below the pavement section.

This document provides guidelines for operation and maintenance of the stormwater management facilities at the Lighthouse site. Much of this O & M Manual is adapted from the *2021 Pierce County Stormwater Management and Site Development Manual*, the Puget Sound Partnership's *Low Impact Development Technical Guidance Manual for Puget Sound, December 2012* (LID Manual) and the Department of Ecology's 2019 *Stormwater Management Manual for Western Washington* (DOE Manual).

Infiltration Gallery

Design

The proposed infiltration gallery on site is designed to provide stormwater flow control through the infiltration of stormwater runoff generated on site. The infiltration gallery receives runoff from the canopy drains and leaders, which is collected through stormwater pipes and conveyed to the infiltration trench. A portion of the paver runoff are collected in a trench drain and conveyed to the infiltration trench as well.

The infiltration gallery has been sized using the WWHM based on the following criteria:

- Trench Length x Width: 40.0' x 24.0'
- Effective Permeable Ballast Depth of 1.83-feet
- Design Infiltration Rate of 10.3 in/hr
- Side slopes H/V: 0
- Infiltrate 100% of runoff up to of the 100-year storm

An overflow pipe will convey any runoff, that exceeds a 100-year storm, to an existing stormwater manhole. The overflow pipe will be set to at a higher elevation than the outflow in the manhole. Any runoff in an event that exceeds a 100-year storm will overflow into the existing manhole.

Operation and Maintenance

Infiltration trenches require periodic maintenance to prevent clogging and maintain infiltration capacity, including:

- Clearing debris from pipe inlets.
- Clearing accumulated trash, debris, excessive vegetation and sediment from inlet pipes.

- Maintain emergency overflow free of debris and vegetation.
- Clearing sediment from drain pipes/cleanouts

See Appendix A for infiltration pond maintenance standards, procedures, and tracking log.

Inspection

Infiltration Basins should be inspected annually during a storm event for infiltration capacity. The overflow control structure should be monitored for water levels at or above the outfall pipe and tracked in the log. Water levels in the upturned tees should be checked during the storm event and the 3 days following the storm event and tracked in the log. If high water levels remain 3 days after a storm event the system is not operating properly and should be evaluated for potential causes.

Roof leader sumps should be visually inspected for the accumulation of sediment and debris that could restrict stormwater from reaching the infiltration basins. Accumulated debris shall be removed regularly.

Permeable Pavement

Design

The proposed permeable pavement on site is designed to provide stormwater flow control through the infiltration of stormwater runoff generated on site. The permeable asphalt will infiltrate the runoff generated from the permeable asphalt and adjacent impermeable asphalt & concrete areas.

The Permeable Pavement has been sized using the WWHM based on the following criteria:

- 4” Permeable Asphalt/Permeable Concrete
- 1” ASTM #8 Stone
- 5” Permeable Ballast
- Design Infiltration Rate of 10.3 in/hr
- Infiltrate 100% of runoff up to of the 100-year storm

Operation and Maintenance

Permeable pavements provide a path for animal waste to get into groundwater and the stormwater conveyance system. Therefore, any animal traffic should be directed away from permeable pavements.

Permeable Pavement require periodic maintenance to prevent clogging and maintain infiltration capacity, including:

- Check if elevation of adjacent planted area is too high, or slopes towards pavement and can be regraded (protect permeable pavement with temporary plastic prior to regrading)
- Mulch and/or plant all of the exposed soils that may erode to the pavement surface
- Clean surface debris from pavement surface using one or a combination of the following methods:
  - Vacuum/sweep permeable paved walkways and paved parking lot with brush brooms and high efficiency regenerative air or vacuum sweeper, respectively.

  - Clearing deposited soil, sediment, debris, trash, vegetation and/or other materials from permeable pavement or adjacent surfacing.
  - Wash permeable pavement with hand held pressure washers with rotating brushes.
- Fill potholes or small cracks with patching mixes.
- Cut and replace areas with large cracks and settlement.

See Appendix A for permeable pavement maintenance standards, procedures, and tracking log.

Inspection

Permeable pavement should be inspected annually during a storm event for infiltration capacity. The permeable pavement should be monitored for ponding on the surface or if the water flows off the permeable pavement surface during a rain event. If this occurs, the permeable pavement should be evaluated for potential causes.

During non-storm events, the permeable pavement should be evaluated annually or after a storm event for deposited soil, sediment, debris, trash, vegetation and/or other materials. Permeable pavement should also be evaluated annually for major cracks or trip hazards and concrete spalling and raveling.

