PCCP20241189

Stormwater Plan

Washington State Fair – International Village Redevelopment

110 9th Avenue SW
Puyallup, WA 98374

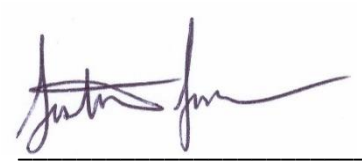
NOTE TO FILE: Report is missing the WWHM 'Analysis' report pages. Requested via MH email dated 10/10/24.

Prepared by
JMJ TEAM
905 Main St Suite 200
Sumner, WA 98390
206.596.2020
Justin Jones, PE

October 4, 2024

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Stormwater Plan for the Washington State Fair – International Village Redevelopment 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

10-04-24

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PROJECT OVERVIEW AND MAPS

The Washington State Fair (WSF) is a 98 acre facility 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 Fair Association is the demolition of the existing International Village Restaurant and construction of a new restaurant with associated site improvements.

The new 14,460 SF International Village Restaurant will be constructed in place of the demolished old International Village Restaurant. The Lot Coverage of the building will increase from the original 8,600 SF to 14,460 SF, including Roof Overhangs and Decks.

EXISTING CONDITIONS SUMMARY

The WSF is made up of two main parcels, and the International Village is located on TPN: 0420331121.

The International Village Redevelopment project site is 64,405 SF. Stormwater runoff in the project area is currently collected by catch basins and roof downspouts. Stormwater runoff from the catch basins and roof downspouts is subsequently conveyed to the 42-inch city main in vacated 5th Street.

See Project Area Coverage Tables and Figures Below. Full size Project Area Coverage Figures are available in Appendix A.

PROPOSED CONDITIONS SUMMARY

The International Village Redevelopment project site proposes the construction of a 14,460 SF two and a half story Restaurant Building with site improvements such as utility connections. This will result in 25,165 SF of impervious surfaces within the project area.

Site improvements include the construction of 29,455 SF of new permeable asphalt pavement, 7,265 SF of new concrete pavement, 9,785 SF of new hydroseeding, and 3,440 SF of replaced asphalt pavement for utility work. The building will also have utility service connections for sewer, water, power, gas, and communications.

Stormwater from the International Village Building will be collected with roof downspouts and conveyed to a proposed EcoRain Detention Tank with a control structure.

Runoff from the proposed pervious asphalt will infiltrate onsite into native soils below the pavements. The pervious pavements are designed to infiltrate 100% of stormwater up to the 100-year storm event. Infiltration testing was performed onsite to obtain a design infiltration rate for on-site soils in the vicinity of stormwater infiltration systems, See Appendix B.

See Project Area Coverage Tables and Figures below.

Description[a]	Onsite	Offsite	Total
Existing Conditions			
Total Project Area[b] (ft²)	64,405-1.479 ac	0-0 ac	64,405-1.479ac
Existing hard surface (ft²)	54,620-1.254 ac	0-0 ac	54,620-1.254ac
Existing vegetation area (ft²)	9,785-0.225 ac	0-0 ac	9,785-0.225ac
Proposed Conditions			
Total Project Area[b] (ft²)	64,405-1.479 ac	0-0 ac	64,405-1.479ac
Amount of new hard surface (ft²)	0-0 ac	0-0 ac	0-0ac
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)	54,620-1.254 ac	0-0 ac	54,620-1.254ac
Amount of replaced PGHS[d] (ft²)	18,420-0.423 ac	0-0 ac	18,420-0.423ac
Amount of new plus replaced hard surface (ft²)	54,620-1.254 ac	0-0 ac	54,620-1.254ac
Amount of new + replaced PGHS (ft²)	18,420-0.423 ac	0-0 ac	18,420-0.423ac
Amount of existing hard surfaces converted to vegetation (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of Land Disturbed (ft²)	64,405-1.479 ac	0-0 ac	64,405-1.479ac
Vegetation to Lawn/Landscaped (acres)	9,785-0.225 ac	0-0 sf	9,785-0.225ac
Native Vegetation to Pasture (acres)	0-0 sf	0-0 sf	0-0 sf
Existing hard surface to remain unaltered (ft²)	0-0 ac	0-0 ac	0-0 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”.

Figure #1 Existing Lot Coverage

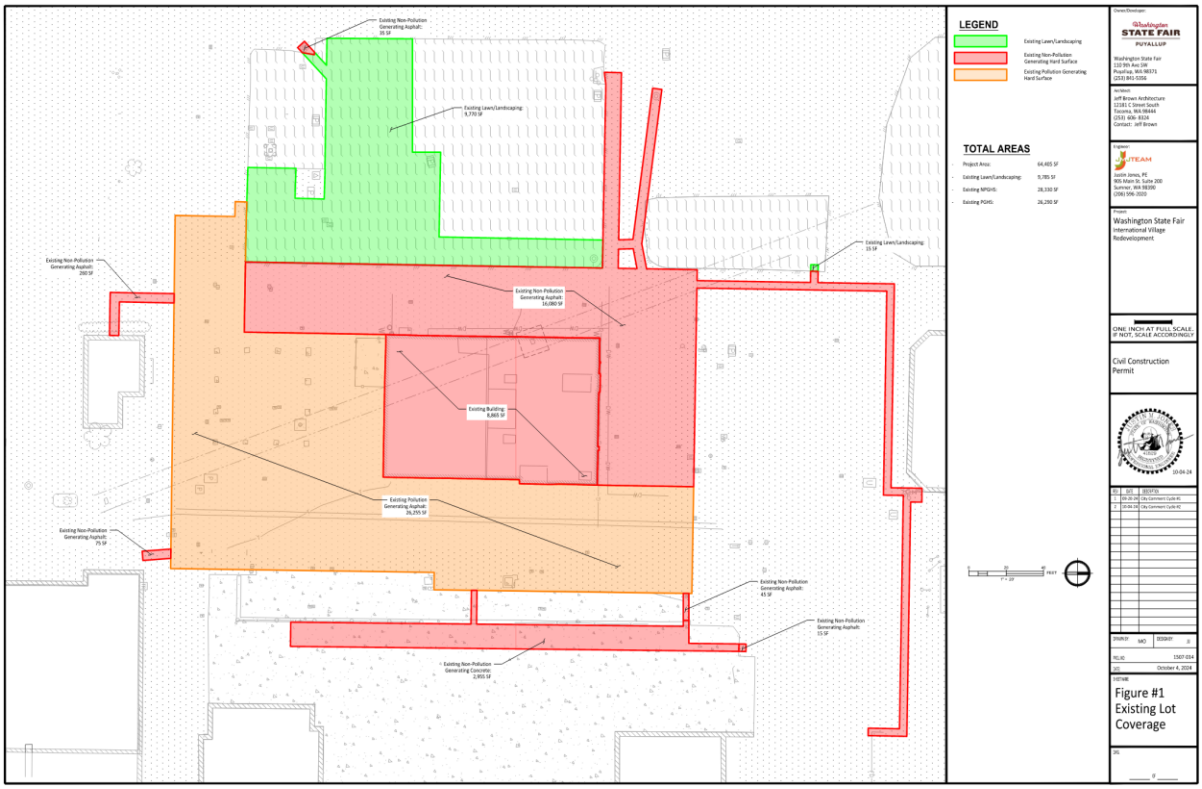


Figure #2 Project Disturbed Area

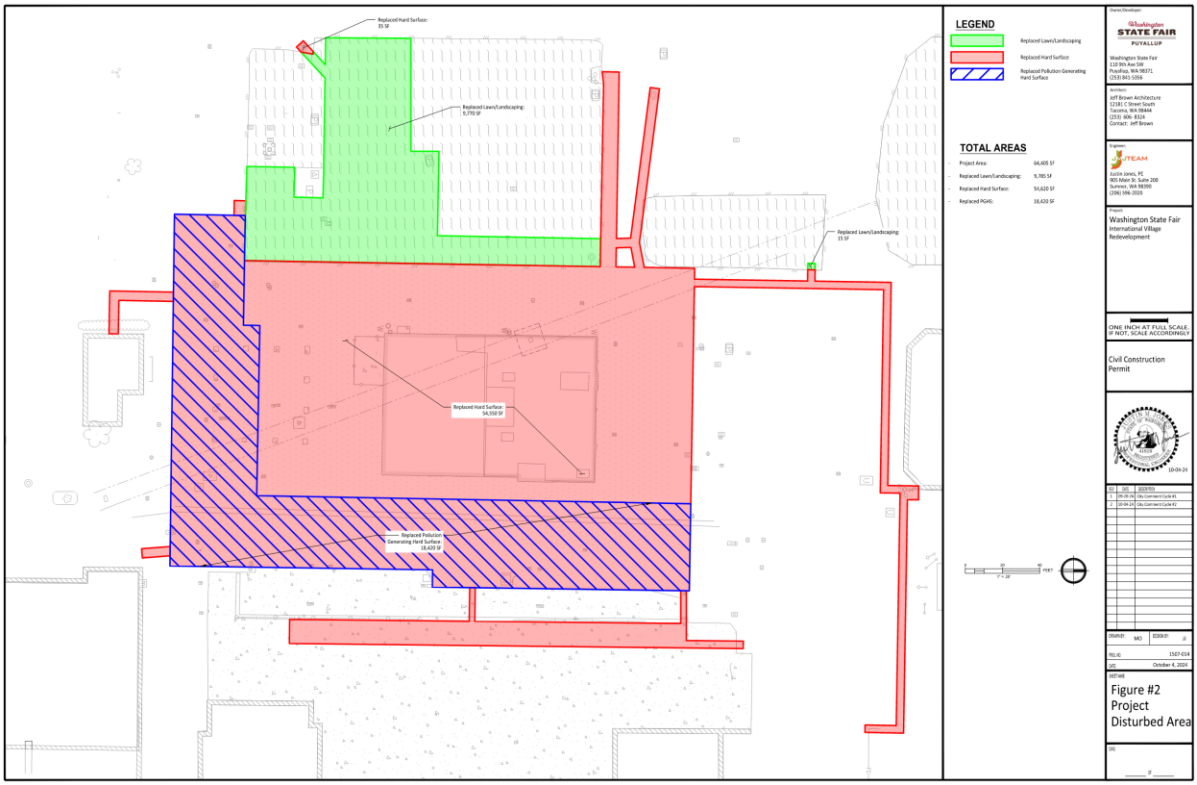
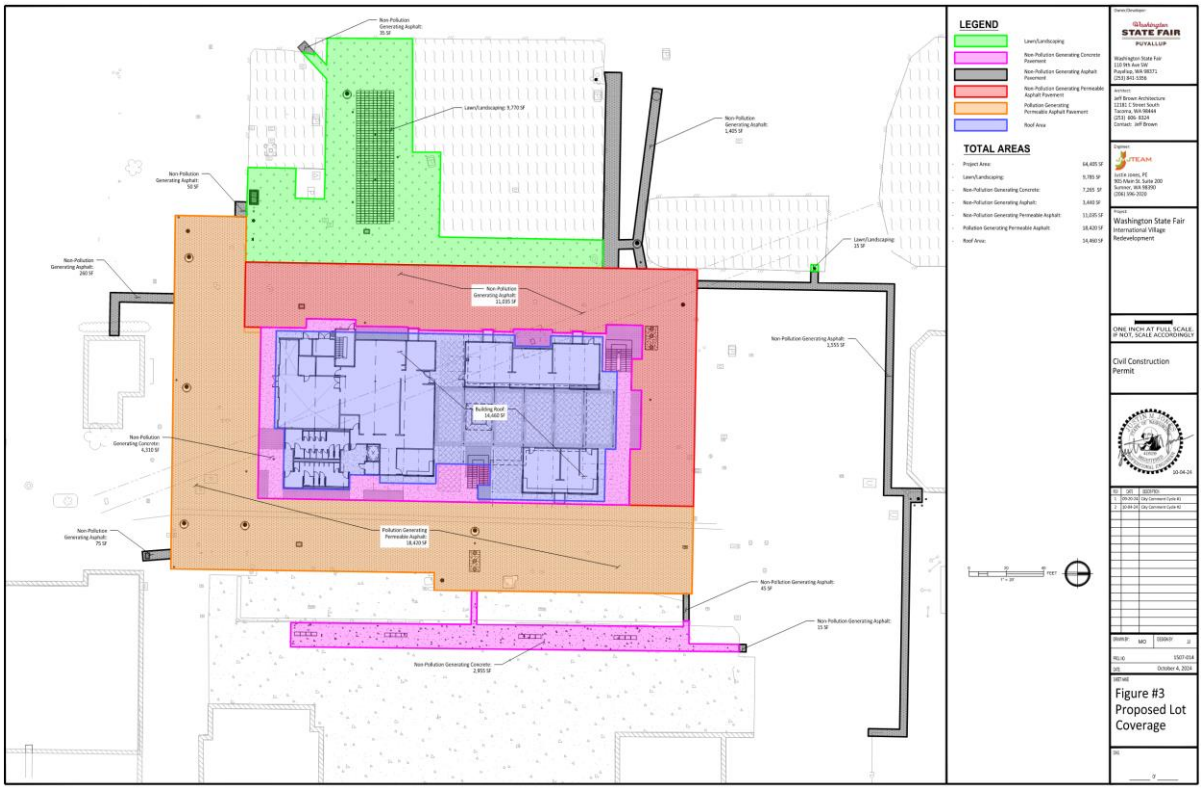


Figure #3 Proposed Lot Coverage

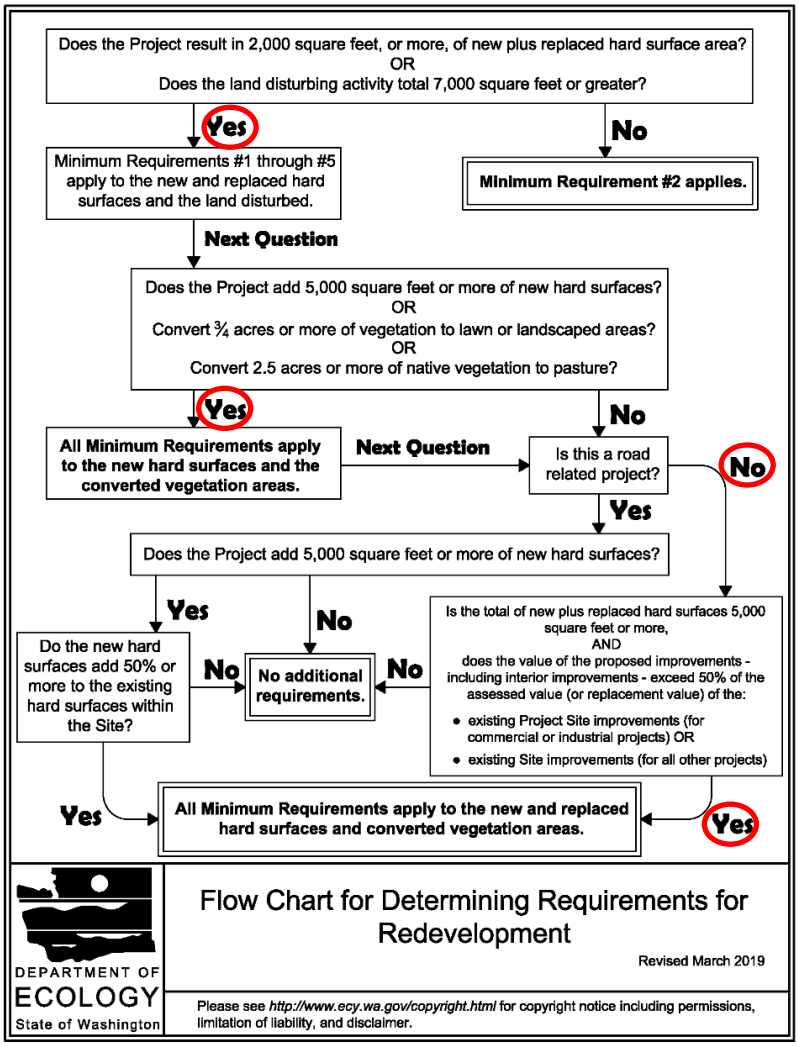


SUMMARY OF MINIMUM REQUIREMENTS

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.

The International Village project site will have 54,620 SF of new and replaced hard surfaces upon project completion, and a total of 64,405 SF of land disturbing activity. The fully developed site will be 39.1% 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 Chart below.

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



MINIMUM REQUIREMENT 1: PREPARATION OF STORMWATER SITE PLANS

Preliminary Stormwater Site Plan drawings have been prepared and included with this Preliminary Site Plan submittal. Final stormwater site plans will be submitted with the civil permit drawings.

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

The International Village Redevelopment project requires a Construction Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will comply with all 12 elements per the Doe manual. The SWPPP will be provided with the construction civil permit and will include the construction NPDES.

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

There are no natural drainage systems or outfalls within the International Village Redevelopment project site. Stormwater from the sites will discharge through new conveyance systems to the existing conveyance system in vacated 5th Street SE, which flows to Meeker Ditch.

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. List #2 requires the evaluation of BMP's in the order listed to determine the most appropriate stormwater management system for landscaped areas, roofs, and hard surfaces.

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 during the wet season . Excavation was conducted to a depth of 4.0-feet. Pilot Infiltration Test (PIT) was conducted in the grass field west of the existing International Village building. The test recorded an infiltration rate of 4.34 inches per hour, and after applying factors of safety the design infiltration rates is 2.0 inches per hour, see Appendix B for Infiltration Report.

Groundwater was encountered during the west season in a groundwater monitoring well. The observed groundwater level is 3.3' below the existing grade of the groundwater monitoring well, see groundwater monitoring

log in Appendix B. Since the existing grade of the well is 37.25', BMP's must maintain the required separation between the assumed groundwater level of 33.95'.

The following Stormwater BMP's in List #2 were evaluated for feasibility with regards to the International Village Redevelopment project:

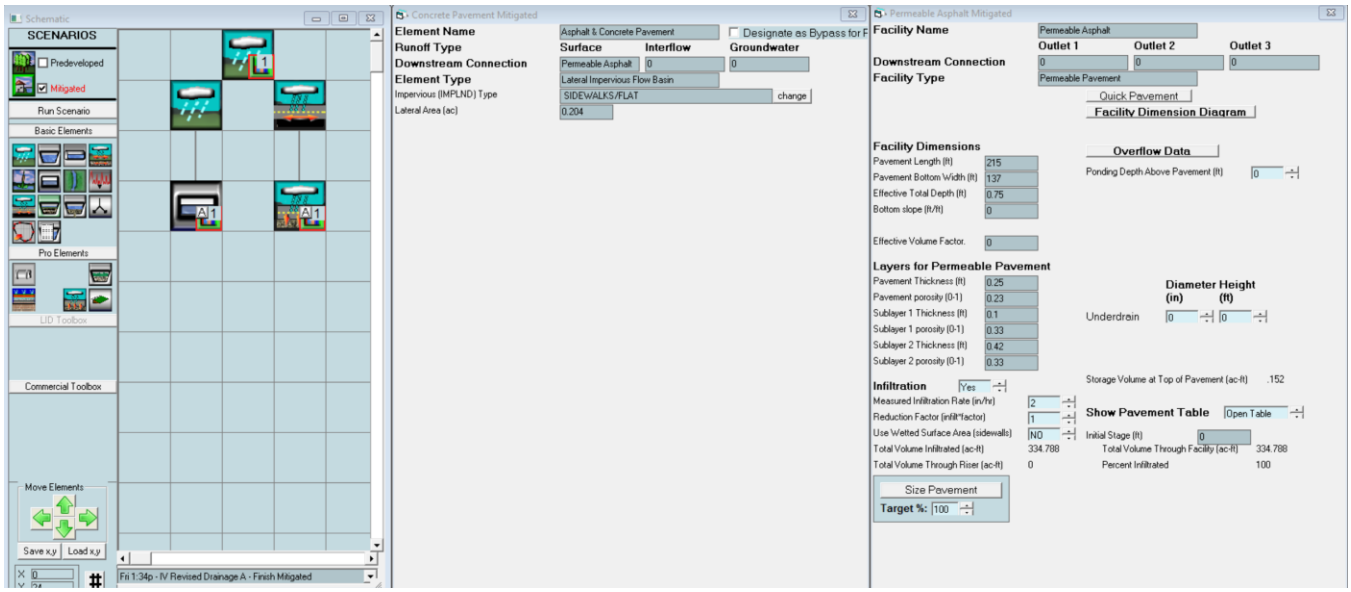
- Lawn & Landscaped Areas:
    - Post Construction Soil Quality: Post Construction soil quality and depth will be utilized for the International Village Redevelopment project in accordance with BMP T5.13.
- Roofs:
    - Full Dispersion: Full dispersion is feasible if a site maintains 65% of its area in a native vegetated condition. The International Village Redevelopment project does not maintain 65% of the site in a native condition and thus full dispersion was deemed infeasible for roof stormwater management.
    - Downspout Infiltration: Downspout infiltration was evaluated for feasibility for the site, and infiltration was deemed infeasible for the site. The proposed roof area exceeds the maximum threshold of 5,000 SF for a commercial building, per the City of Puyallup Stormwater Code Section 210.1(2).
    - Bioretention: Bioretention was evaluated for feasibility for the site, and bioretention was deemed infeasible for the site. The Seasonal high groundwater level is 3.3' below finish grade and the building roof area is 14,460 SF. Since the building roof area exceeds 5,000 SF, 3-feet of separation is needed between the bottom of the Bioretention Swales and the seasonal high groundwater level. Therefore the minimum 3-foot separation between the bottom of the Bioretention swale and the seasonal high groundwater level cannot be maintained.
    - Downspout Dispersion Systems: Downspout Systems were evaluated for feasibility for the site, and downspout dispersion was deemed infeasible for the site. There is insufficient vegetated pervious areas in the project area.
    - Perforated Stub-Out Connections: Perforated Stub-Out-Connections were evaluated for feasibility for the site, and were deemed infeasible for the site. There is insufficient vegetated pervious areas in the project area.
- Other Hard Surfaces:
    - Full Dispersion: Full dispersion is feasible if a site maintains 65% of its area in a native vegetated condition. The International Village Redevelopment 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 International Village Redevelopment 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 C for WWHM report. Permeable Pavements have been sized utilizing the WWHM Model for permeable pavement based on the following criteria:

