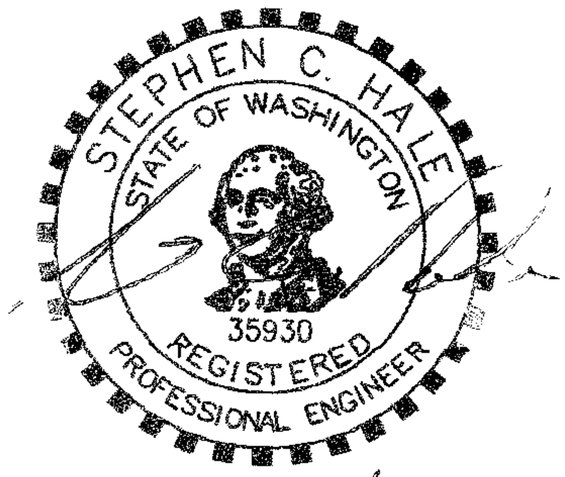
PRELIMINARY STORMWATER REPORT

Project Name:	Haley Short Plat
Case File:	PA18-38
Description:	a 2-lot short plat of boundary line adjusted lot 1 of Short Plat Book 3, Page 253
Site Location:	4550 SE 5th Avenue, Camas, WA 98607
Parcel Number:	127155000
Engineer:	Hale Development Services Stephen C. Hale, PE/PLS 204 E 45th St. Vancouver, WA 98663 Ph: 360-291-2603 Email: stephenchale@me.com
Property Owner:	Dale E & Leta Anderson Trustee 4420 SW 5th Ave Camas, WA 98607



2/26/19

Report by: Stephen C. Hale, PE, PLS
Date: February 2019

Engineers Statement of Completeness and Feasibility

Stephen C. Hale, PE/PLS, project engineer, states that to the best of his professional knowledge and abilities that all information required by the City of Camas Municipal Code is included in the preliminary plan set and includes a stormwater plan, and that the proposed stormwater facilities are feasible.

Stephen C. Hale, PE. PLS.
Phone: 360-921-2603 ● stephenchale@me.com

TABLE OF CONTENTS

Report:

Stephen C. Hale, PE. PLS.
Phone: 360-921-2603 ● stephenchale@me.com

A. PROJECT OVERVIEW

Existing Conditions

This 2-lot short plat is a portion of adjust (BLA) lot 1 of Short Plat Bk. 3, Pg. 253, located at 5500 SW 5th Avenue, Camas, WA. The northern boundary of the site is bounded by the southerly right-of-way line of S, P. & S. Railroad, and the southerly boundary is the Mean High-Water Mark of the Columbia River.

The existing vegetative cover is predominately maintained lawn and some deciduous trees that are to remain. The site slopes from north to south at ±20% along the northerly 1/3 of the site and is mostly flat (±2%) within the middle portion, and then slopes down ±25% to the top bank of the Columbia river. Refer to the existing conditions plan for additional information. The southerly ±35' of the parcel is within the 100-year floodplain and the entire site presently drains to the Columbia River. The Columbia River is a flow control exempt waterbody as Referenced in SWMMWW, Flow Control Exempt Surface Waters, Appendix I-E (page 133).

Project Description

The project's storm drainage measures have been designed, in conformance to CMC 14.02 Stormwater Control. Preliminary stormwater plan (sheet 5) shows the contributing basin boundary for the proposed driveway for lot 1. A bioretention planter is proposed for treatment of the runoff from the proposed driveway. A roof drain lateral is to be supplied as shown on the stormwater plan, with an outfall rip rap pad and flow spreader to be installed approximately 6 feet from top bank of the river.

B. MINIMUM REQUIREMENTS

The land disturbing activities are to include installation of a driveway and a residential home on lot 1. There are no improvements proposed for lot 2. The lot 1 preliminary proposal estimates that the new lot could generate as much as 8,500 square feet (sf) of total impervious pollution generating surfaces, 5,200 sf of possible residential building area and 3,300 sf of driveway (impervious). The estimated total impervious area for lot 1 is greater than 5,000 sf, triggering the water quality requirements. The stormwater requirements for water quantity (detention) are not triggered because this project drains into a flow control exempt waterbody, the Columbia River. The proposed project is to meet the runoff treatment (water quality) by utilizing a bioretention planter to treat the runoff from the driveway and a portion of the paved existing private access road. The project will create more than 5,000 square feet of impervious surfaces and must comply with Minimum Requirements #1 through #9 for the new hard surfaces and the converted vegetated areas.

	Description	Area (Sq. Ft)
1	Existing impervious surface	0
2	Possible New impervious surface	*±8,500
3	Replaced impervious surface	0
4	Native vegetation converted to lawn or landscaping	0
5	Land disturbing activity	±13,600

*includes estimate of 5,200 sf per residential building area & 3,300 for the driveway

Minimum Requirement #1: Preparation of Stormwater Site Plans:
Stormwater plan is part of the preliminary plan set included in this submittal – completed

Minimum Requirement #2: Construction Stormwater Pollution Prevention Plan (SWPPP): SWPPP required with final permit submittal. See SWPPP Elements below

1. Preserve Vegetation/Mark Clearing Limits:

a. Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.

b. Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practicable.

2. Establish Construction Access:

a. Limit construction vehicle access and exit to one route, if possible.

b. Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking of sediment onto public roads.

c. Locate wheel wash or tire baths on-site, if the stabilized constructions entrance is not effective in preventing tracking sediment onto roads.

d. If sediment is tracked off site, clean the affected roadways thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.

e. Conduct street washing only after sediment is removed in accordance with 2.d, above.

f. Control street wash wastewater by pumping back on-site, or otherwise prevent it from discharging into systems tributary to waters of the State.