During the Summer, permeable pavement should be checked for moss growth that could inhibit infiltration or pose a safety hazard.

Sources:

Puget Sound Partnership Low Impact Development Technical Guidance Manual for Puget Sound, December 2012
Department of Ecology Stormwater Management Manual for Western Washington 2019
Pierce County Stormwater Management and Site Development Manual 2021

Log Sheet

Use copies of this log sheet to keep track of when maintenance checks occur and what items, if any, are repaired or altered. The completed sheets will serve as a record of past maintenance activities and will provide valuable information on how your facilities are operating. This information will be useful for future requirements regarding the types of facilities that are installed. It helps to keep all log sheets in a designated area so that others can easily access them.

Date Checked: ______/_____/______
Checked By:
Name: ___________________________________
Position: ____________________________________
Address: __________________________________ City: ______________________ State: ________ Zip: _______
Phone Number: (______) ______________________

Part of Facility Checked	***Observations (List things that should be done)***	***Follow-up Actions Taken***	***Date Action Taken***

Appendix V-A: BMP Maintenance Tables

Ecology intends the facility-specific maintenance standards contained in this section to be conditions for determining if maintenance actions are required as identified through inspection. Recognizing that Permittees have limited maintenance funds and time, Ecology does not require that a Permittee perform all these maintenance activities on all their stormwater BMPs. We leave the determination of importance of each maintenance activity and its priority within the stormwater program to the Permittee. We do expect, however, that sufficient maintenance will occur to ensure that the BMPs continue to operate as designed to protect ground and surface waters.

Ecology doesn't intend that these measures identify the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the Permittee shall adjust inspection and maintenance schedules to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic feet per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance and inspection access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g.,rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed engineer in the state of Washington should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.

Table V-A.1: Maintenance Standards - Detention Ponds (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Liner (if Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Ponds Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation If settlement is apparent, measure berm to determine amount of settlement Settling can be an indication of more severe problems with the berm or outlet works. A licensed engineer in the state of Washington should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed engineer in the state of Washington should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway	Emergency Overflow/Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.

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

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

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

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

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	vegetation management			protocols)

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM - Integrated Pest Management

ISA - International Society of Arboriculture

Table V-A.22: Maintenance Standards - Permeable Pavement

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◦ Walk-behind vacuum (sidewalks) ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◦ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods:

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				◦ Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. ◦ Hand held pressure washer or power washer with rotating brushes ◦ Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials
Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◦ Walk-behind vacuum (sidewalks) ◦ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◦ ShopVac or brush brooms (small areas) Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.
	A b		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				• Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). • Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Vacuum sweep or stiff broom/power brush for cleaning moss from pavement surface
	A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations
	A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections
	A		Settlement of surface	May require resetting
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A[b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of aggregate material in paving grid	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue)
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	A_b		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	Rehabilitate per manufacturer's recommendations.
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2" top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				
Inlet/outlet pipe	A		Pipe is damaged	Repair/replace
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from under-drain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.

Table V-A.22: Maintenance Standards - Permeable Pavement (continued)

Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMPs/facilities".

a Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

b Inspection should occur during storm event.

Table V-A.23: Maintenance Standards - Vegetated Roofs

Activity	Objective	Schedule	Notes
Structural and Drainage Components			
Clear inlet pipes: Remove soil substrate, vegetation or other debris.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect drain pipe: Check for cracks settling and proper alignment, and correct and re-compact soils or fill material surrounding pipe, if necessary.	Maintain free drainage of inlet pipes.	Twice annually.	
Inspect fire ventilation points for proper operation	Fire and safety.	Twice annually.	
Maintain egress and ingress: Clear routes of obstructions and maintained to design standards.	Fire and safety.	Twice annually.	
Insects: (see note)			Roof garden design should provide drainage rates that do not allow pooling of water for periods that promote insect larvae development. If standing water is present for extended periods correct drainage problem. Chemical sprays should not be used.
Prevent release of contaminants: Identify activities (mechanical systems maintenance, pet access, etc.) that can potentially release pollutants to the roof garden and establish agreements to prevent release.	Water quality protection.	During construction of roof and then as determined by inspection.	Any cause of pollutant release should be corrected as soon as identified and the pollutant removed.
Vegetation and Growth Medium			
Invasive or nuisance plants: Remove manually and without herbicide applications.	Promote selected plant growth and survival, maintain aesthetics.	Twice annually.	At a minimum, schedule weeding with inspections to coincide with important horticultural cycles (e.g., prior to major weed varieties dispersing seeds).