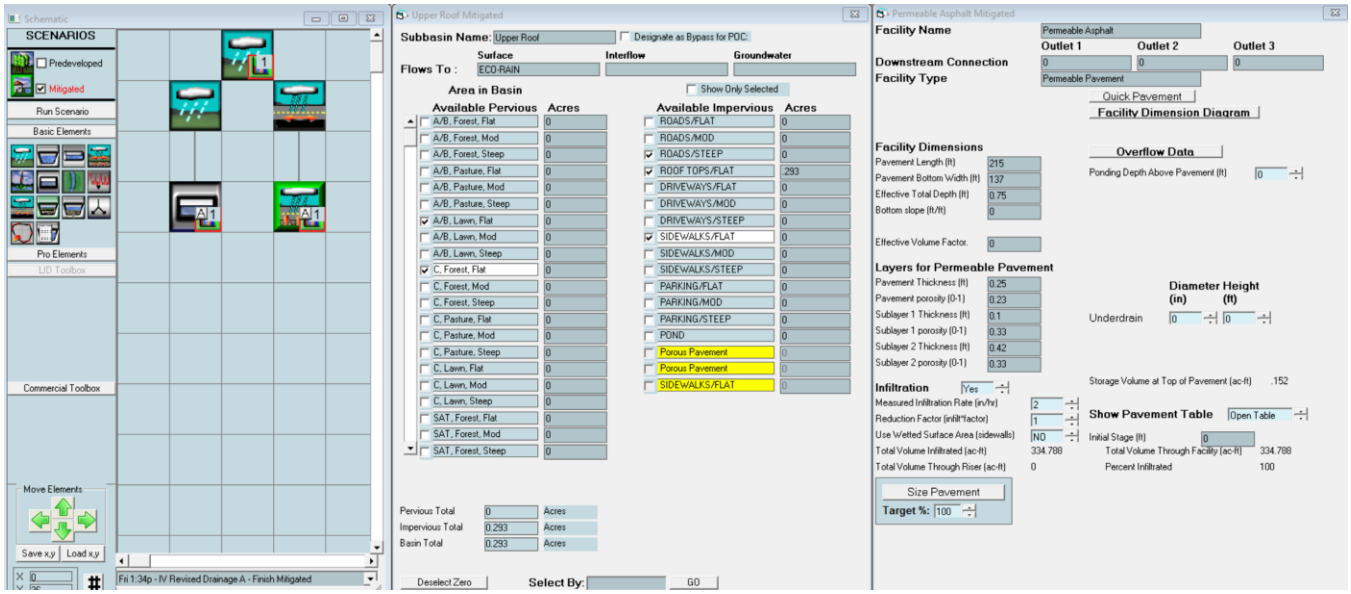
- Infiltration rate of 2.0 in/hr
- Drain Rock Basin with a porosity of 0.33
- 4” Drainage/Storage Layer thickness
- Minimum 1-foot of separation between the bottom of the permeable pavement and the seasonal high groundwater level
- 0.204-acre lateral flow basin conveyed to permeable pavement from adjacent pavement.

- Permeable Pavements will include the following:
  - 5” minimum ASTM #8 Stone
  - Impermeable geotextile along building walls

See screenshot below for permeable pavement WWHM Modelling:



Based upon the evaluation of the above BMP’s, an EcoRain Detention Tank will be used to manage roof stormwater runoff. Building roof runoff will be collected from the downspout locations inside the building and routed to an 8-inch DI pipe and connect to a catch basin prior to the EcoRain Detention Tank. Cleanouts will be provided along the perimeter of the facility to provide maintenance and access, see Appendix D for Eco-Rain product specifications. WWHM modeling was conducted to size the facility. See screenshot below for detention WWHM modeling:

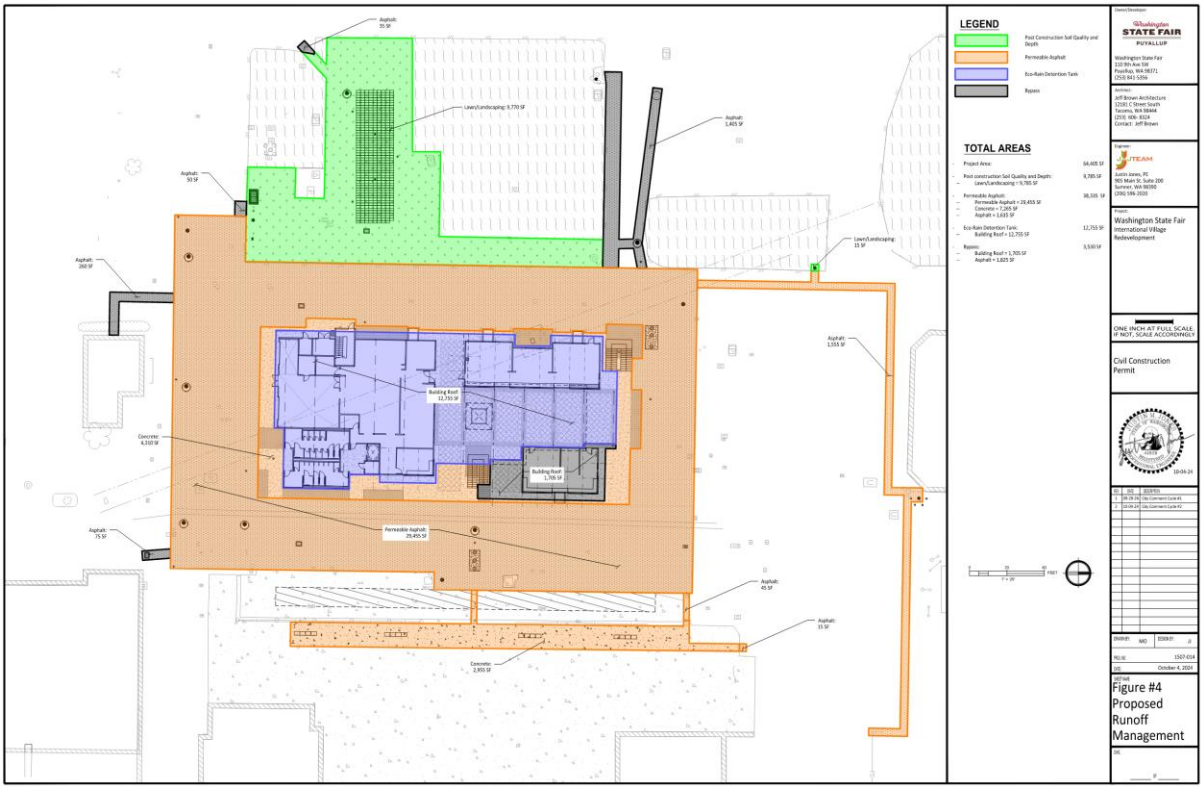


The EcoRain Detention Tank was modeled using the WWHM detention vault since the EcoRain Detention Tank geometry is like that of the vault WWHM element, see Appendix C for WWHM Report. EcoRain Detention Tanks consist of crates that are assembled with individual plates. Each crate has a 97% Void space and a predetermined water storage volume. A “Single” tank (1.34’x2.23’x1.45’) has 4.20 cubic feet of water storage. The “Single” tank was used to size the detention vault model, but a “Single + Half” tank will be installed. A “Single + Half” tank has an increased depth of 2.19’; the 0.74’ vertical difference between the “Single” and “Single + Half” Tanks will be dead/sediment storage.

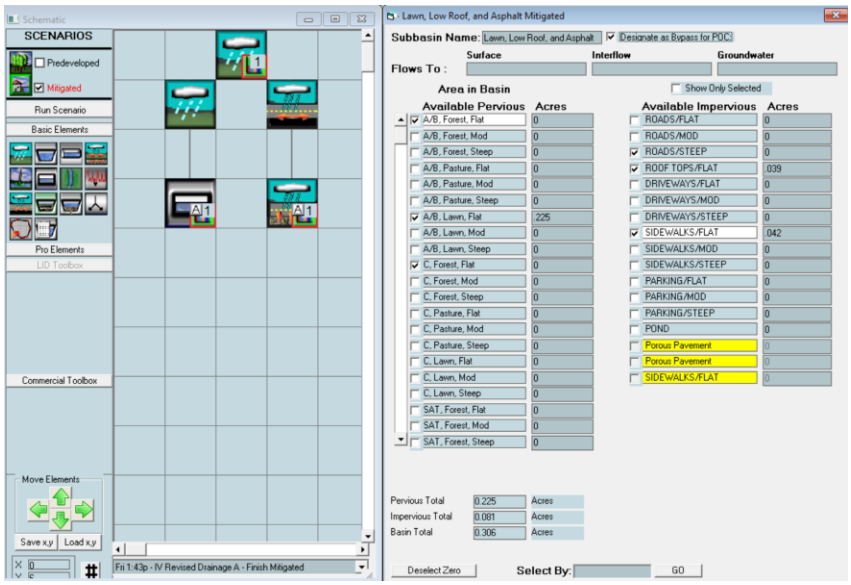
Per the modeling, a 37.1’x37.1’x1.45’ facility with half a foot of freeboard will manage the stormwater runoff. The minimum facility volume is subsequently 1,996 cubic feet. (477) “Single” EcoRain Tanks will provide 2,003 cubic feet of water storage and meet the volume demand, per WWHM.

Due to project and site constraints, this portion of the lower roof runoff could not be collected and conveyed to the detention tank. Therefore, this portion of the lower roof runoff will be collected and conveyed directly to an existing catch basin. See figure below for proposed runoff management.

Figure #4 Proposed Runoff Management



The roof area that is bypassing the detention tank is approximately 1,705 SF (0.039 Acres). In addition, 1,825 SF of replaced asphalt will bypass the detention tank and be conveyed directly to the existing stormwater system. See below for WWHM modeling.



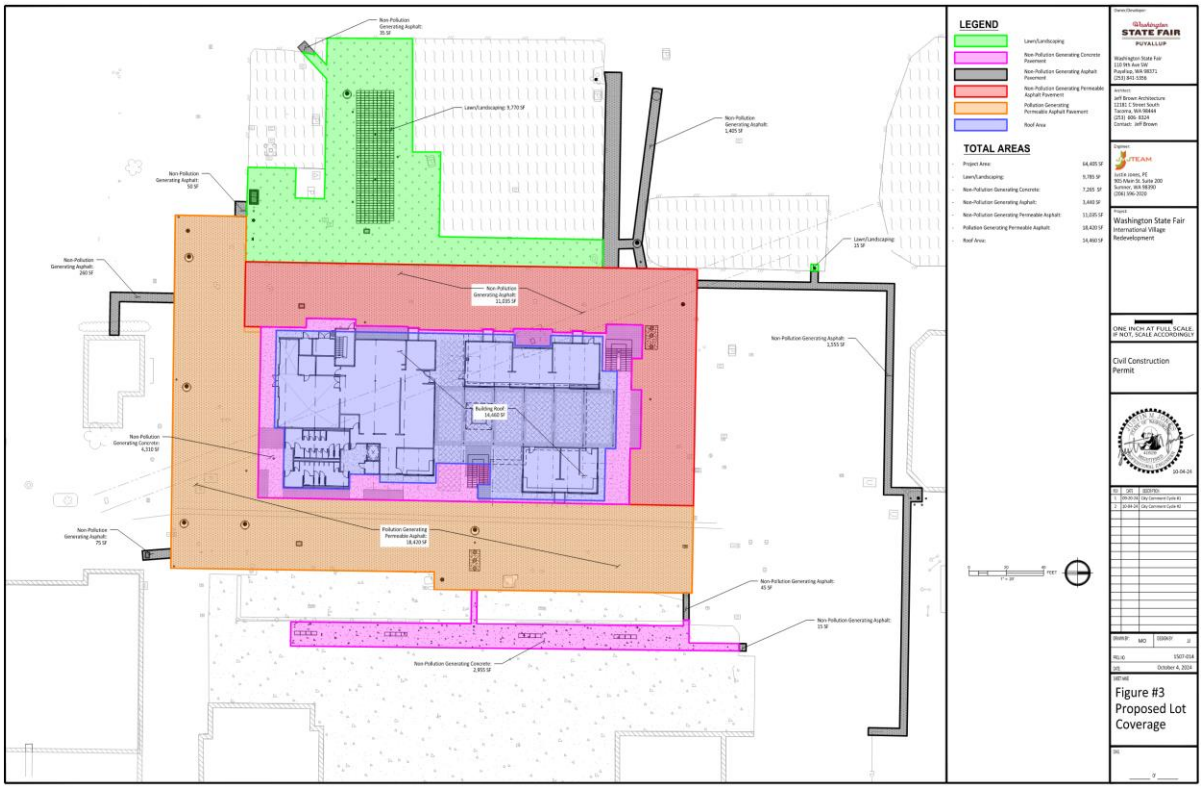
Permeable pavements located within the International Village Redevelopment project area have been sized to infiltrate 100% of stormwater runoff up to the 100-year storm event. Stormwater runoff in these areas will infiltrate through the pavement surface, and through the storage layer into native soils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

Standard asphalt and concrete pavement will be used for the replaced portions of existing asphalt concrete and will maintain existing surface runoff flow characteristics. All proposed concrete runoff will sheetflow onto the proposed permeable pavement and infiltrate. Asphalt runoff will either sheetflow onto the proposed permeable pavement and infiltrate or sheetflow to the existing stormwater system.

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 proposes a 14,460 SF two-story restaurant, 29,455SF of permeable asphalt, 7,265 SF of concrete pavement, and is therefore subject to runoff treatment for pollution generating areas. A portion (18,420 SF) of the proposed permeable pavements is expected to have heavy vehicle traffic. This area is designated as a vehicle pathway. Therefore, the International Village Redevelopment project is proposing Pollution Generating Hard Surfaces and is not exempt from Minimum Requirement #6. See below for pavement areas with vehicle traffic.

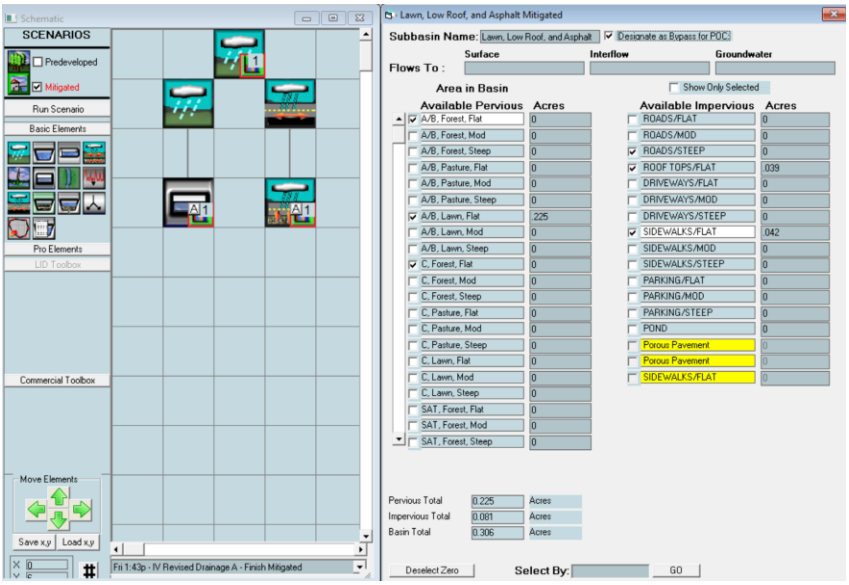
Figure #3 Proposed Lot Coverage



The proposed permeable pavement has been designed to infiltrate 100% of flows from paved areas received on site into native soils below. A 6” layer of sand will be installed at the bottom of the highlighted asphalt pavement above to treat the runoff from the primary drive aisles on the south and east sides of the project, per BMP T8.10: Basic Sand Filter Basin. The proposed sand medium must meet the No. 100 and No. 200 sieve requirements, see DOE Table V-6.1. All pollution generating runoff from the proposed pavement will infiltrate through the pavement layer and be treated by the sand layer

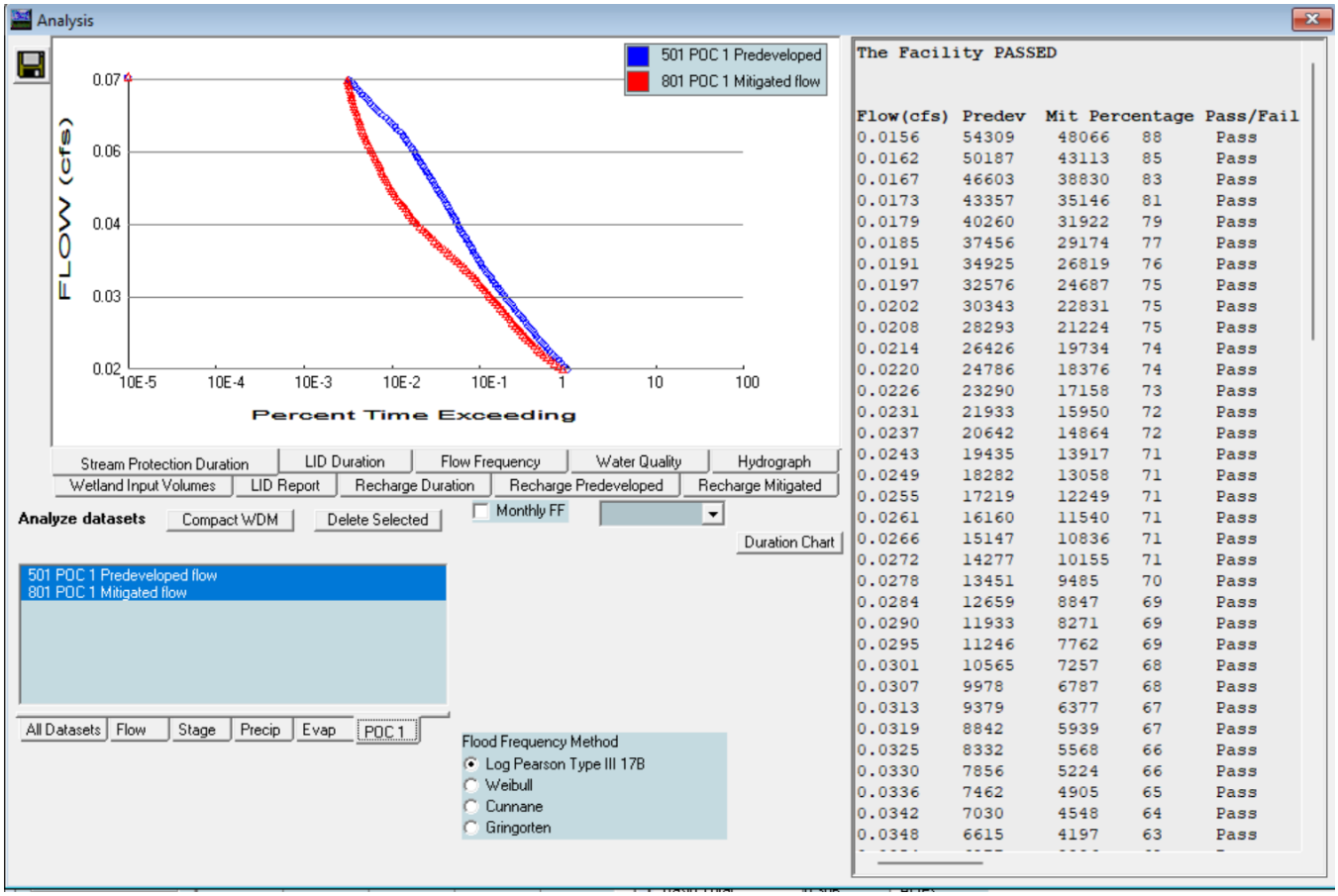
MINIMUM REQUIREMENT 7: FLOW CONTROL

The International Village Redevelopment project site uses detention to meet the requirement of Minimum Requirement 7 Flow Control. An EcoRain Detention Tank with a control structure will manage the majority of roof runoff. The remaining roof runoff will bypass the Detention Tank and be directly conveyed to the city stormwater system. A portion of the replaced asphalt will also be conveyed directly to the city stormwater system. See below for areas diverted from Permeable Pavement and Detention Tank.



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. WWHM modeling was conducted to confirm that the predeveloped flows are under the flow duration from 50% of the 2-year peak flow to the full 50-year peak flow. The annual peaks for the proposed site coverage are within the mitigated threshold and WWHM facility check, satisfying the requirement per the Department of Ecology Stormwater Management Manual. The Detention Facility will have a detention volume of approximately 0.03 acre-feet at the riser head. See figure below for annual peak flow check.

Flow Frequency Check:



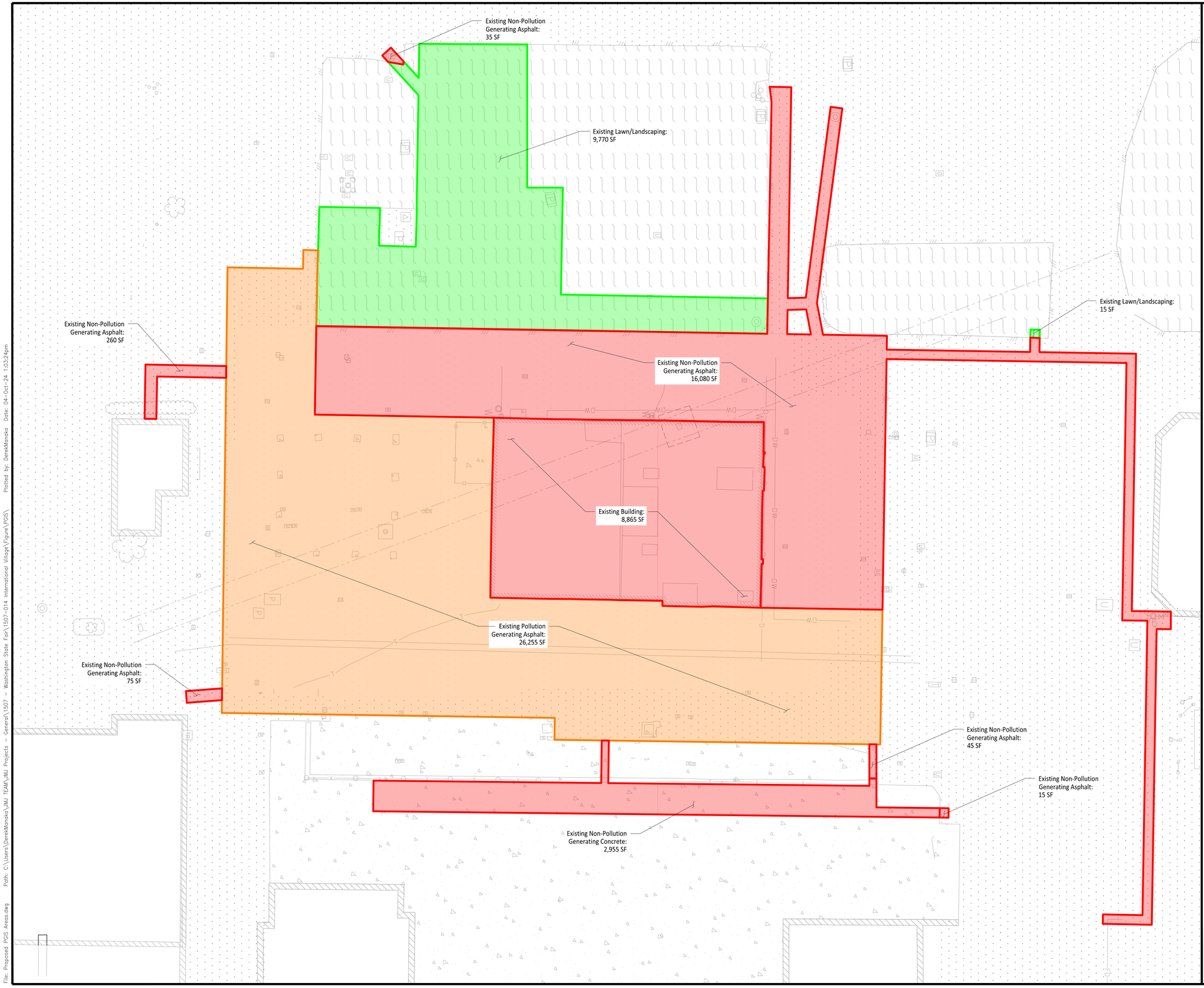
MINIMUM REQUIREMENT 8: WETLANDS PROTECTION

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 WSF International Village Redevelopment 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

An Operations & Maintenance Manual for all new stormwater BMP's installed with the project will be provided in a future submittal.

APPENDIX A



LEGEND

- Existing Lawn/Landscaping
- Existing Non-Pollution Generating Hard Surface
- Existing Pollution Generating Hard Surface

TOTAL AREAS

-	Project Area:	64,405 SF
-	Existing Lawn/Landscaping:	9,785 SF
-	Existing NPGHS:	28,330 SF
-	Existing PGHS:	26,290 SF

0 20 40 FEET
1" = 20'

Owner/Developer:
Washington State Fair
110 9th Ave SW
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Architect:
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Contact: Jeff Brown

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Project:
Washington State Fair
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ONE INCH AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY

Civil Construction Permit

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER
10-04-24

REV	DATE	DESCRIPTION
1	09-20-24	City Comment Cycle #1
2	10-04-24	City Comment Cycle #2

DRAWN BY: MO | DESIGN BY: JJ
PROJ. NO: 1507-014
DATE: October 4, 2024

SHEET NAME
Figure #1
Existing Lot Coverage

DWG.
____ OF ____

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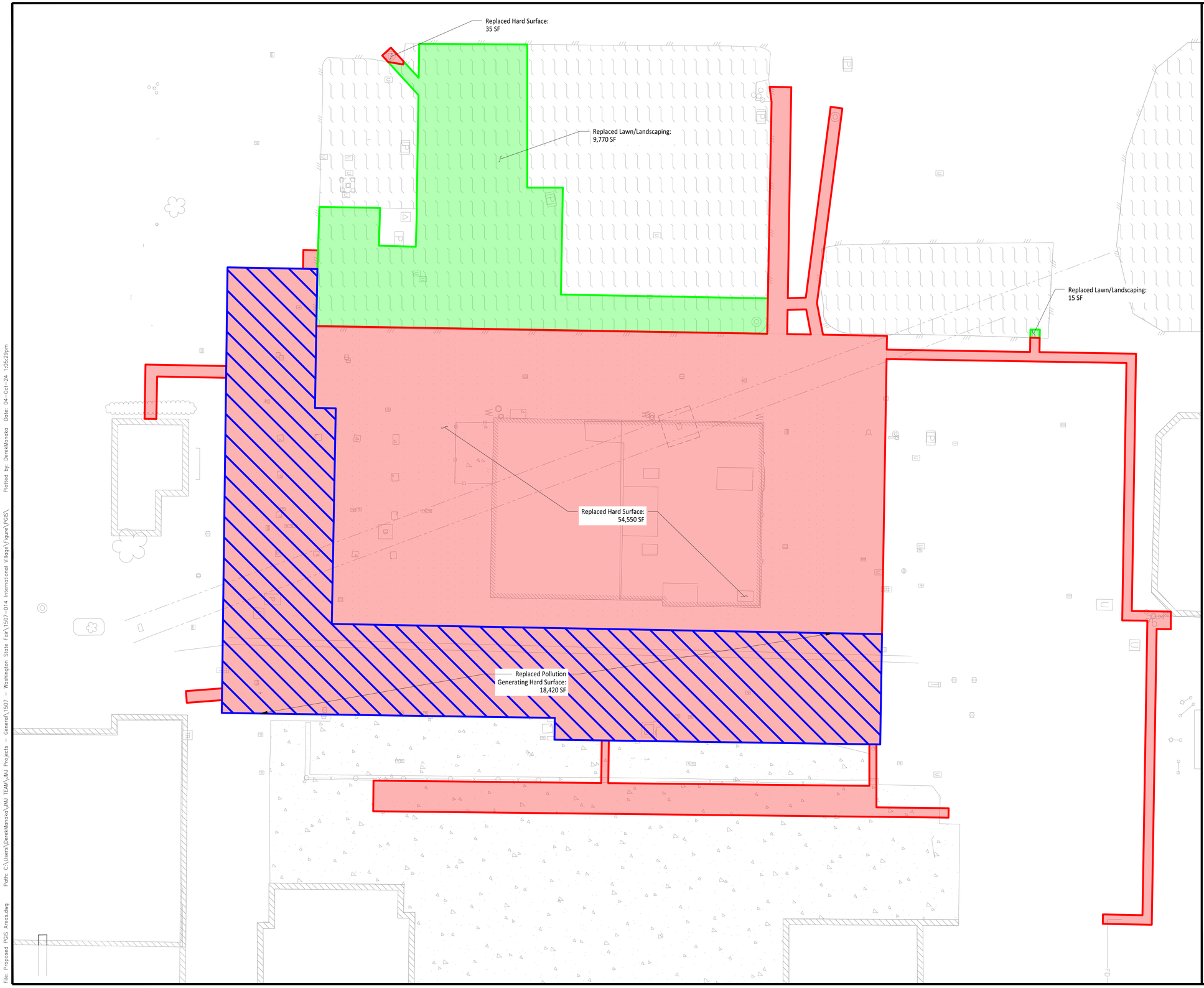

LEGEND

- Replaced Lawn/Landscaping
- Replaced Hard Surface
- Replaced Pollution Generating Hard Surface

TOTAL AREAS

-	Project Area:	64,405 SF
-	Replaced Lawn/Landscaping:	9,785 SF
-	Replaced Hard Surface:	54,620 SF
-	Replaced PGHS:	18,420 SF

0 20 40 FEET
1" = 20'

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DRAWN BY: MO
DESIGN BY: JJ
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DATE: October 4, 2024

SHEET NAME
Figure #2
Project
Disturbed Area

DWG.
____ OF ____

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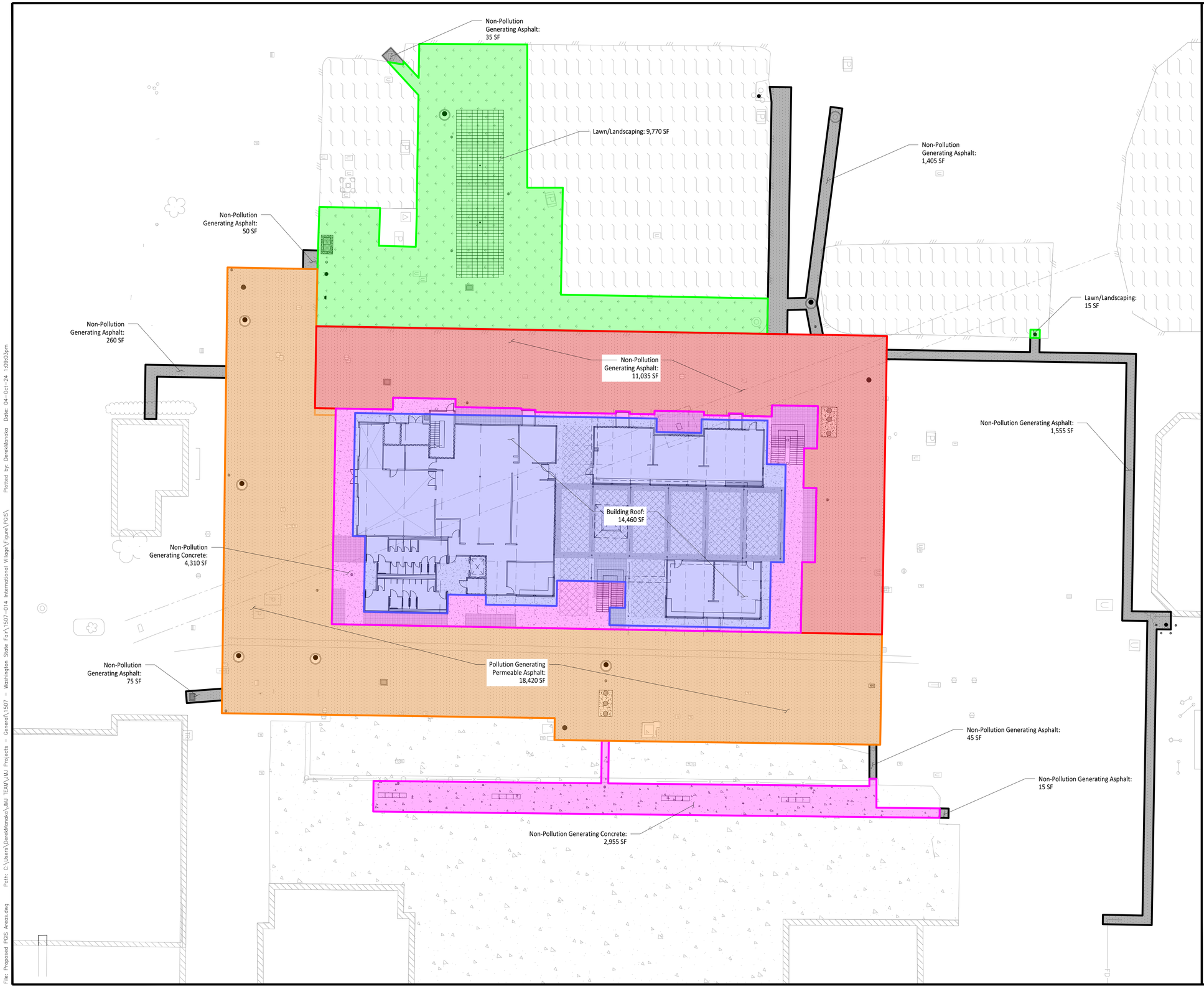

LEGEND

- Lawn/Landscaping
- Non-Pollution Generating Concrete Pavement
- Non-Pollution Generating Asphalt Pavement
- Non-Pollution Generating Permeable Asphalt Pavement
- Pollution Generating Permeable Asphalt Pavement
- Roof Area

TOTAL AREAS

-	Project Area:	64,405 SF
-	Lawn/Landscaping:	9,785 SF
-	Non-Pollution Generating Concrete:	7,265 SF
-	Non-Pollution Generating Asphalt:	3,440 SF
-	Non-Pollution Generating Permeable Asphalt:	11,035 SF
-	Pollution Generating Permeable Asphalt:	18,420 SF
-	Roof Area:	14,460 SF

0 20 40 FEET
1" = 20'

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Civil Construction Permit

JUSTIN M. JONES
STATE OF WASHINGTON
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REGISTERED
PROFESSIONAL ENGINEER
10-04-24

REV	DATE	DESCRIPTION
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2	10-04-24	City Comment Cycle #2

DRAWN BY: MO
DESIGN BY: JJ
PROJ.NO: 1507-014
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SHEET NAME
Figure #3
Proposed Lot Coverage

DWG.
____ OF ____

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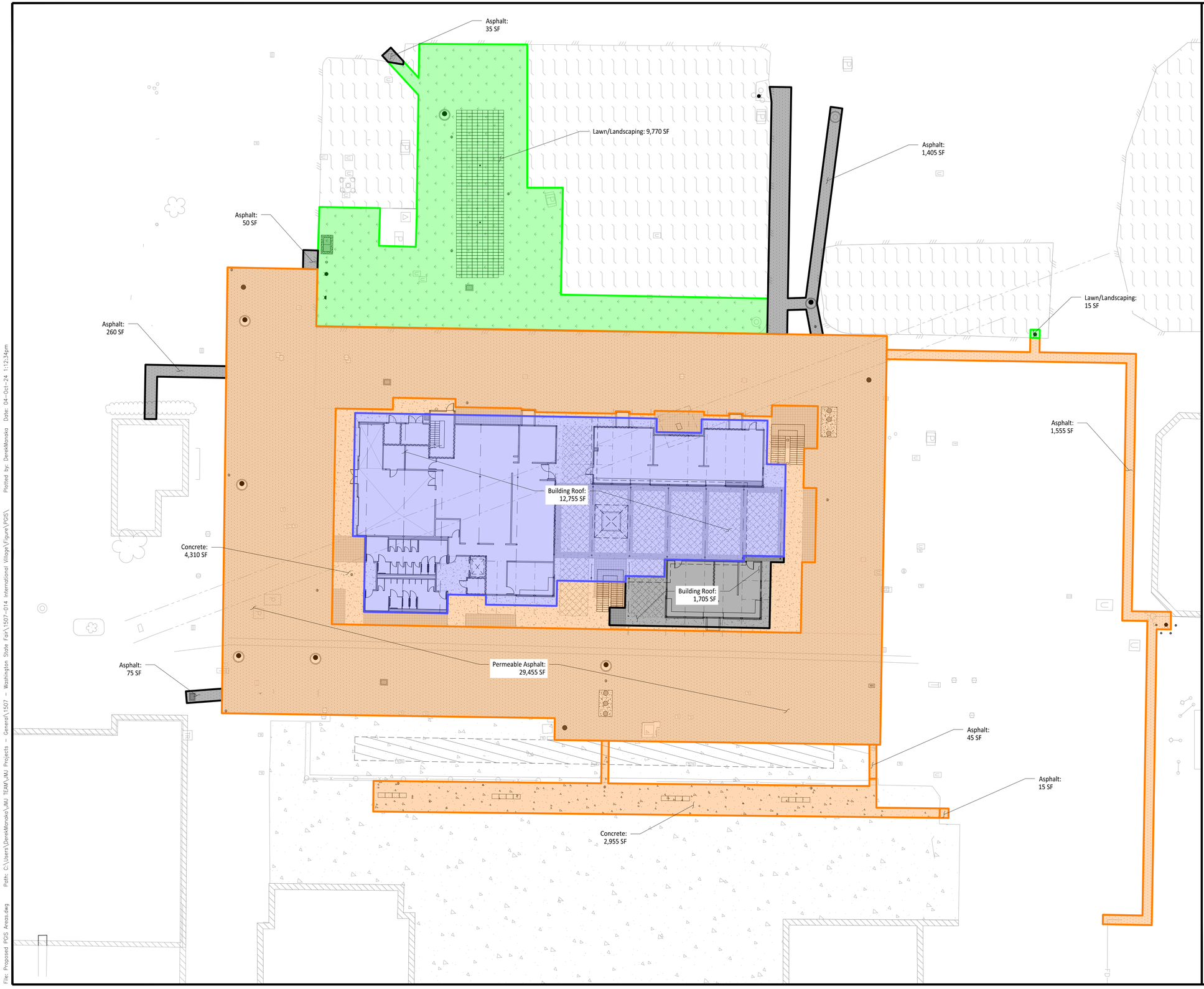
File: Proposed PGS Areas.dwg



LEGEND

- Post Construction Soil Quality and Depth
- Permeable Asphalt
- Eco-Rain Detention Tank
- Bypass

TOTAL AREAS

-	Project Area:	64,405 SF
-	Post construction Soil Quality and Depth:	9,785 SF
--	Lawn/Landscaping = 9,785 SF	
-	Permeable Asphalt:	38,335 SF
--	Permeable Asphalt = 29,455 SF	
--	Concrete = 7,265 SF	
--	Asphalt = 1,615 SF	
-	Eco-Rain Detention Tank:	12,755 SF
--	Building Roof = 12,755 SF	
-	Bypass:	3,530 SF
--	Building Roof = 1,705 SF	
--	Asphalt = 1,825 SF	

Owner/Developer:

Washington State Fair
110 9th Ave SW
Puyallup, WA 98371
(253) 841-5356

Architect:

Jeff Brown Architecture
12181 C Street South
Tacoma, WA 98444
(253) 606- 8324
Contact: Jeff Brown

Engineer:

Justin Jones, PE
905 Main St. Suite 200
Sumner, WA 98390
(206) 596-2020

Project:

Washington State Fair
International Village
Redevelopment

ONE INCH AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY

Civil Construction Permit

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER

10-04-24

REV	DATE	DESCRIPTION
1	09-20-24	City Comment Cycle #1
2	10-04-24	City Comment Cycle #2

DRAWN BY:	MO
DESIGN BY:	JJ
PROJ. NO:	1507-014
DATE:	October 4, 2024

SHEET NAME

Figure #4 Proposed Runoff Management

DWG.

_____ OF _____

APPENDIX B

Infiltration Testing Report

Washington State Fair – International Village

Puyallup, WA

Prepared for

Washington State Fair
110 9th Avenue SW
Puyallup, WA 98374

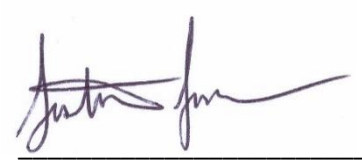
Prepared by

JMJ TEAM
905 Main St Suite 200
Sumner, WA 98390
206.596.2020
Justin Jones, PE

October 4, 2024

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Infiltration Testing Report for Washington State Fair – International Village 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

10-04-2024

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SUMMARY

This report details the results of infiltration testing for use in the stormwater system design of Washington State Fair International Village located within Puyallup, WA. One Pilot Infiltration Test (PIT) was conducted on March 1st 2024, on site during the wet season (October-March) 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 test pit is excavated to a depth of 5.0-feet below existing grade and observed for groundwater.

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
Infiltration Rate	Infiltration Rate Factor of Safety	0.45	N/A
	Test Hole 1 Infiltration Rates	Uncorrected: 4.34 inches per hour	≥ 0.3 inches per hour
		Design: 2.0 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 10-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

An 8.5’ deep groundwater monitoring well was installed to conduct groundwater monitoring for the WSF project site during the wet season. Groundwater was observed during multiple attempts to measure the seasonal high groundwater.

Date	Groundwater Observed	Elevation Observed (Feet)
03/01/2024	YES	3.4
03/10/2024	YES	3.3
03/21/2024	YES	3.6
04/05/2024	YES	4.5

The known seasonal high groundwater level is 3.3’ below the existing grade of 37.25’. Therefore, the known seasonal high groundwater level is 33.95’.

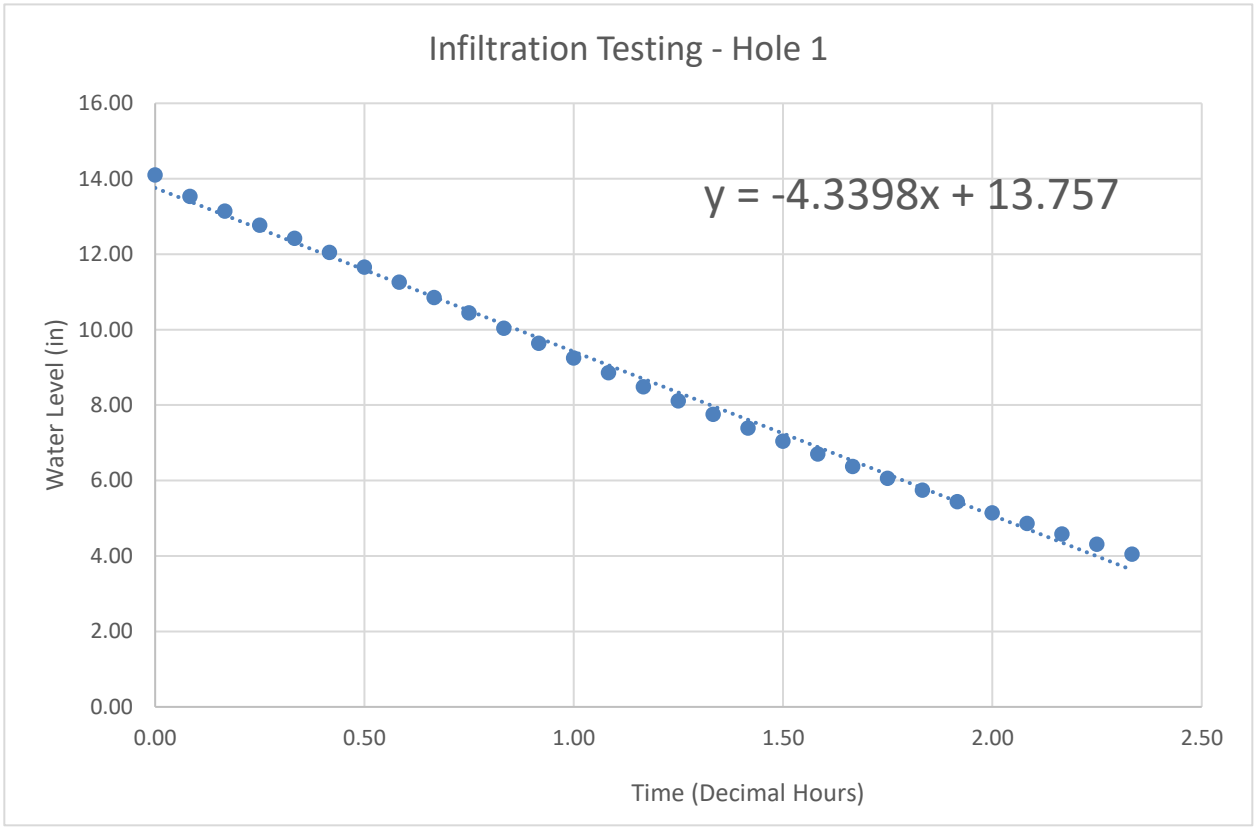
With known groundwater conditions for each test hole, there is adequate spacing between groundwater and BMPs. An overflow should be installed with BMP in case of large storm events.

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 average of the drawdown measurements resulted in an infiltration rate of resulted in the following infiltration rates:

- Test Hole 1: 4.34 inches per hour



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, $CF_T = CF_v \times CF_t \times CF_m$

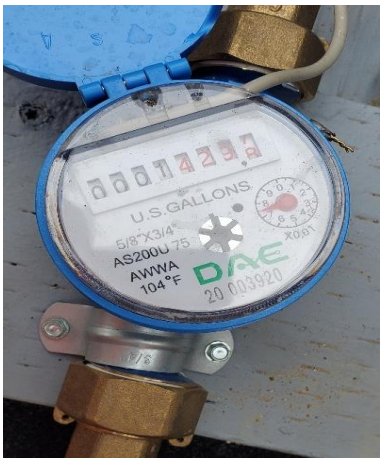
Based on multiple geotechnical reports from nearby projects, soils are known to be consistent in this area. Per the Stormwater Manual, a site variability correction of 1 is used. A correction of 0.5 for the small-scale PIT and 0.9 for the degree of influent are also used. A total correction factor of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

- Test Hole 1: 2.0 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



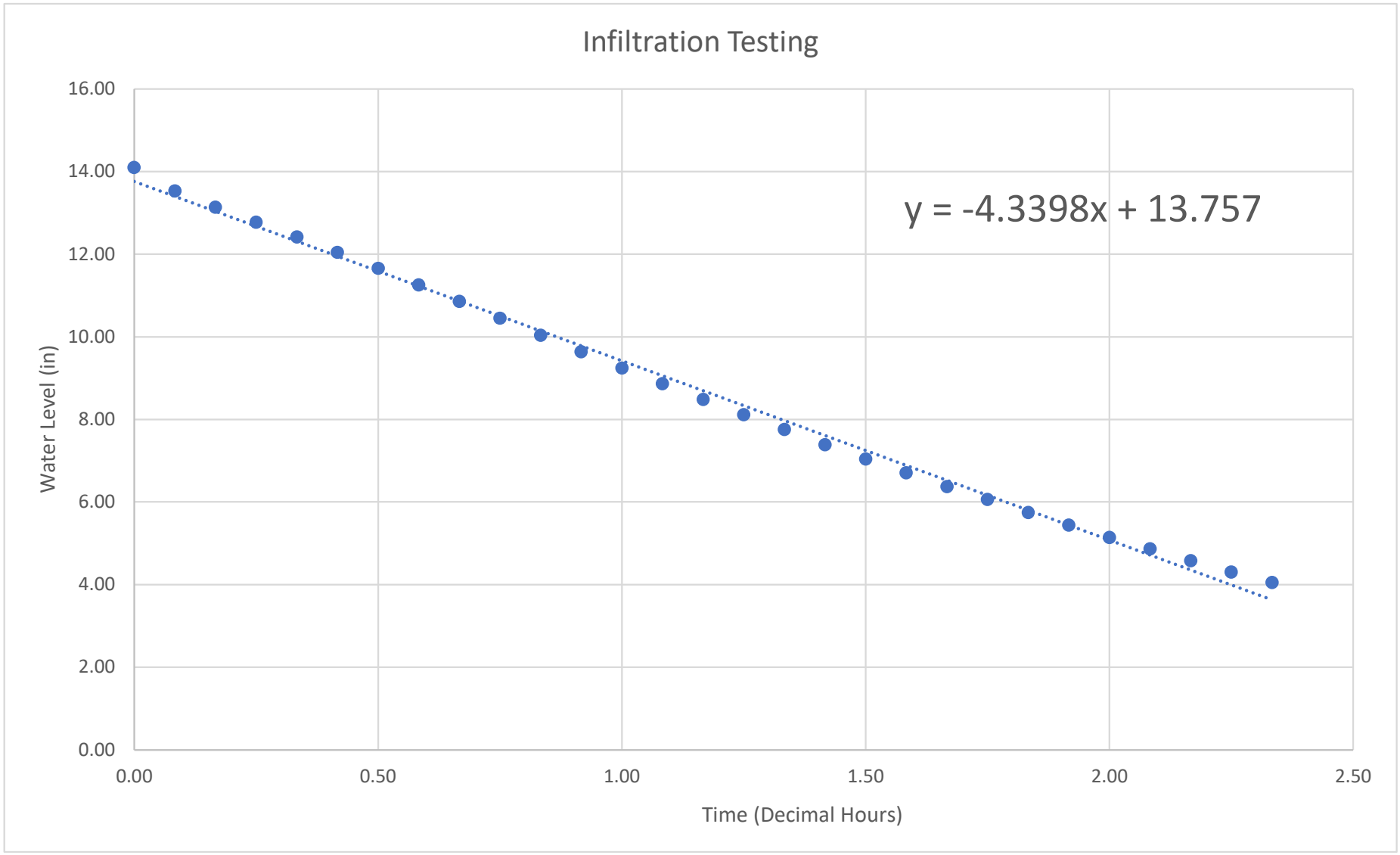
1-hour GPM Test

Pressure Transducer Drawdown Test

Over Excavation to observe if Groundwater is Mounding

Backfill Test Hole

APPENDIX A


Infiltration Testing
y = -4.3398x + 13.757
Water Level (in)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
Time (Decimal Hours)

Project Location:		International Village						
Date of Test:		3/1/2024						
Test Pit Dimensions:		Width (feet)	3	Length (feet)	4	Depth (inches)	48	
Presoak:		8:30 AM - at 12-inch water column						
Infiltration Test:								
		Water Column Maintained (inches):		12				
		Gallons Per Inch:	7.48					
		Time(Minutes)	**Volume (gallons)**	**Flow Rate (GPM)**			**Flow (Gallons)**	**Infiltration Rate (in/hr)**
				Meter Start	Meter End	Flow (Gallons)		
		0		90.2	90.7	0.5	0.5	
		15		97.5	97.93	0.5	7.7	
		30		104.8	105.2	0.4	15.0	
		45		111.8	112.4	0.6	22.2	
		60		118.7	119.1	0.4	28.9	**3.9**
Drawdown Test (Sensor): JMJ 02								
Sensor Name:		JMJ 02 (**CRS451V Sensors from Campbell Scientic**)						
Time (Decimal Hours)	**Measurement (Min)**	**Time Stamp**	**Record #**	**Reading (PSI)**	**Level (in)**			
0.00	0	1:10 PM	0	0.508626	14.10			
0.08	5	1:15 PM	1	0.4881584	13.53			
0.17	10	1:20 PM	2	0.4740808	13.14			
0.25	15	1:25 PM	3	0.4608536	12.77			
0.33	20	1:30 PM	4	0.4480413	12.42			
0.42	25	1:35 PM	5	0.4346205	12.05			
0.50	30	1:40 PM	6	0.4206924	11.66			
0.58	35	1:45 PM	7	0.4062418	11.26			
0.67	40	1:50 PM	8	0.3916707	10.86			
0.75	45	1:55 PM	9	0.3769647	10.45			
0.83	50	2:00 PM	10	0.3621393	10.04			
0.92	55	2:05 PM	11	0.3476817	9.64			
1.00	60	2:10 PM	12	0.3336124	9.25			
1.08	65	2:15 PM	13	0.3197146	8.86			
1.17	70	2:20 PM	14	0.3060788	8.48			
1.25	75	2:25 PM	15	0.2927326	8.11			
1.33	80	2:30 PM	16	0.279787	7.76			
1.42	85	2:35 PM	17	0.2667154	7.39			
1.50	90	2:40 PM	18	0.2541027	7.04			
1.58	95	2:45 PM	19	0.2420167	6.71			
1.67	100	2:50 PM	20	0.2300327	6.38			
1.75	105	2:55 PM	21	0.218632	6.06			
1.83	110	3:00 PM	22	0.2073317	5.75			
1.92	115	3:05 PM	23	0.1963682	5.44			
2.00	120	3:10 PM	24	0.1855206	5.14			
2.08	125	3:15 PM	25	0.175577	4.87			
2.17	130	3:20 PM	26	0.1654123	4.59			
2.25	135	3:25 PM	27	0.1554903	4.31			
2.33	140	3:30 PM	28	0.1461914	4.05			
					Average Infiltration Rate:	4.34		
					Factor of Safety:	0.45		
					Infiltration Rate of 2.0 in/hr Used for Sizing of System			

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

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 C

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: IV Revised Drainage A
Site Name:
Site Address:
City:

Report Date:	10/4/2024
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
C, Forest, Flat	1.479
Pervious Total	1.479
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.479

Mitigated Land Use

Upper Roof

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.293
Impervious Total	0.293
Basin Total	0.293

Asphalt & Concrete Pavement

Bypass:	No
Impervious Land Use	acre
SIDEWALKS FLAT	0.204

Lawn and Low Roof

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.225
Pervious Total	0.225

Impervious Land Use	acre
ROOF TOPS FLAT	0.039
SIDEWALKS FLAT	0.042
Impervious Total	0.081
Basin Total	0.306

Routing Elements
Predeveloped Routing

Mitigated Routing

ECO-RAIN

Width: 37.1 ft.
Length: 37.1 ft.
Depth: 1.45 ft.
Discharge Structure
Riser Height: 0.95 ft.
Riser Diameter: 10 in.
Orifice 1 Diameter: 0.800 in. Elevation:0 ft.
Orifice 2 Diameter: 1.000 in. Elevation:0.5 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.031	0.000	0.000	0.000
0.0161	0.031	0.000	0.002	0.000
0.0322	0.031	0.001	0.003	0.000
0.0483	0.031	0.001	0.003	0.000
0.0644	0.031	0.002	0.004	0.000
0.0806	0.031	0.002	0.004	0.000
0.0967	0.031	0.003	0.005	0.000
0.1128	0.031	0.003	0.005	0.000
0.1289	0.031	0.004	0.006	0.000
0.1450	0.031	0.004	0.006	0.000
0.1611	0.031	0.005	0.007	0.000
0.1772	0.031	0.005	0.007	0.000
0.1933	0.031	0.006	0.007	0.000
0.2094	0.031	0.006	0.007	0.000
0.2256	0.031	0.007	0.008	0.000
0.2417	0.031	0.007	0.008	0.000
0.2578	0.031	0.008	0.008	0.000
0.2739	0.031	0.008	0.009	0.000
0.2900	0.031	0.009	0.009	0.000
0.3061	0.031	0.009	0.009	0.000
0.3222	0.031	0.010	0.009	0.000
0.3383	0.031	0.010	0.010	0.000
0.3544	0.031	0.011	0.010	0.000
0.3706	0.031	0.011	0.010	0.000
0.3867	0.031	0.012	0.010	0.000
0.4028	0.031	0.012	0.011	0.000
0.4189	0.031	0.013	0.011	0.000
0.4350	0.031	0.013	0.011	0.000
0.4511	0.031	0.014	0.011	0.000
0.4672	0.031	0.014	0.011	0.000
0.4833	0.031	0.015	0.012	0.000
0.4994	0.031	0.015	0.012	0.000
0.5156	0.031	0.016	0.015	0.000
0.5317	0.031	0.016	0.017	0.000
0.5478	0.031	0.017	0.018	0.000
0.5639	0.031	0.017	0.019	0.000
0.5800	0.031	0.018	0.020	0.000
0.5961	0.031	0.018	0.021	0.000
0.6122	0.031	0.019	0.022	0.000

0.6283	0.031	0.019	0.023	0.000
0.6444	0.031	0.020	0.024	0.000
0.6606	0.031	0.020	0.025	0.000
0.6767	0.031	0.021	0.025	0.000
0.6928	0.031	0.021	0.026	0.000
0.7089	0.031	0.022	0.027	0.000
0.7250	0.031	0.022	0.027	0.000
0.7411	0.031	0.023	0.028	0.000
0.7572	0.031	0.023	0.028	0.000
0.7733	0.031	0.024	0.029	0.000
0.7894	0.031	0.024	0.030	0.000
0.8056	0.031	0.025	0.030	0.000
0.8217	0.031	0.026	0.031	0.000
0.8378	0.031	0.026	0.031	0.000
0.8539	0.031	0.027	0.032	0.000
0.8700	0.031	0.027	0.032	0.000
0.8861	0.031	0.028	0.033	0.000
0.9022	0.031	0.028	0.033	0.000
0.9183	0.031	0.029	0.034	0.000
0.9344	0.031	0.029	0.034	0.000
0.9506	0.031	0.030	0.035	0.000
0.9667	0.031	0.030	0.054	0.000
0.9828	0.031	0.031	0.088	0.000
0.9989	0.031	0.031	0.131	0.000
1.0150	0.031	0.032	0.183	0.000
1.0311	0.031	0.032	0.240	0.000
1.0472	0.031	0.033	0.303	0.000
1.0633	0.031	0.033	0.370	0.000
1.0794	0.031	0.034	0.441	0.000
1.0956	0.031	0.034	0.515	0.000
1.1117	0.031	0.035	0.591	0.000
1.1278	0.031	0.035	0.668	0.000
1.1439	0.031	0.036	0.744	0.000
1.1600	0.031	0.036	0.820	0.000
1.1761	0.031	0.037	0.894	0.000
1.1922	0.031	0.037	0.965	0.000
1.2083	0.031	0.038	1.033	0.000
1.2244	0.031	0.038	1.097	0.000
1.2406	0.031	0.039	1.155	0.000
1.2567	0.031	0.039	1.209	0.000
1.2728	0.031	0.040	1.257	0.000
1.2889	0.031	0.040	1.300	0.000
1.3050	0.031	0.041	1.337	0.000
1.3211	0.031	0.041	1.369	0.000
1.3372	0.031	0.042	1.397	0.000
1.3533	0.031	0.042	1.422	0.000
1.3694	0.031	0.043	1.462	0.000
1.3856	0.031	0.043	1.489	0.000
1.4017	0.031	0.044	1.516	0.000
1.4178	0.031	0.044	1.542	0.000
1.4339	0.031	0.045	1.568	0.000
1.4500	0.031	0.045	1.594	0.000
1.4661	0.031	0.044	1.619	0.000

Permeable Asphalt

Pavement Area:0.6762 acre.Pavement Length:215.00 ft.

Pavement Width:	137.00 ft.
	Pavement slope 1:0 To 1
Pavement thickness:	0.25
Pour Space of Pavement:	0.23
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:	2
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	334.788
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	334.788
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	19.117

Analysis Results
POC 1

Model Default Modifications

Total of 0 changes have been made.

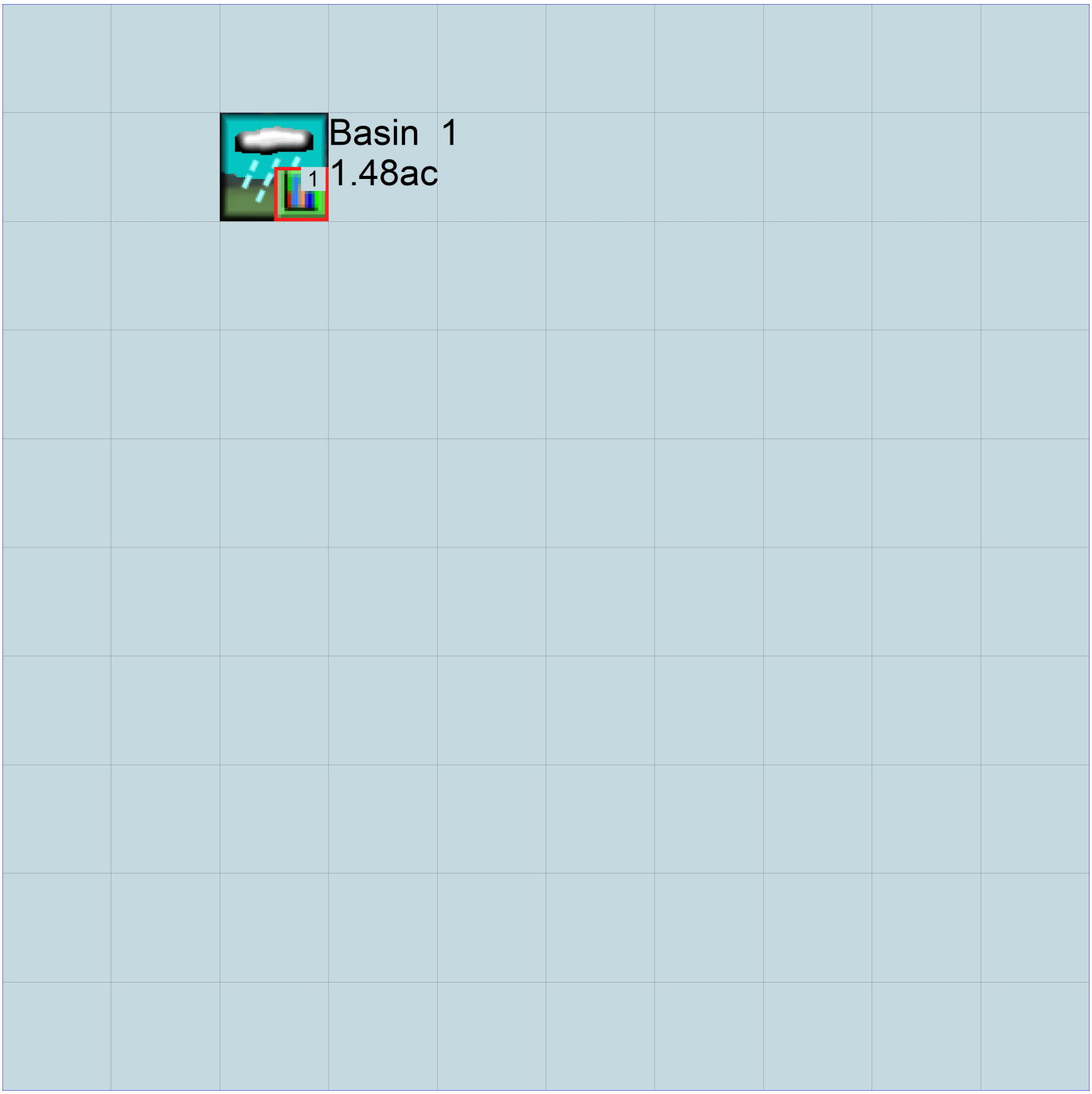
PERLND Changes

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   IV Revised Drainage A.wdm
MESSU       25   PreIV Revised Drainage A.MES
            27   PreIV Revised Drainage A.L61
            28   PreIV Revised Drainage A.L62
            30   POCIV Revised Drainage A1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        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           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

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

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

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

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

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

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

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                       1.479     COPY   501     12
PERLND  10                       1.479     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

```
WDM      1 EVAP     ENGL    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       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       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   IV Revised Drainage A.wdm
MESSU       25   MitIV Revised Drainage A.MES
            27   MitIV Revised Drainage A.L61
            28   MitIV Revised Drainage A.L62
            30   POCIV Revised Drainage A1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      IMPLND       4
      IMPLND      17
      PERLND       7
      IMPLND       8
      RCHRES       1
      IMPLND      16
      RCHRES       2
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        ECO-RAIN                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    7     A/B, Lawn, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

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

```
    7         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    7         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    7         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    7             0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    7             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    7          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    7             0         0         0         0         3         1         0
  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
   17      SIDEWALKS/FLAT         1    1    1   27    0
    8      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
   17         0    0    1    0    0    0
    8         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
   17         0    0    4    0    0    0    1    9
    8         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
   17         0    0    0    0    0
    8         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
   17            400      0.01       0.1       0.1
    8            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
   17              0         0
    8              0         0
   16              0         0
  END IWAT-PARM3

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

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Upper Roof***
IMPLND   4                      0.293     RCHRES   1      5
Asphalt & Concrete Pavement***
IMPLND  17                     0.3017     IMPLND  16     53
IMPLND  16                     0.6762     RCHRES   2      5
Lawn and Low Roof***
PERLND   7                      0.225     COPY   501     12
PERLND   7                      0.225     COPY   601     12
IMPLND   4                      0.039     COPY   501     15
IMPLND   4                      0.039     COPY   601     15
IMPLND   8                      0.042     COPY   501     15
IMPLND   8                      0.042     COPY   601     15

******Routing******
IMPLND   4                      0.293     COPY     1     15
IMPLND  17                      0.204     COPY     1     15
RCHRES   1                          1     COPY   501     16
RCHRES   2                          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     ECO-RAIN                1    1    1    1   28    0    1
    2     Permeable Asphal-006    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  0  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      0.04       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    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      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.031598  0.000000  0.000000
  0.016111  0.031598  0.000509  0.002204
  0.032222  0.031598  0.001018  0.003118
  0.048333  0.031598  0.001527  0.003818
  0.064444  0.031598  0.002036  0.004409
  0.080556  0.031598  0.002545  0.004929
  0.096667  0.031598  0.003054  0.005400
  0.112778  0.031598  0.003564  0.005832
  0.128889  0.031598  0.004073  0.006235
  0.145000  0.031598  0.004582  0.006613
  0.161111  0.031598  0.005091  0.006971
```

0.177222	0.031598	0.005600	0.007311
0.193333	0.031598	0.006109	0.007636
0.209444	0.031598	0.006618	0.007948
0.225556	0.031598	0.007127	0.008248
0.241667	0.031598	0.007636	0.008538
0.257778	0.031598	0.008145	0.008818
0.273889	0.031598	0.008654	0.009089
0.290000	0.031598	0.009163	0.009353
0.306111	0.031598	0.009673	0.009609
0.322222	0.031598	0.010182	0.009859
0.338333	0.031598	0.010691	0.010102
0.354444	0.031598	0.011200	0.010340
0.370556	0.031598	0.011709	0.010572
0.386667	0.031598	0.012218	0.010800
0.402778	0.031598	0.012727	0.011022
0.418889	0.031598	0.013236	0.011241
0.435000	0.031598	0.013745	0.011455
0.451111	0.031598	0.014254	0.011665
0.467222	0.031598	0.014763	0.011871
0.483333	0.031598	0.015272	0.012074
0.499444	0.031598	0.015781	0.012274
0.515556	0.031598	0.016291	0.015855
0.531667	0.031598	0.016800	0.017493
0.547778	0.031598	0.017309	0.018786
0.563889	0.031598	0.017818	0.019901
0.580000	0.031598	0.018327	0.020902
0.596111	0.031598	0.018836	0.021822
0.612222	0.031598	0.019345	0.022680
0.628333	0.031598	0.019854	0.023488
0.644444	0.031598	0.020363	0.024256
0.660556	0.031598	0.020872	0.024989
0.676667	0.031598	0.021381	0.025693
0.692778	0.031598	0.021890	0.026370
0.708889	0.031598	0.022399	0.027025
0.725000	0.031598	0.022909	0.027660
0.741111	0.031598	0.023418	0.028276
0.757222	0.031598	0.023927	0.028876
0.773333	0.031598	0.024436	0.029460
0.789444	0.031598	0.024945	0.030031
0.805556	0.031598	0.025454	0.030588
0.821667	0.031598	0.025963	0.031134
0.837778	0.031598	0.026472	0.031668
0.853889	0.031598	0.026981	0.032192
0.870000	0.031598	0.027490	0.032706
0.886111	0.031598	0.027999	0.033211
0.902222	0.031598	0.028508	0.033707
0.918333	0.031598	0.029018	0.034195
0.934444	0.031598	0.029527	0.034675
0.950556	0.031598	0.030036	0.035264
0.966667	0.031598	0.030545	0.054639
0.982778	0.031598	0.031054	0.088504
0.998889	0.031598	0.031563	0.131943
1.015000	0.031598	0.032072	0.183033
1.031111	0.031598	0.032581	0.240528
1.047222	0.031598	0.033090	0.303433
1.063333	0.031598	0.033599	0.370846
1.079444	0.031598	0.034108	0.441894
1.095556	0.031598	0.034617	0.515696
1.111667	0.031598	0.035126	0.591357
1.127778	0.031598	0.035636	0.667964
1.143889	0.031598	0.036145	0.744596
1.160000	0.031598	0.036654	0.820331
1.176111	0.031598	0.037163	0.894270
1.192222	0.031598	0.037672	0.965549
1.208333	0.031598	0.038181	1.033370
1.224444	0.031598	0.038690	1.097018
1.240556	0.031598	0.039199	1.155898
1.256667	0.031598	0.039708	1.209554
1.272778	0.031598	0.040217	1.257709
1.288889	0.031598	0.040726	1.300294

```
1.305000  0.031598  0.041235  1.337483
1.321111  0.031598  0.041745  1.369730
1.337222  0.031598  0.042254  1.397809
1.353333  0.031598  0.042763  1.422847
1.369444  0.031598  0.043272  1.462185
1.385556  0.031598  0.043781  1.489487
1.401667  0.031598  0.044290  1.516292
1.417778  0.031598  0.044799  1.542626
1.433889  0.031598  0.045308  1.568514
1.450000  0.031598  0.045817  1.593977
END FTABLE  1
FTABLE      2
 91    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
0.000000  0.676194  0.000000  0.000000  0.000000
0.008333  0.676194  0.001860  0.000000  1.363657
0.016667  0.676194  0.003719  0.000000  1.363657
0.025000  0.676194  0.005579  0.000000  1.363657
0.033333  0.676194  0.007438  0.000000  1.363657
0.041667  0.676194  0.009298  0.000000  1.363657
0.050000  0.676194  0.011157  0.000000  1.363657
0.058333  0.676194  0.013017  0.000000  1.363657
0.066667  0.676194  0.014876  0.000000  1.363657
0.075000  0.676194  0.016736  0.000000  1.363657
0.083333  0.676194  0.018595  0.000000  1.363657
0.091667  0.676194  0.020455  0.000000  1.363657
0.100000  0.676194  0.022314  0.000000  1.363657
0.108333  0.676194  0.024174  0.000000  1.363657
0.116667  0.676194  0.026033  0.000000  1.363657
0.125000  0.676194  0.027893  0.000000  1.363657
0.133333  0.676194  0.029753  0.000000  1.363657
0.141667  0.676194  0.031612  0.000000  1.363657
0.150000  0.676194  0.033472  0.000000  1.363657
0.158333  0.676194  0.035331  0.000000  1.363657
0.166667  0.676194  0.037191  0.000000  1.363657
0.175000  0.676194  0.039050  0.000000  1.363657
0.183333  0.676194  0.040910  0.000000  1.363657
0.191667  0.676194  0.042769  0.000000  1.363657
0.200000  0.676194  0.044629  0.000000  1.363657
0.208333  0.676194  0.046488  0.000000  1.363657
0.216667  0.676194  0.048348  0.000000  1.363657
0.225000  0.676194  0.050207  0.000000  1.363657
0.233333  0.676194  0.052067  0.000000  1.363657
0.241667  0.676194  0.053926  0.000000  1.363657
0.250000  0.676194  0.055786  0.000000  1.363657
0.258333  0.676194  0.057646  0.000000  1.363657
0.266667  0.676194  0.059505  0.000000  1.363657
0.275000  0.676194  0.061365  0.000000  1.363657
0.283333  0.676194  0.063224  0.000000  1.363657
0.291667  0.676194  0.065084  0.000000  1.363657
0.300000  0.676194  0.066943  0.000000  1.363657
0.308333  0.676194  0.068803  0.000000  1.363657
0.316667  0.676194  0.070662  0.000000  1.363657
0.325000  0.676194  0.072522  0.000000  1.363657
0.333333  0.676194  0.074381  0.000000  1.363657
0.341667  0.676194  0.076241  0.000000  1.363657
0.350000  0.676194  0.078100  0.000000  1.363657
0.358333  0.676194  0.079960  0.000000  1.363657
0.366667  0.676194  0.081819  0.000000  1.363657
0.375000  0.676194  0.083679  0.000000  1.363657
0.383333  0.676194  0.085539  0.000000  1.363657
0.391667  0.676194  0.087398  0.000000  1.363657
0.400000  0.676194  0.089258  0.000000  1.363657
0.408333  0.676194  0.091117  0.000000  1.363657
0.416667  0.676194  0.092977  0.000000  1.363657
0.425000  0.676194  0.094836  0.000000  1.363657
0.433333  0.676194  0.096696  0.000000  1.363657
0.441667  0.676194  0.098555  0.000000  1.363657
0.450000  0.676194  0.100415  0.000000  1.363657
```

```
  0.458333  0.676194  0.102274  0.000000  1.363657
  0.466667  0.676194  0.104134  0.000000  1.363657
  0.475000  0.676194  0.105993  0.000000  1.363657
  0.483333  0.676194  0.107853  0.000000  1.363657
  0.491667  0.676194  0.109712  0.000000  1.363657
  0.500000  0.676194  0.111572  0.000000  1.363657
  0.508333  0.676194  0.113432  0.000000  1.363657
  0.516667  0.676194  0.115291  0.000000  1.363657
  0.525000  0.676194  0.116587  0.000000  1.363657
  0.533333  0.676194  0.117883  0.000000  1.363657
  0.541667  0.676194  0.119179  0.000000  1.363657
  0.550000  0.676194  0.120475  0.000000  1.363657
  0.558333  0.676194  0.121771  0.000000  1.363657
  0.566667  0.676194  0.123067  0.000000  1.363657
  0.575000  0.676194  0.124363  0.000000  1.363657
  0.583333  0.676194  0.125659  0.000000  1.363657
  0.591667  0.676194  0.126955  0.000000  1.363657
  0.600000  0.676194  0.128251  0.000000  1.363657
  0.608333  0.676194  0.129547  0.000000  1.363657
  0.616667  0.676194  0.130843  0.000000  1.363657
  0.625000  0.676194  0.132140  0.000000  1.363657
  0.633333  0.676194  0.133436  0.000000  1.363657
  0.641667  0.676194  0.134732  0.000000  1.363657
  0.650000  0.676194  0.136028  0.000000  1.363657
  0.658333  0.676194  0.137324  0.000000  1.363657
  0.666667  0.676194  0.138620  0.000000  1.363657
  0.675000  0.676194  0.139916  0.000000  1.363657
  0.683333  0.676194  0.141212  0.000000  1.363657
  0.691667  0.676194  0.142508  0.000000  1.363657
  0.700000  0.676194  0.143804  0.000000  1.363657
  0.708333  0.676194  0.145100  0.000000  1.363657
  0.716667  0.676194  0.146396  0.000000  1.363657
  0.725000  0.676194  0.147692  0.000000  1.363657
  0.733333  0.676194  0.148988  0.000000  1.363657
  0.741667  0.676194  0.150284  0.000000  1.363657
  0.750000  0.676194  0.151580  0.000000  1.363657
  END FTABLE  2
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   2     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   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   2 HYDR   RO     1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1        1      WDM   1005 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1003 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       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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

  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

Mitigated HSPF Message File

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APPENDIX D

EcoRain Tank Systems SUBMITTAL

Technical Specifications, H-25 Traffic Loading, Detention, & Infiltration Tank Installation

PART I – GENERAL

1. General Provisions

A. The Conditions of the Contract and all Sections of Division 1 are a part of these Sections.

2. Description of Work

A. Work Included:

1. Provide excavation and base preparation per Engineer's recommendations and/or as shown on drawings, to provide adequate support for project design loads. Provide excavation safety in accordance with OHSA requirements. (*See Part II – Products 2. Materials)*
2. Provide Soils Report that supports appropriate use of EcoRain Tanks (Infiltration or capture and reuse).
3. Provide EcoRain Tank modular units only, constructed and installed per the manufacturer's instructions furnished under this section. Each unit/section shall have a minimum of two interior plates evenly spaced.

B. Related Work

1. Sub-grade Excavation and Preparation - Under Earthwork Section of drawings and specifications.
2. Sub-surface Drainage Materials - Under Sub-Surface Drainage and Structures Section of drawings and specifications as needed.

3. Quality Assurance

A. Record discussions of meeting decisions and agreements reached and furnish copy of record to each party attending. Review foreseeable methods and procedures related to installation, including the following:

1. Review preparation and installation steps, coordinating and scheduling required with related work.
2. Review proposed sources of materials.
3. Tour, inspect and discuss condition of sub-grade, drainage structures, and other preparatory work.
4. Review requirements for protecting the EcoRain Tank structure, including restriction of traffic during installation period and for remainder of construction period.
5. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Review installation requirements (soils report, drawings, specifications, manufacturer's recommendations about installation in this submittal) and other contract documents.
7. Review required submittals, both completed and yet to be completed.
8. Review required inspections & testing procedures.

9. Sign and date a copy of this Submittal verifying that the Installer has read and understands instructions. Send a copy of the signed Submittal to: EcoRain Tank Systems of America, 12400 Ventura Blvd., #167, Studio City, CA 91604; Fax: 818.501.0713; E-mail: contact@ecoraintank.com
10. Review weather and forecasted weather conditions, and procedures for coping with unfavourable conditions.
11. Review safety precautions relating to installation.

B. Installation: Performed only by skilled workers with satisfactory record of performance on pipe, chamber, or pond/landfill construction projects of comparable size and quality.

4. Submittals

A. Submit manufacturer's product data and installation instructions. Submit panels of one EcoRain Tank and one 20-inch x 20-inch section of geotextile fabric for product review. Return reviewed and accepted samples to the Contractor.

B. Submit material specifications for EcoRain Tank, Class 1 non-woven geotextile fabric, Biaxial Geogrid or Ecovoid 2" Cell layer if required, base course, and backfill materials.

5. Delivery, Storage, and Handling

A. Protect all materials from damage during delivery and store under tarps to protect from sunlight exposure exceeding 5 days.

B. Handle with equipment appropriate to the size (height) of EcoRain Tanks and site conditions, which may include, hand, handcart, forklifts, extension lifts, small cranes, etc; give care to minimize damage to material. Full pallets require the use of a forklift, unloaded on flat surfaces.

C. Storage should occur on smooth surfaces, free from dirt, mud, and debris.

6. Project Conditions

A. All Weather

1. Review installation procedures and coordinate EcoRain Tank work with other work, such as grading, excavation, utilities, construction access, and erosion control.
2. Prevent all non-installation related construction traffic around the EcoRain Tank installation.
3. **Either complete adjacent construction prior to the installation of EcoRain Tanks or provide detours for all traffic exceeding load rating for the structure.**
4. When installing EcoRain Tanks, take care against damage from other construction traffic when work is in progress.
5. Following completion of backfill, mark structure perimeter with highly visible construction tape, fencing, or other means until all site construction is complete.
6. Protect adjacent work from damage during EcoRain Tank installation.
7. Direct all site stormwater runoff away from the installation area. The installation area shall not receive site runoff until the runoff area is maintained with temporary erosion control device and/or site landscaping is established to completely diminish washing of silts and clays into the installation area.

B. Cold Weather

1. Do not use frozen materials or materials mixed or coated with ice or frost.
2. Do not build on frozen, wet, saturated, or muddy sub-grade.

PART II – PRODUCTS

1. Availability

A. Manufacturer: EcoRain Tank Systems of America, Inc.
12400 Ventura Boulevard #167
Studio City, CA 91604
+ 1.818.501.0424
contact@ecoraintank.com

B. Supplier: Request a list for your area.

2. Materials *Specifications herein are minimum requirements for installations subject to repetitive **AASHTO H25** wheel loading. When installed in competent soil conditions the **AASHTO H25** loading allows a total load of 50,000 lbs as shown in test data. Backfill material, geotextile fabric and Biaxial Geogrid may vary depending upon surface loading conditions, infiltration requirements, soil conditions and soil gradation.* ***Always follow Engineer's requirements to address these concerns.***

A. **Base Excavation:** Shall be smooth soil, level and free of lumps or debris. Compact as required by **Soils** Engineer. Structural fill material may be used to amend the structural capacity of the soil **or six to eight inches of gravel or sand may be used as a structural base as determined by the Soils Engineer.** Geogrid and/or ET-1301 or ET-1401 may be required to achieve the minimum saturated bearing capacity in the base soils.

B. **Geotextile:** Shall be non-woven Class 1, wrapped around all sides, top and bottom of the Tank assembly, with a minimum six-inch joint overlap. *(See Geotextile Fabric Specifications Sheet)*

C. **Geogrid:** Where required, use a Biaxial Geogrid (Tensar BX1200, Terragrid B120 or Synteen SF12 or equivalent) or Ecovoid HD 2" Cell (405 psi) layer for structural support. EcoRain Tank Systems recommends using Biaxial Geogrid or a layer of Ecovoid HD 2" Cells in traffic rated installations. Follow Geogrid manufacturers or EcoRain Tank Systems recommendation for Ecovoid HD 2" Cell layers as to placement.

D. **EcoRain Tank:** Injection moulded recycled polypropylene plastic units, 1.34' wide by 2.23' long and from .79' tall **as specified by the Engineer**, assembled from flat interlocking panels. Each unit shall have a minimum of two interior panels equally spaced plus two end panels for landscape applications and a minimum of three interior panels equally spaced plus two end panels for vehicle load applications. Assemble units into vertical structures as shown in the plan, **maximum five units tall**. *(For taller EcoRain Tanks, contact the manufacturer – EcoRain Tank Systems or consult a qualified Geotechnical Engineer.)*

E. **Bedding Layer**: Layer a minimum of **two inches** of clean sand, gravel materials or a mix of both, free from lumps and debris or any other sharp materials - must be properly compacted as in A. above.

F. **Placement:** Place the EcoRain Tanks vertically into excavation per manufacturer's recommendations. Abut assembled Tanks in the excavation and wrap in Class 1 non-woven geotextile fabric to create one structure.

G. **Pipes:** Connect pipes, if any, before backfilling.

H. **Filters:** All water entering the Tank structure must be filtered, either through a rock/sand/soil profile or if water is directed via pipe, use of a manufactured filter that will not allow any debris to bypass the filter must be installed on all inlet pipes.

I. **Side Backfill:** Side backfill must be completed before top backfill is started. Fill with clean sand or gravel (¾" minus or less – no limestone) materials or a mix of both, free from lumps

and debris or any other sharp materials to backfill along the sides of the Tank. During compaction with powered mechanical compactor, cover the side of the Tank with a sheet of plywood to protect fabric and Tank from the compactor. Move the plywood sheet as the compactor moves. Compact side fill in lifts that do not exceed 12 inches as required by a Soils Engineer, to provide a settlement free surface of the sides of the structure. Verify by meter during progression.

I. Top Backfill for Parking Lots and Heavy Load Applications:

1. Use a minimum of five ET-1507 Small Plates in each unit of Double, Triple, Triple + Half, Quad, Quad + Half, and Pent Tanks for parking lot applications.
2. Use minimum 24 inches fill material as required by approving agency for parking lots or driveways (please contact us if project calls for less or more depth – specification will change depending on design and may include the use of additional Small Plates instead of traffic load five Small Plates per unit and/or Ecovoid HD Cells). All fill materials shall be compacted for parking lots or heavy load application as specified by a Soils Engineer. The use of an Ecovoid HD 2" Cell layer or Biaxial Geogrid layer between the top of the Tank structure and finished grade is recommended – follow manufacturer recommendation for placement.
3. After the side backfill is fully in place and compacted, backfill top in lifts of 12-inch depths and compact each layer, including self-compacting fill, with low-pressure tire or track vehicles, walk-behind vibratory plate compactors, or approved equipment. Do not use vibratory rollers at any time, even after full backfill. *(See Equipment Sheet for approved compactors.)*
4. Top backfill will not exceed four feet in depth without prior review and written approval from the manufacturer.
5. Do not operate AASHTO H-25 load rated equipment over the EcoRain Tank structure until a properly compacted approved minimum cover and pavement is in place. *(See Part III - Execution, 3. Installation, F.)*

J. Top Backfill for Non-Vehicle Load Applications:

1. Use 18-inch minimum of porous top fill to allow infiltration into the EcoRain Tanks as specified by the Soils Engineer for non-vehicle load bearing swales and landscapes above the EcoRain Tanks. Please contact us if project calls for less than 18-inches or more than 48-inches depth – specification will change depending on design and may include the use of additional Small Plates and/or Cells.

PART III – EXECUTION

1. Inspection

A. Examine prepared excavation and conditions for level smoothness to within ½" or as specified, and compaction. Correct unsatisfactory conditions before start of EcoRain® Tank installation. Check for presence of high-water table, which must be always kept at levels below the bottom of the EcoRain Tank structure (a layer of Ecovoid HD 2" Cells can be used as the underdrain medium - contact manufacturer for details).

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact the Engineer for resolution. Saturated sub-base soils shall have a minimum allowable bearing value of 35 psi.

2. Preparation

A. Keep all construction traffic away from the limits of excavation until the project is complete and final surface materials are in place by delineating with high visibility tape or other means.

B. Following OSHA requirements, excavate site to proper depth, accounting for 2-inch bedding and specified height of EcoRain Tank and specified depth of cover over EcoRain Tanks. Smooth the subgrade, free of lumps, roots, & debris.

C. If it rains after excavation, but before installation of Tanks, the base must be dry and levelled before installation begins.

D. Place a minimum 2-inch-thick layer of clean sand or gravel materials, free from lumps and debris or any other sharp materials over prepared sub-grade. Screed a 2-inch-thick layer to ensure level surface to within ½" or as shown on plan.

E. Where an impervious liner is specified to harvest rainwater or prevent groundwater intrusion, install in accordance with the plans, and Engineer's or other professional's specifications. As recommended by the liner manufacturer, place a layer of geotextile fabric in the bottom and sides of the excavation to protect the outside of the liner. Place and unfold the liner on top of the geotextile fabric. Chalk or paint lines for layout in the excavation are recommended.

F. Inside the liner, place and stretch smooth Class 1 non-woven geotextile fabric over the entire base area and sides of the excavation in strips with enough to encase the completed EcoRain Tank structure. Create minimum 6-inch joint overlaps.

G. Assemble EcoRain Tank units as indicated in assembly directions provided by manufacturer or distributor. Assembled unit panels shall be firmly interlocked. Place tall elevation on the vertical plane. Place narrower side in the horizontal plane. Each unit shall have a minimum of two interior Small Plates in landscape/non-traffic areas and three interior Small Plates in vehicle traffic areas. Do not use cracked or broken plates – replace with intact plates. Zip ties may be used to secure vertically stacked units. Zip tie ends must be turned inward into the Tanks to avoid tears to the Geotextile material wrap.

H. Inspection Ports are not required with the EcoRain Tank System if all debris is filtered out prior to water entering the EcoRain Tanks. However, if the designing Engineer desires to install maintenance/inspection ports, EcoRain prefers that they are installed in the outside perimeter of the tank structure where a 6 - 12" diameter pipe can be angled downward to a partial or full channel (See ET-1210 & ET-1210A) unless specific approval is gained by designing Engineer.

3. Installation of EcoRain Tanks

A. Place assembled interlocked vertical Tank units in position on top of the Geotextile fabric in the excavation. Chalk lines for layout in the excavation are recommended. Abut vertically stacked Tank units' side by side. Contractor may use EcoRain Tank clips to connect Tanks. Keep geotextile fabric on bottom, sides, and top clear of construction activity, and ensure adequate length is available to wrap the completed Tank size. **Orient** all Tanks so that the **Large Plate** is on the perimeter of the installation. This means that two ends of the structure will have a row of Tanks placed perpendicular to all the other rows. See ET-1211 drawing of Typical EcoRain Tank Assembly Layout. If not possible to place Tanks perpendicular on the ends, reinforce ends with either EcoRain 1" or Ecovoid HD 2" Cell layers. In structures that are using EcoRain Triple, Triple + Half, Quad, Quad + Half, or Pent Tanks, ***place perpendicular rows between every six rows or less***. See EcoRain drawing ET-1212B.

B. Identify locations of filters and inlet pipes, outlet pipes, inspection ports, and/or cleanout portals, if any. Secure pipe connections to geotextile fabric using stainless steel pipe clamps, zip ties,

and/or fully securing with HDPE Tape so that no soil can enter the structure. Connect pipe as follows: For side mounted inlet/outlet pipes exceeding six inches in diameter, place a layer of Ecovoid HD 2" Cells vertically next to the Large Plate side only, where the pipe aligns with the Tank. In a second layer of Ecovoid HD 2" Cells, cut a hole the size of the pipe, place this layer next to the first layer, pull the geotextile fabric over the layers, and mark and cut an X in the fabric at the pipe opening in the Ecovoid HD 2" Cell layer. Cut a fabric collar with an X cut for the pipe, pull over end of pipe. Then place the pipe end in the cut layer of Ecovoid HD 2" Cells, push the collar into the fabric layer surrounding the Tanks, pull the ends of the fabric over the pipe and secure so that no soil/sand can enter the Tank. (See ER-1216 for Pipe Collar detail). Support pipe in trenches and during backfill operations to prevent damage to pipe or liner if used. **Connect pipes prior to backfilling.** See EcoRain drawing ET-1207 or ET-1215 for pipe connections. Proceed as outlined in C. below.

C. When the EcoRain Tank modular structure is fully in place, stretch geotextile fabric up the sides and over the top of the structure, smooth wrinkles in the fabric, overlap seams by at least six inches and seal joints, fully securing with HDPE Tape so that no soil can enter the structure. (See ET-1216 for Pipe Collar detail.) Trim and fold excess geotextile fabric at corners to lay flat against sides of structure, securing folds and seams with HDPE Tape. If an impermeable liner is installed, place a layer of protective fabric in the pit before laying out the liner. Follow the Liner manufacturer's recommended instructions to secure the liner around the structure. **Follow the Liner manufacturer's instructions to cut and seal holes in the liner.**

D. Install 2-foot lengths of metallic underground locator tape on each top corner of the Tank structure.

E. Place backfill carefully to avoid shoving or damage to tanks and geotextile fabric. **Excavator equipment** shall remain **clear of the excavation**. Backfill on opposite sides of the structure at the same time, compacting material in 8 to 12-inch lifts. Keep compactor equipment clear of tank structure and cover the side of the tank with a sheet of plywood to protect the fabric, tank (and liner if used) from the compactor. This plywood sheet must be moved as the compactor moves, as it acts as a temporary cover to protect the side of the structure from the compactor to avoid any possible damage to the side of the Tanks, fabric, and liner.

F. After sides are completely backfilled, check for broken plates on the top of the structure, if any they MUST be replaced. Then place backfill material over top of structure - material shall not be dropped vertically on the tank from a distance greater than **one foot**. Place a minimum of 12 inches of cover before driving equipment on top of structure to protect the Tank and fabric. Compact in 8 to 12-inch lifts **as specified by a Soils Engineer**, using low-pressure tire or track vehicles, light-weight vibratory plate compactors, walk behind rollers or approved equipment (Do not use equipment exceeding 6,000 lbs.). ***Equipment shall not make turning movements on top of the Tank.** For parking lots or heavy-duty installations as specified by the Engineer, place a layer of Ecovoid HD 2" Cells or Biaxial Geogrid at least 12 inches below finished grade covering entire excavation (top of Tank plus 3-foot overlap of the structure, pinning the edges into solid ground). Provide at least 12 inches compacted fill (as specified by the Engineer) under Biaxial Geogrid/Cells if used. Place additional cover and compact with low-pressure tire or track vehicles, lightweight vibratory plates, walk-behind rollers, or approved equipment******Do not use vibratory rolling compactors at any time.***

G. Place surfacing materials, such as groundcovers or shrubs, or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

4. Site Cleaning

A. Perform cleaning during the installation of work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

Sign and date a copy of this page verifying that the Installer has read and understands these instructions. Send a hard copy of this signed page to:

- EcoRain Tank Systems of America 12400 Ventura Blvd., #167, Studio City, CA 91604
- Fax: 818.501.0713 Email: contact@ecoraintank.com

_____

Name of Project City & State

_____ _____

Signature of Installer Date

DIMENSIONS CHART

BURIED IN A LANDSCAPE AREA – *AASHTO H-20 LOAD CAPACITY* – FOUR SMALL PLATES/UNIT

PLATES NEEDED FOR ASSEMBLY

Tank Units	Size in Feet	97% Water Storage Cubic Feet	ET-1506 Large Plates	ET-1507 Small Plates	ET-1508 Large Half Plates	ET-1509 Small Half Plates
Half	1.34' w x 2.23' l x .8' h	2.31	2	-	2	4
Single	1.34' w x 2.23' l x 1.45' h	4.20	4	4	-	-
Single + Half	1.34' w x 2.23' l x 2.19' h	6.34	5	4	2	4
Double	1.34' w x 2.23' l x 2.84' h	8.22	7	8	-	-
Double + Half	1.34' w x 2.23' l x 3.58' h	10.37	8	8	2	4
Triple	1.34' w x 2.23' l x 4.23' h	12.26	10	12	-	-
Triple + Half	1.34' w x 2.23' l x 4.96' h	14.37	11	12	2	4
Quad	1.34' w x 2.23' l x 5.61' h	16.26	13	16	-	-
Quad + Half	1.34' w x 2.23' l x 6.35' h	18.40	14	16	2	4
Pent	1.34' w x 2.23' l x 7.00' h	20.28	16	20	-	-

BURIED IN A VEHICLE AREA – *AASHTO H-25 LOAD CAPACITY* – FIVE SMALL PLATES/UNIT

PLATES NEEDED FOR ASSEMBLY

Tank Units	Size in Feet	97% Water Storage Cubic Feet	ET-1506 Large Plates	ET-1507 Small Plates	ET-1508 Large Half Plates	ET-1509 Small Half Plates
Half	1.34' w x 2.23' l x .8' h	2.31	2	-	2	5
Single	1.34' w x 2.23' l x 1.45' h	4.20	4	5	-	-
Single + Half	1.34' w x 2.23' l x 2.19' h	6.34	5	5	2	5
Double	1.34' w x 2.23' l x 2.84' h	8.22	7	10	-	-
Double + Half	1.34' w x 2.23' l x 3.58' h	10.37	8	10	2	5
Triple	1.34' w x 2.23' l x 4.23' h	12.26	10	15	-	-
Triple + Half	1.34' w x 2.23' l x 4.96' h	14.37	11	15	2	5
Quad	1.34' w x 2.23' l x 5.61' h	16.26	13	20	-	-
Quad + Half	1.34' w x 2.23' l x 6.35' h	18.40	14	20	2	5
Pent	1.34' w x 2.23' l x 7.00' h	20.28	16	25	-	-

ET-1506 Large Plate: 26 ¾" x 16 ⅛" / ET-1507 Small Plate: 14 ¼" x 15 ¾"
ET-1508 Large Half Plate: 26 ¾" x 8" / ET-1509 Small Half Plate: 14 ¼" x 8" / Plate Depth: ¾ "

ET-1301 EcoRain 1" Cell - 1" x 19.70" x 23.6" = 3.23 square feet - .27 cu ft/.22 cu ft void at 80%
ET-1401 Ecovoid 2" Cell - 2" x 11.75" x 19.4" = 1.59 square feet - .28 cu ft/.24 cu ft void at 87.6%

Product layouts and estimates available: Send email to contact@ecoraintank.com or call 818.501.0424 #1
Conceptual layouts available on www.caddetails.com

02/01/23

APPENDIX E

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED FAIRGROUND IMPROVEMENTS
902 SOUTH MERIDIAN AND 705 – 15TH AVENUE SOUTHWEST
PUYALLUP, WASHINGTON

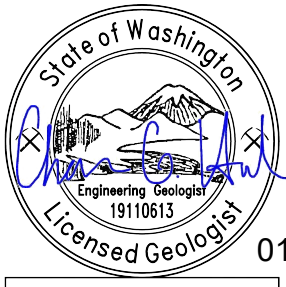
ES-9092

15365 N.E. 90th Street, Suite 100 Redmond, WA 98052
(425) 449-4704 Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

WASHINGTON STATE FAIR

January 11, 2024



01/11/2024

Chase G. Halsen

Chase G. Halsen, L.G., L.E.G.
Project Manager

01/11/2024

Keven D. Hoffmann, P.E.
Associate Principal Engineer

GEOTECHNICAL ENGINEERING STUDY
PROPOSED FAIRGROUND IMPROVEMENTS
902 SOUTH MERIDIAN AND 705 – 15TH AVENUE SOUTHWEST
PUYALLUP, WASHINGTON

ES-9092

Earth Solutions NW, LLC
15365 Northeast 90th Street, Suite 100
Redmond, Washington 98052
Phone: 425-449-4704 | Fax: 425-449-4711
www.earthsolutionsnw.com

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

January 11, 2024
ES-9092

Washington State Fair
110 – 9th Avenue Southwest
Puyallup, Washington 98371

Attention: Renee McClain

Greetings:

Earth Solutions NW, LLC (ESNW) is pleased to present this geotechnical engineering report to support the proposed project. Based on the results of our investigation, the construction of the proposed fairground improvements/structures is considered feasible from a geotechnical standpoint. Based on our explorations, the subject site is underlain by extensive alluvial deposits. The local groundwater table was present at an approximate depth of five feet below grade during the May 2023 exploration.

Based on our findings, the project may consider the use of subgrade improvements to establish adequate support for the proposed foundation systems. Foundation design considerations, design parameters, and associated risks (from a geotechnical standpoint) are provided in this report.

From a geotechnical standpoint, it is our opinion that infiltration is generally infeasible for the project. The variability of the encountered alluvial soils and shallow exposure of the local groundwater table were the primary bases for this opinion. Shallow LID designs may be considered where surficial exposures of sandy soils are present and where vertical separation from the groundwater table can be successfully achieved.

Pertinent geotechnical recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Chase G. Halsen, L.G., L.E.G.
Project Manager

cc: Jeff Brown Architecture, LLC
Attention: Jeff Brown
Snogyi Cho

Chris Fynboe, P.E.

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ES-9092

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Cont'd

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GEOTECHNICAL ENGINEERING STUDY
PROPOSED FAIRGROUND IMPROVEMENTS
902 SOUTH MERIDIAN AND 705 – 15TH AVENUE SOUTHWEST
PUYALLUP, WASHINGTON

ES-9092

INTRODUCTION

General

This geotechnical engineering study was prepared for the proposed improvements to be completed within the Washington State Fairgrounds, in Puyallup, Washington. This study was prepared to provide geotechnical recommendations for the currently proposed improvements and included the following geotechnical services:

- Subsurface exploration to characterize soil and groundwater conditions, including soil borings and a seismic cone penetration test (SCPT).
- Laboratory testing of representative soil samples collected at the boring locations.
- Geotechnical engineering analyses.

Project Description

ESNW understands that the project scope will include the following:

- Construction of a 16-foot-tall canopy structure at the Gold Gate entrance.
- Demolition and construction of a new, approximately 10,000-square-foot, single-story event space in place of the existing International Building.

The canopy structure will be comprised of steel and will be supported by four 42-inch-diameter concrete columns with concrete foundation elements. Column loading for the canopy structure is estimated at 81 kips, including the weight of the columns. Loading conditions for the event space were not provided to ESNW for review at the time of this report; however, we anticipate perimeter loads of about 2 to 3 kips will be included in the design. Grade cuts and/or fills of less than five feet are expected to achieve the design elevations across the proposed improvement areas. We assume conventional detention designs or collection and discharge to an appropriate location and/or structure will be utilized for stormwater management.

If the above design assumptions either change or are incorrect, ESNW should be contacted to review the recommendations provided in this report. ESNW should review the final designs to confirm that appropriate geotechnical recommendations have been incorporated into the plans.

SITE CONDITIONS

Surface

The project areas are located within the northeastern and west-central portions of the Washington State Fairgrounds, located in Puyallup, Washington. The Gold Gate and International Building areas are currently developed with various structures and are primarily surfaced with asphalt. Topography is relatively level with less than five feet of elevation change occurring in each site area.

Subsurface

An ESNW representative observed, logged, and sampled the advancement of six soil borings and one SCPT on May 22 and 23, 2023. The explorations were generally targeted to the areas of proposed improvements and ranged in depths from about 11.5 to 100 feet below the existing ground surface (bgs). All explorations were completed using machinery and operators retained by ESNW. The approximate locations of the explorations are depicted on Plate 2 (Boring Location Plan). Please refer to the exploration logs provided in Appendix A for a more detailed description of the encountered subsurface conditions.

Representative soil samples collected at the exploration locations were analyzed following the Unified Soil Classification System (USCS) and United States Department of Agriculture methods and procedures. Samples were analyzed in our laboratory for moisture content and grain size distribution in general accordance with ASTM procedures. Laboratory test results are provided in Appendix B.

Topsoil and Fill

Surficial topsoil may be expected in areas surfaced with landscaping or gravel. Based on our experience in the area, an approximate topsoil section of about 12 inches can be anticipated.

Fill was interpreted at B-2 and B-3 and observed extending to a depth of about one to three feet bgs. The fill was characterized as poorly graded gravel with silt and sand. The in-situ condition of the fill was characterized primarily as very loose to loose and moist.

Native Soil and Geologic Setting

Native soils were characterized as poorly graded sand with variable fines content (USCS: SP to SP-SM), silty sand (USCS: SM), sandy silt (USCS: ML), and silty gravel with sand (USCS: GM). In general, the native soils were encountered in a very loose to loose and moist to water-bearing condition, extending to the maximum boring depth of about 31.5 feet bgs. A similar soil profile was interpreted from the SCPT, which was advanced to a depth of about 100 feet bgs. Based on our observations, native soils appear to be representative of alluvial deposits (Qa), which have been mapped across the subject site.

The referenced Web Soil Survey resource indicates the site is underlain by Puyallup fine sandy loam. This series is generally associated with terraces and flood plains and is derived from alluvium. Based on the observed site conditions, native soils are generally considered representative of alluvium per local geologic mapping designations.

Groundwater

The local groundwater table was exposed at a depth of between 5 and 10 feet bgs at the boring locations during the May 2023 fieldwork. Data acquired from the SCPT indicates a static groundwater table depth of about 4.7 feet bgs in the approximate area of advancement. In our opinion, the SCPT data should be considered the most accurate depiction of the local groundwater table elevation at the time of the May 2023 exploration.

The presence of groundwater and fluctuation of the local groundwater table elevation can depend on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater elevations are higher during the winter, spring, and early summer months.

Review of Geologically Hazardous Areas

ESNW understands that the City of Puyallup recognizes areas susceptible to the processes of landslides, erosion, seismic, and volcanic activity as geologically hazardous areas, as outlined in Puyallup Municipal Code (PMC) 21.06.1210. Based on our investigation, the site is considered to possess a seismic hazard (related to liquefaction) and is sited within a volcanic hazard area (Lahar flow path).

Seismic Hazard (Liquefaction Evaluation)

Based on our site investigation and subsequent review, the site is considered to possess moderate liquefaction potential. The site is underlain by a thick alluvium deposit that consists of alternating layers of sand-, silt-, and gravel-dominated soils that extend to at least 100 feet bgs, with the local groundwater table interpreted at a depth of about 4.7 feet bgs during the May 2023 exploration.

ESNW evaluated liquefaction potential by modeling the site soil and groundwater profile using the LiquefyPro computer program. Soil and groundwater data were imported into the software using the SCPT data collected on site. Some modeling parameters, such as total unit weight and approximate fines content, were assigned to the various layers based on our observations, representative sieve analyses, and experience with similar soil deposits. A site-modified peak ground acceleration of 0.6 *g* and an earthquake magnitude of 7.0 were used to model the subject seismic event. In the current site condition, total settlement of up to about 10 inches across the entire 100-foot-deep soil profile was indicated by the computer program, with liquefaction primarily occurring in the sand-dominate layers. Parametric analyses that evaluated the settlement response of the soil within the upper 50 feet, 25 feet, and 10 feet of the subsurface profile suggest reduced total settlement estimates on the order of 6.75 inches to less than 1 inch.

Based on the results of our analyses, it is our opinion that the site may experience between about 3 to 5 inches of total settlement and 1.5 to 2.5 inches of differential settlement across each respective improvement area during the modeled seismic event. Although the model suggests that the 100-foot explored (upper) soil profile may experience greater total settlement, it is our opinion that not all subsurface soil layers are susceptible to liquefaction; thus, deeper potential settlement will be attenuated and is not likely to be directly expressed at the surface (where the proposed improvements will be sited).

The estimated settlement values provided in this section are considered an adequate representation of potential settlements that could be experienced during the modeled seismic event. Smaller or larger settlement amounts could occur, depending on the magnitude and location of the seismic event.

The effects of seismically induced settlement can be reduced—but not eliminated— following the completion of subgrade improvement activities. If the reduced settlement values are considered tolerable, then the foundation support methodology provided in this report (see the *Foundation Considerations* section) is considered viable for the project. However, if the reduced settlement estimates are not tolerable, alternative means of foundation support (such as surcharging or deep pile support) will likely be necessary. ESNW can provide further evaluations and recommendations relating to alternative foundation support designs, if requested.

Volcanic Hazard

Based on a review of the City of Puyallup Critical Areas application, the subject site is within an area identified as a potential volcanic hazard/lahar flow path. As such, the project will need to adhere to the standards provided in PMC 21.06.1260.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed improvements is considered feasible from a geotechnical standpoint. The primary geotechnical considerations for the proposed project are structural fill placement and compaction, foundation and subgrade preparation and design, geologically hazardous areas mitigation, and stormwater management.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and site clearing and demolition activities. Subsequent earthwork activities will involve site grading and installation of limited infrastructure and stormwater management improvements.

Temporary Erosion Control

The following temporary erosion and sediment control Best Management Practices (TESC BMPs) are offered:

- Temporary construction entrances and drive lanes should be constructed with at least six inches of quarry spalls to both minimize off-site soil tracking and provide a stable access entrance surface. A woven geotextile fabric can be placed beneath the quarry spalls to provide greater stability, if needed.

- Silt fencing should be placed around the site perimeter.

- When not in use, soil stockpiles should be covered or otherwise protected.

- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed before beginning earthwork activities.

- Dry soils disturbed during construction should be wetted to reduce dust.

- When appropriate, permanent planting or hydroseeding will help to stabilize site soils.

Additional TESC BMPs, as specified by the project civil engineer on the plans, should be incorporated into construction activities. ESNW can assist the project design team in designating appropriate BMPs, if requested, and can review TESC plans for applicability and to provide input. TESC measures will require upkeep and potential modification during construction to ensure proper function; such upkeep should be coordinated with the site erosion control lead, where applicable.

Stripping

Topsoil should be expected in existing landscaping and unimproved areas. In general, a topsoil section of 12 inches may be assumed for preliminary stripping estimations. ESNW should be contacted to evaluate appropriate stripping depths and areas subject to overexcavation during initial grading activities. Where encountered, organic-rich topsoil should be stripped and segregated into a stockpile for later use on site or to be exported.

Existing fill, which was exposed at B-2 and B-3, should be removed from improvement areas. ESNW can evaluate existing fill soils at the time of construction to evaluate in-situ competency and potential use as structural fill or structural element support.

Excavations and Slopes

Based on the soil conditions observed and inferred from the exploration locations, a maximum allowable temporary slope inclination of one-and-one-half horizontal to one vertical (1.5H:1V) may be used during construction. This recommendation is consistent with applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) guidelines for Type C soil.

Steeper temporary slope inclinations within undisturbed, dense native soil may be feasible based on the soil and groundwater conditions exposed within the excavations. ESNW can evaluate the feasibility of utilizing steeper temporary slopes at the time of construction on a case-by-case basis. In any event, an ESNW representative should observe temporary slopes to confirm inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope stability recommendations, as necessary.

If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations. Permanent slopes should be graded to 2H:1V (or flatter) and planted with vegetation to enhance stability and minimize erosion potential. Permanent slopes should be observed by ESNW before vegetation and landscaping.

In-situ and Imported Soil

Successful use of the on-site soil as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Based on the conditions observed during the subsurface exploration, the native alluvial soil is considered to possess a moderate to severe moisture sensitivity. Depending on the time of year construction occurs, moisture conditioning measures (such as adding water to the on-site soil) may be necessary as part of site grading and earthwork activities. If the on-site soil cannot be successfully compacted, the use of imported soil may be necessary.

Imported structural fill soil should consist of well-graded, granular soil that can achieve a suitable working moisture content. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Subgrade Preparation

Foundation and slab subgrade surfaces should consist of competent, undisturbed native soil or structural fill placed and compacted atop competent soil. ESNW should observe subgrade areas before placing formwork. Supplementary recommendations for subgrade improvement may be provided at the time of construction; such recommendations would likely include further mechanical compaction effort or overexcavation and replacement with suitable structural fill.

Structural Fill

Structural fill is defined as compacted soil placed in the foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. The following recommendations are provided for soils intended for use as structural fill:

- Moisture content — At or slightly above optimum
- Relative compaction (minimum) — 95 percent (per ASTM D1557)
- Loose lift thickness (maximum) — 12 inches

Native site soil may only be considered suitable for use as structural fill if a suitable moisture content is achieved at the time of placement and compaction. Existing fill soil may be considered for use as structural fill only if the soil is free of organics and debris and can achieve a suitable moisture content at the time of compaction. ESNW should evaluate soils intended for use as structural fill at the time of construction. If the on-site soil cannot achieve the above specifications, the use of imported structural fill material will likely be necessary. Concerning underground utility installations and backfill, local jurisdictions will likely dictate soil type(s) and compaction requirements.

Foundation Considerations

Based on the observed and inferred soil conditions, it is our opinion that the native alluvium will not provide adequate support for the proposed improvements in the current condition. As such, mitigation will be necessary as part of the project to establish competent bearing conditions and reduce the potential for settlement in both the static and seismic cases.

From a geotechnical standpoint, it is feasible to complete localized subgrade improvements in the Gold Gate and International Building areas of the project. The following recommendations can be considered for the subgrade improvement and grid foundation system approach:

- Overexcavate a minimum of two feet below the design foundation subgrade elevation. Depending on the conditions exposed, additional overexcavation may be recommended by ESNW at the time of construction. Additional overexcavation may also be necessary where existing fill is present.

- Mechanically compact the exposed soil surface with heavy machinery until a firm and unyielding condition is established, as confirmed by ESNW representatives.

- Place a suitable geotextile fabric (as recommended by ESNW at the time of construction) atop the compacted subgrade to provide separation and/or strengthening. Restore grades using crushed rock or suitable granular fill in accordance with the recommendations provided in the *Structural* Fill section of this report. ESNW should be contacted to evaluate all material proposed for use as structural fill before placement and compaction.

For the Gold Gate, we understand that four, 42-inch-diameter concrete columns will be utilized. For the International Building, the foundation should be constructed as a grid system with no independent or isolated footings.

The above subgrade improvement program would be adequate in establishing competent soil bearing conditions for the proposed structures. However, this approach is not intended to fully mitigate post-construction settlement potential. Based on our evaluations, a total static settlement of two to three inches and differential static settlement of one to one-and-one-half inches may be experienced. Under seismic conditions, a total settlement of three to five inches and differential settlement of one-and-one-half to two-and-one-half inches may be experienced.

The anticipated static and seismically induced settlement estimates are independent. As such, the building designer should account for both static and seismically induced settlements in their designs. Based on our experience, targeted subgrade improvements would likely be the most cost- and time-efficient mitigation strategy. However, there is a higher risk of both static and seismically induced settlements with this approach. If the anticipated settlements associated with these targeted subgrade improvements are not tolerable, the project should consider alternative means of foundation support.

Provided the foundations will be supported as recommended, following the completion of the subgrade improvements activities outlined above, the following parameters may be used for design:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.35

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a factor-of-safety of 1.5. ESNW should be afforded the opportunity to review the site layout and building load plans to confirm the recommendations provided in this report are applicable and appropriate for the project. Additional foundation preparation and design considerations may be provided at that time, as necessary.

Seismic Design

The 2018 International Building Code recognizes the most recent edition of the Minimum Design Loads for Buildings and Other Structures manual (ASCE 7-16) for seismic design, specifically with respect to earthquake loads. ESNW recognizes that the presence of potentially liquefiable soils typically warrants a Site Class F designation; however, as presented in section 20.3.1.1, projects with structures that possess a fundamental period of vibration equal to or less than 0.5 seconds (which is assumed to apply to the proposed structures) do not require a site response analysis. As such, a site class determination in accordance with Section 20.3 and the corresponding values of F_a and F_v is permitted.

Based on the data collected at the SCPT location, in accordance with the designation criteria provided in Table 20.1-1 of ASCE 7-16, Site Class E should be used for the subject site and project. This determination is based on the calculated averaged shear wave velocity of 552 ft/sec for the upper 100 feet.

Further discussion between the project structural engineer and ESNW may be prudent to determine appropriate earthquake design parameters for the project. ESNW can provide additional consulting services to aid with design efforts, including supplementary geotechnical and geophysical investigation, upon request. ESNW can assist in determining appropriate seismic design coefficients during the appropriate phase of the project.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed structures should be supported by competent, firm, and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill before slab construction. A capillary break consisting of at least four inches of free-draining crushed rock or gravel should be placed below each slab. The free-draining material should have a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, the installation of a vapor barrier below the slab should be considered. Vapor barriers should be made from material specifically designed for use as a vapor barrier and should be installed in accordance with the manufacturer's recommendations.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for the design:

- Active earth pressure (unrestrained condition) — 40 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 60 pcf
- Traffic surcharge* (passenger vehicles) — 70 psf (rectangular distribution)
- Passive earth pressure — 225 pcf (equivalent fluid)
- Coefficient of friction — 0.35
- Seismic surcharge — 8H psf†

* *Where applicable.*
† *Where H equals the retained height (in feet).*

The above passive pressure and friction values include a factor-of-safety of 1.5 and are based on a level backfill condition and level grade at the wall toe. The design parameters provided above assume native soil will be retained behind the wall. If a sufficient thick zone of structural fill is retained by the wall (with respect to vertical and lateral extent), less stringent design parameters can be provided. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along with the height of the wall and to a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of less permeable soil, if desired. A sheet drain may be considered instead of free-draining backfill. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. Hydrostatic pressures should be included in the wall design if drainage is not provided.

Drainage

Zones of perched groundwater seepage could develop in site excavations depending on the time of year grading operations take place, particularly within deeper excavations for utilities and/or the stormwater facility. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during preliminary grading to both identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Feasibility

From a geotechnical standpoint, infiltration is generally considered infeasible for the subject project areas. The variability of the encountered alluvial soils and relatively shallow exposure of the local groundwater table were the primary bases for this opinion. Shallow LID designs may be considered where surficial exposures of sandy soils are present and where vertical offsets from the groundwater table can be successfully achieved. ESNW would be pleased to assist in further evaluating LID infiltration feasibility at the appropriate phase of site design.

Utility Support and Trench Backfill

In our opinion, the native soil will generally be suitable for the support of utilities. Remedial measures will very likely be necessary for some areas to provide support for utilities, such as overexcavation and replacement with structural fill and/or placement of geotextile fabric. Groundwater may be encountered within utility excavations, and caving of trench walls may occur where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering or temporary trench shoring may be necessary during utility excavation and installation.

The on-site soil is not considered suitable for use as structural backfill throughout the utility trench excavations unless the soil is at (or slightly above) the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soil may be necessary at some locations before use as structural fill. Each section of the utility lines must be adequately supported by the bedding material. Utility trench backfill should be placed and compacted to the structural fill specifications previously detailed in this report or to the applicable specifications of the presiding jurisdiction.

LIMITATIONS

This study has been prepared for the exclusive use of the Washington State Fair and its representatives. The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. No warranty, express or implied, is made. Variations in the soil and groundwater conditions observed at the test locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

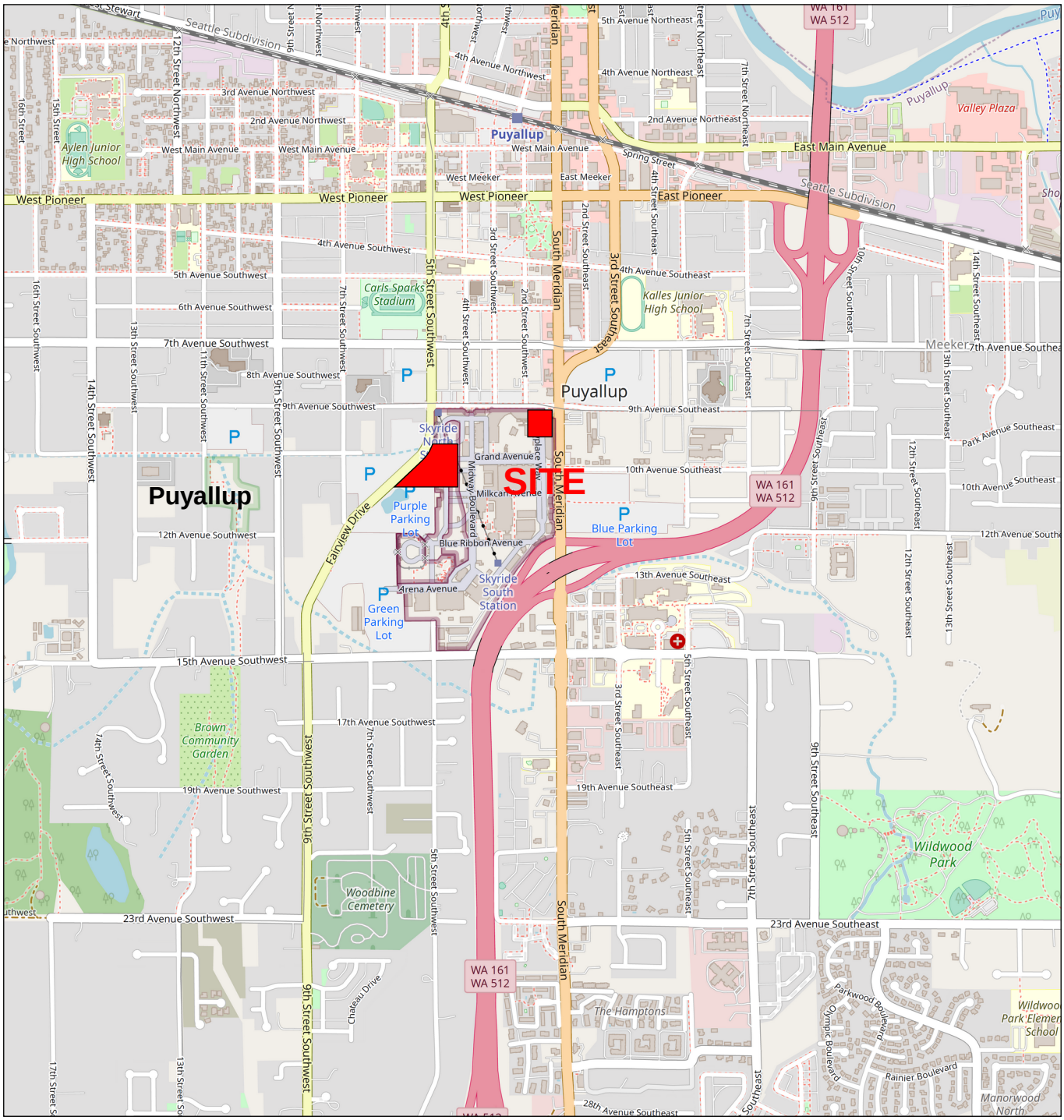
Additional Services

ESNW should have an opportunity to review the final project plans concerning the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.

REFERENCES

The following documents and maps were reviewed as part of the preparation of this study:

- Site Plan, prepared by JMJ Team, Figure 1, dated January 31, 2017
- Web Soil Survey, maintained by the Natural Resources Conservation Service under the United States Department of Agriculture
- Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington, compiled by J. Eric Schuster et al., November 2015
- Chapter 21.06, Article XII of the Puyallup Municipal Code



Reference:
Pierce County, Washington
OpenStreetMap.org

NORTH

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

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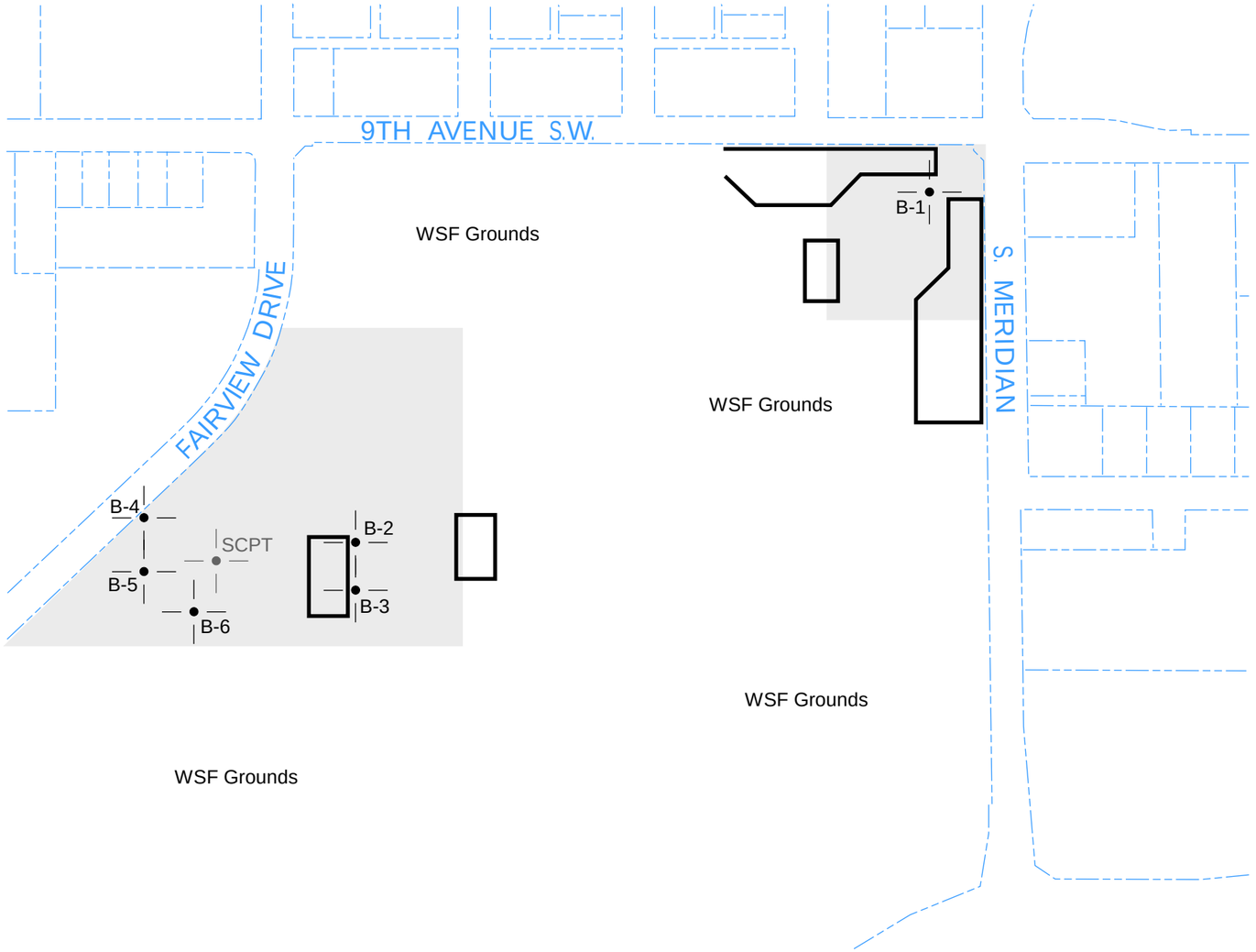
Vicinity Map
Washington State Fair
Puyallup, Washington

Drawn MRS	Date 06/29/2023	Proj. No. 9092
Checked CGH	Date June 2023	Plate 1



LEGEND

B-1 — Approximate Location of ESNW Boring, Proj. No. ES-9092, May 2023

Subject Site

Existing Building

NORTH

NOT - TO - SCALE

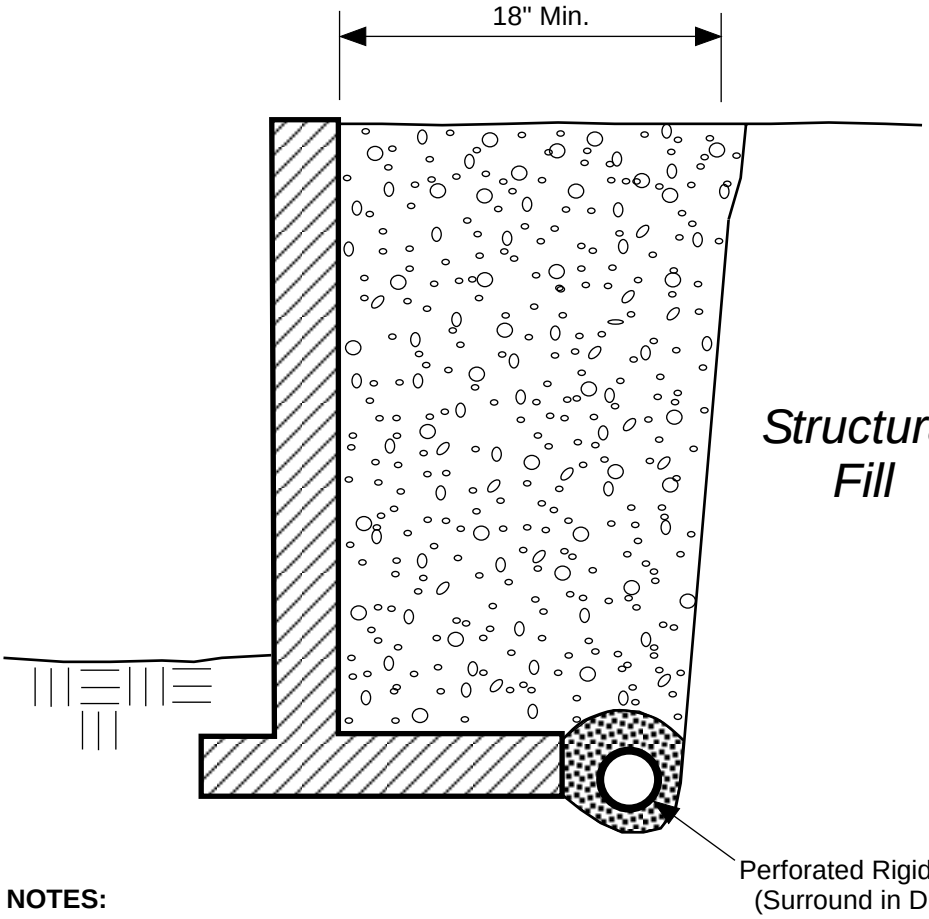
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Boring Location Plan
Washington State Fair
Puyallup, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drawn	MRS
Checked	CGH
Date	01/10/2024
Proj. No.	9092
Plate	2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Free-draining Structural Backfill

1-inch Drain Rock

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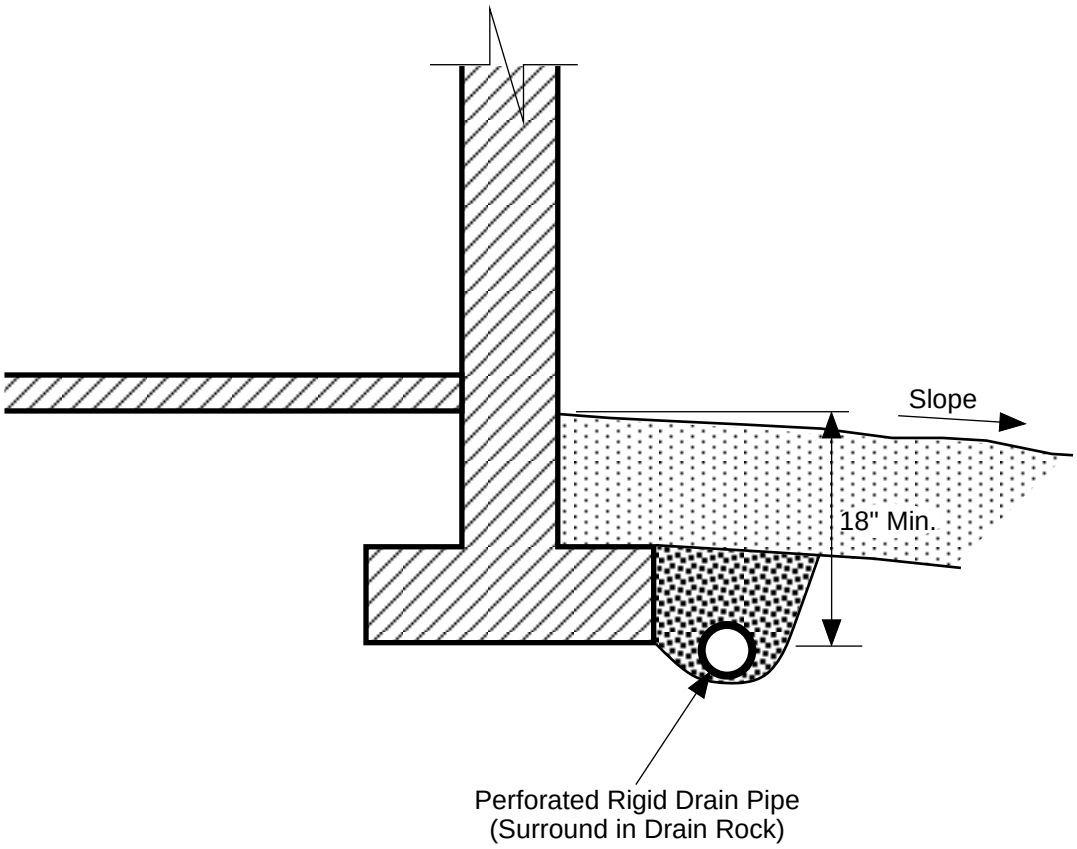
Retaining Wall Drainage Detail
Washington State Fair
Puyallup, Washington

Drawn CAM	Date 07/18/2023	Proj. No. 9092
Checked CGH	Date July 2023	Plate 3



NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Surface Seal: native soil or other low-permeability material.

1-inch Drain Rock

Earth Solutions NW LLC
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Footing Drain Detail
Washington State Fair
Puyallup, Washington

Drawn CAM	Date 07/18/2023	Proj. No. 9092
Checked CGH	Date July 2023	Plate 4

Appendix A

Subsurface Exploration Logs

ES-9092

Subsurface conditions at the subject site were explored on May 22 and 23, 2023. Six soil borings and one SCPT were advanced using exploratory equipment and operators retained by ESNW. The approximate locations of the explorations are illustrated on Plate 2 of this study. The boring logs and associated SCPT charts are provided in this Appendix. The explorations were advanced to depths of about 11.5 to 100 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve	Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve	< 5% Fines	GW	Well-graded gravel with or without sand, little to no fines
			GP	Poorly graded gravel with or without sand, little to no fines
		> 12% Fines	GM	Silty gravel with or without sand
			GC	Clayey gravel with or without sand
	Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve	< 5% Fines	SW	Well-graded sand with or without gravel, little to no fines
			SP	Poorly graded sand with or without gravel, little to no fines
		> 12% Fines	SM	Silty sand with or without gravel
			SC	Clayey sand with or without gravel
Fine-Grained Soils - 50% or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less Than 50		ML	Silt with or without sand or gravel; sandy or gravelly silt
			CL	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt
			CH	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils
Fill			FILL	Made Ground

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

Damp - Perceptible moisture, likely below optimum MC

Moist - Damp but no visible water, likely at/near optimum MC

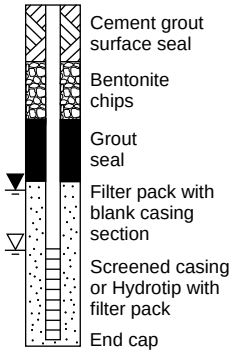
Wet - Water visible but not free draining, likely above optimum MC

Saturated/Water Bearing - Visible free water, typically below groundwater table

Symbols

ATD = At time of drilling

Static water level (date)



Terms Describing Relative Density and Consistency

Coarse-Grained Soils:

Density	SPT blows/foot
Very Loose	< 4
Loose	4 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	≥ 50

Fine-Grained Soils:

Consistency	SPT blows/foot
Very Soft	< 2
Soft	2 to 3
Medium Stiff	4 to 7
Stiff	8 to 14
Very Stiff	15 to 29
Hard	≥ 30

Test Symbols & Units

Fines = Fines Content (%)

MC = Moisture Content (%)

DD = Dry Density (pcf)

Str = Shear Strength (tsf)

PID = Photoionization Detector (ppm)

OC = Organic Content (%)

CEC = Cation Exchange Capacity (meq/100 g)

LL = Liquid Limit (%)

PL = Plastic Limit (%)

PI = Plasticity Index (%)

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

Modifier Definitions

Percentage by Weight (Approx.)	Modifier
< 5	Trace (sand, silt, clay, gravel)
5 to 14	Slightly (sandy, silty, clayey, gravelly)
15 to 29	Sandy, silty, clayey, gravelly
≥ 30	Very (sandy, silty, clayey, gravelly)

Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

EXPLORATION LOG KEY

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Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-499-4711

BORING NUMBER B-1

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18413 **LONGITUDE** -122.29411

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Asphalt 1"- 2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					GM		Brown silty GRAVEL with sand, loose, wet
	SS	100	3-4-4 (8)	MC = 26.5			
5							-becomes moist
	SS	33	9-4-3 (7)	MC = 11.5 Fines = 28.7			[USDA Classification: very gravelly LOAM]
							7.5 ▽
	SS	67	3-2-4 (6)	MC = 31.7	ML		Brown sandy SILT, loose, water bearing
10							-groundwater table
							10.0
	SS	100	2-2-3 (5)	MC = 28.1	SP		Gray poorly graded SAND, loose, water bearing
15							
	SS	100	3-4-5 (9)	MC = 20.0			-becomes black
							-heave
20							20.0

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BORING NUMBER B-1

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18413 **LONGITUDE** -122.29411

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Asphalt 1"- 2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	100	3-1-5 (6)	MC = 19.7	SP		Black poorly graded SAND, loose, water bearing
						21.5	-heave

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 7.5 feet during excavation. Boring backfilled with bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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BORING NUMBER B-2

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18243 **LONGITUDE** -122.29838

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Asphalt ~2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					GP-GM		Brown poorly graded GRAVEL with silt and sand, very loose, moist (Fill)
	SS	33	7-2-2 (4)	MC = 18.3			3.0 Brown sandy SILT, very loose, moist to wet
5							
	SS	33	6-4-6 (10)	MC = 26.9 Fines = 57.9			-becomes medium dense, wet to saturated [USDA Classification: silghtly gravelly LOAM]
							▽ -groundwater table
	SS	100	3-2-4 (6)	MC = 30.3			-becomes gray, loose, water bearing
10							
	SS	100	3-2-2 (4)	MC = 26.2	ML		-becomes very loose
15							
	SS	100	4-3-2 (5)	MC = 27.4			-becomes loose
20							20.0

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BORING NUMBER B-2

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18243 **LONGITUDE** -122.29838

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Asphalt ~2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	67	4-5-12 (17)	MC = 28.1	SM		Brown silty SAND, medium dense, water bearing -organic/wood debris (tree stump?) -exaggerated blow counts
25	SS	33	13-23-34 (57)				-wood debris in sampler
							26.5

Boring terminated at 26.5 feet below existing grade due to refusal on obstruction. Groundwater table encountered at 7.5 feet during drilling. Boring backfilled with bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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BORING NUMBER B-3

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18219 **LONGITUDE** -122.29837

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 10 ft

SURFACE CONDITIONS Asphalt ~2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					GP-GM		Brown poorly graded GRAVEL with silt and sand, loose, moist (Fill)
						1.0	
					SM		Brown silty SAND, loose, moist
5						5.0	
	SS	67	2-2-3 (5)	MC = 25.3	SP-SM		Brown poorly graded SAND with silt, loose, wet
10						10.0 ▽	
	SS	100	2-2-4 (6)	MC = 30.9 Fines = 82.7	ML		Gray SILT with sand, loose, water bearing -groundwater table [USDA Classification: LOAM]
15							
	SS	100	3-2-4 (6)	MC = 33.4			
20						20.0	

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BORING NUMBER B-3

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18219 **LONGITUDE** -122.29837

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 10 ft

SURFACE CONDITIONS Asphalt ~2" **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	3-1-3 (4)	MC = 36.1	ML		Brown sandy SILT, very loose, water bearing
25							25.0
	SS	100	2-3-4 (7)	MC = 33.8	SP		Black poorly graded SAND, loose, water bearing -layered silty sand -trace organics/wood fragments
30	SS	67	2-9-10 (19)	MC = 26.2			-becomes medium dense (exaggerated blow counts due to heave) -6" silty sand lens
							31.5

Boring terminated at 31.5 feet below existing grade. Groundwater table encountered at 10.0 feet during drilling. Boring backfilled with bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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BORING NUMBER B-4

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18254 **LONGITUDE** -122.29994

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Grass **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					ML		Brown sandy SILT, very loose, moist
	SS	0	2-2-2 (4)				-no recovery
5							-moderate perched groundwater seepage -becomes wet [USDA Classification: slightly gravelly LOAM]
	SS	67	2-2-2 (4)	MC = 34.1 Fines = 60.3			
	SS	100	3-3-3 (6)	MC = 33.1			▽ -groundwater table -becomes loose, water bearing
10							
	SS	100	2-2-4 (6)	MC = 42.5			-4" to 6" silt lens
15							15.0
	SS	100	6-6-7 (13)	MC = 29.1	SP		Black poorly graded SAND, medium dense, water bearing
20							

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BORING NUMBER B-4

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18254 **LONGITUDE** -122.29994

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Grass **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	67	5-5-6 (11)	MC = 15.1	SP		Black poorly graded SAND, medium dense, water bearing *(continued)* -organic/wood fragments
21.5							

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 7.5 feet and groundwater seepage encountered at 5.0 feet during drilling. Boring backfilled with bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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BORING NUMBER B-5

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/22/23 **COMPLETED** 5/22/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18224 **LONGITUDE** -122.29989

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 7.5 ft

SURFACE CONDITIONS Grass **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Brown sily SAND, loose, moist
	SS	17	2-2-3 (5)	MC = 32.4			
5							
	SS	67	3-3-3 (6)	MC = 28.0	SM		-becomes gray, wet
							▽ -groundwater table, becomes water bearing
	SS	100	4-4-4 (8)	MC = 30.2			-heterogeneous color, gray to brown
10							
	SS	100	3-3-4 (7)	MC = 33.3			
							11.5

Boring terminated at 11.5 feet below existing grade. Groundwater table encountered at 7.5 feet during drilling. Boring backfilled with soil cuttings/bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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BORING NUMBER B-6

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/23/23 **COMPLETED** 5/23/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18208 **LONGITUDE** -122.29957

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 5 ft

SURFACE CONDITIONS Grass **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0							Brown silty SAND, loose, moist
	SS	33	8-4-4 (8)	MC = 10.1	SM		
5							▽ -becomes very loose, water bearing -groundwater table
	SS	100	2-2-1 (3)	MC = 32.9			
							7.5
	SS	100	2-2-3 (5)	MC = 27.5	SP-SM		Dark gray poorly graded SAND with silt, loose, water bearing
10							10.0
	SS	100	3-1-2 (3)	MC = 32.8	SM		Gray silty SAND, very loose, water bearing
							-becomes loose
15							
	SS	100	3-4-3 (7)	MC = 30.4			-layered sections of poorly graded sand and silty sand
20							20.0

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BORING NUMBER B-6

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair

DATE STARTED 5/23/23 **COMPLETED** 5/23/23 **GROUND ELEVATION**

DRILLING CONTRACTOR Geologic Drill Partners **LATITUDE** 47.18208 **LONGITUDE** -122.29957

LOGGED BY CGH **CHECKED BY** KDH **GROUND WATER LEVEL:**

NOTES ▽ **AT TIME OF DRILLING** 5 ft

SURFACE CONDITIONS Grass **AFTER DRILLING**

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20							
	SS	100	2-3-2 (5)	MC = 28.7	SM		Dark gray silty SAND, loose, water bearing -6" sand lens
21.5							

Boring terminated at 21.5 feet below existing grade. Groundwater table encountered at 5.0 feet during drilling. Boring backfilled with bentonite.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

Appendix B

Laboratory Test Results

ES-9092

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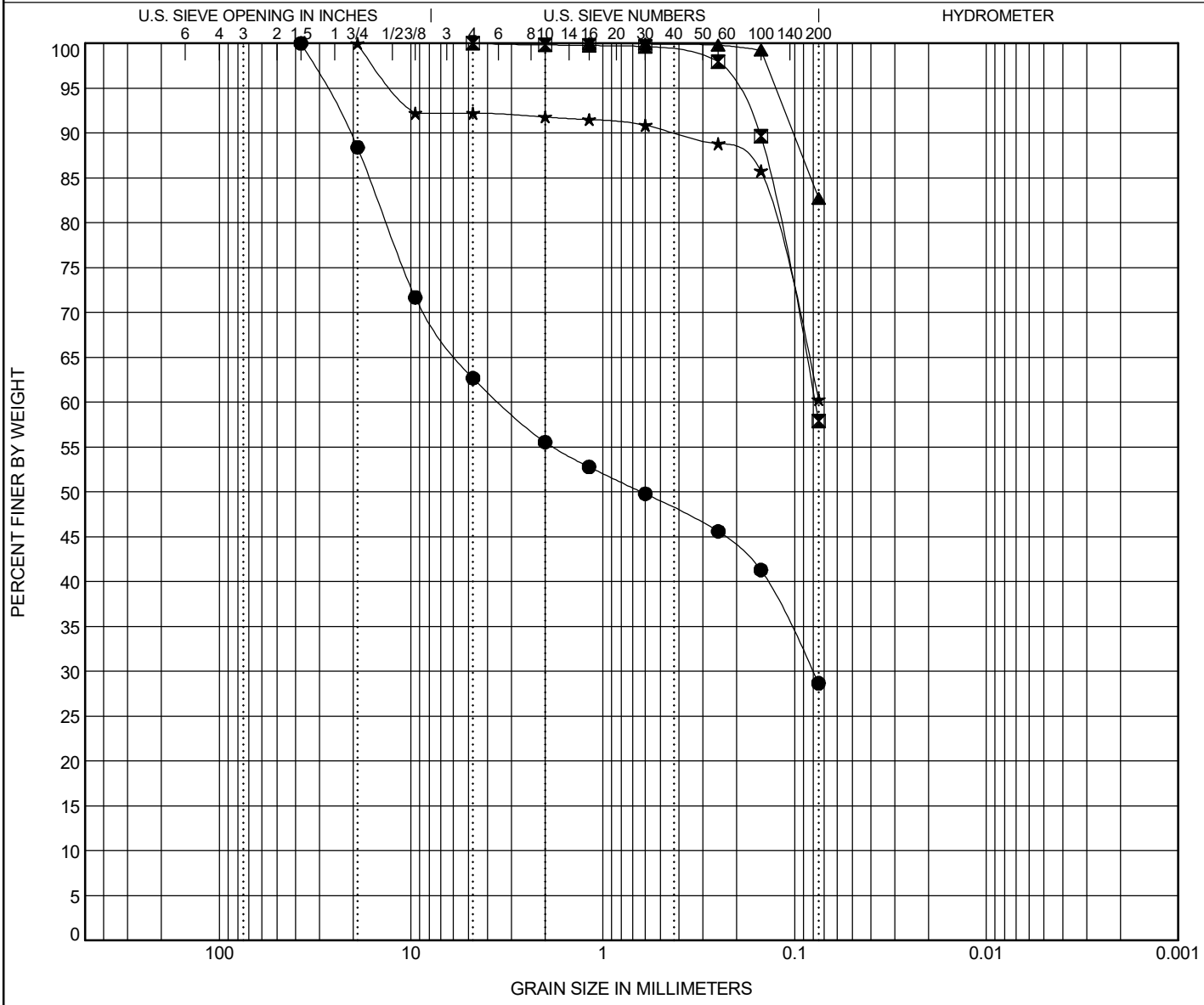
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-9092 **PROJECT NAME** Washington State Fair



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	B-01	5.00ft.	USDA: Brown Very Gravelly Loam. USCS: GM with Sand.		
⊠	B-02	5.00ft.	USDA: Brown Slightly Gravelly Loam. USCS: Sandy ML.		
▲	B-03	10.00ft.	USDA: Gray Loam. USCS: ML with Sand.		
★	B-04	5.00ft.	USDA: Brown Slightly Gravelly Loam. USCS: Sandy ML.		

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	B-01	5.0ft.	37.5	3.429	0.081					28.7	
⊠	B-02	5.0ft.	4.75	0.079						57.9	
▲	B-03	10.0ft.	1.18							82.7	
★	B-04	5.0ft.	19							60.3	