3. Control Flow Rates:

a. Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.

b. Where necessary to comply with 3.a, above, construct stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g., impervious surfaces).

c. If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

4. Install Sediment Controls:

a. Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.

b. Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.

c. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.

d. Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP but must meet the flow control performance standard in 3.a, above.

e. Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.

f. Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

5. Stabilize Soils:

a. Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base early on areas to be paved, and dust control.

b. Control stormwater volume and velocity within the site to minimize soil erosion.

c. Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.

d. Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:

- During the dry season (May 1 – September 30): 7 days
- During the wet season (October 1 – April 30): 2 days

e. Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.

f. Stabilize soil stockpiles from erosion, protect with sediment trapping measures, and where possible, locate away from storm drain inlets, waterways and drainage channels.

g. Minimize the amount of soil exposed during construction activity.

h. Minimize the disturbance of steep slopes.

i. Minimize soil compaction and, unless infeasible, preserve topsoil.

6. Protect Slopes:

a. Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).

b. Divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.

c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.

- Temporary pipe slope drains must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year 1- hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

d. Place excavated material on the uphill side of trenches, consistent with safety and space considerations.

e. Place check dams at regular intervals within constructed channels that are cut down a slope.

7. Protect Drain Inlets:

a. Protect storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

b. Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

8. Stabilize Channels and Outlets:

a. Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:

- Channels must handle the peak volumetric flow rate calculated using a 10- minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

b. Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

9. Control Pollutants:

a. Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.

b. Handle and dispose all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.

c. Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double- walled tanks do not require additional secondary containment.

d. Conduct maintenance, fueling and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.

e. Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.

f. Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.

g. Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated

from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.

h. Adjust the pH of stormwater if necessary to prevent violations of water quality standards.

i. Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.

j. Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust PH.

10. Control De-Watering:

a. Discharge foundation, vault, and trench de-watering water, which have similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.

b. Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in 8, above, provided the de-watering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.

c. Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.

d. Other treatment or disposal options may include:

(i) Infiltration

(ii) Transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.

(iii) Ecology-approved on-site chemical treatment or other suitable treatment technologies.

(iv) Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.

(v) Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.

11. Maintain BMPs:

a. Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.

b. Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

12. Manage the Project:

a. Phase development projects to the maximum degree practicable and take into account seasonal work limitations.

b. Inspection and monitoring – Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function.

c. Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.

d. Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present on-site or on-call at all times.

13. Protect Low Impact Development BMPs

a. Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.

b. Prevent compacting Bioretention and Rain Garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.

c. Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.

d. Pavements fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures from the local stormwater manual or the manufacturer's procedures.

e. Keep all heavy equipment off existing soils under LID BMPs that have been excavated to final grade to retain the infiltration rate of the soils.

Minimum Requirement #3: Source Control of Pollution:
Project is installing a bioretention planter and is to be protected form any sediment laden runoff. All disturbed and/or exposed soils are to be stabilized prior to installing or completing the full soil & gravel section of the planter.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls:
There are no existing natural drainage systems on this project. Existing flows infiltrate naturally or flow to southerly into the Columbia River. Maintain as much of the existing lawn (±30 feet) as a natural buffer between the edge of construction (home building) and the river bank.

Minimum Requirement #5: On-site Stormwater Management:

Stephen C. Hale, PE. PLS.
Phone: 360-921-2603 ● stephenchale@me.com

Refer to the stormwater plan sheet 5 for all on-site stormwater management

Minimum Requirement #6: Runoff Treatment:
The PGHS = ±8,500 sq. ft. > 5,000
The PGPS = ±11,000 sq. ft. = 0.25 Acres < ¾
Acres - Stormwater treatment facility
REQUIRED

Minimum Requirement #7: Flow Control:
N/A – Site drains directly to a flow control exempt waterbody, the Columbia River

Minimum Requirement #8: Wetlands Protection:
N/A no stormwater discharges to wetlands.

Minimum Requirement #9: Operation and Maintenance:
See content worksheet below that is to be followed to complete the O&M Manual

Project name: Project Number:

Applicant Use	Item Description	Staff Use
OPERATIONS & MAINTENANCE MANUAL		
☐	Narrative for operations and management of the site including description of stormwater system and receiving waters for runoff that leaves site	☐
☐	Itemized list of stormwater facilities and components found on site (quantity of catch basins, pipe, treatment vaults, ponds, etc.)	☐
☐	Project site map including access for maintenance and location of facilities including native soil and vegetation protection areas	☐
☐	Specify the ownership of the proposed facilities and clearly indicate long-term maintenance responsibility	☐
☐	Funding guidelines for maintenance including planning for higher costs during plant establishment, media filter replacements and facility life expectancy. Estimate costs for average routine maintenance, eventual replacement and how best practices like street sweeping and catch basin cleaning can reduce costs.	☐
☐	Inspection checklists for specific facilities on the site using Ecology's *Western Washington LID O&M Guidance* or *Stormwater Manual* Vol V	☐
☐	Special instruction or attachments for emerging technology or proprietary ("brand-name") systems	☐
☐	Flow dispersion areas delineated with locations of easements or separate tracts.	☐

☐	Disposal guidance on sediments removed from stormwater facilities including relevant materials anticipated to be handled on site, indicators of contaminants and proper disposal.	☐
☐	Log forms including dates, components inspected or maintained, waste disposal and proprietary system reports	☐

WATER RESOURCE PROTECTION (POLLUTION SOURCE CONTROL PROGRAM)

	Minimum standards	
☐	Precautions to prevent accidental releases	☐
☐	Hazardous materials management protective of human health and the environment	☐
☐	Leaks and spills containment, proper cleanup and notification to the City of Vancouver	☐
☐	Oil/water separator inspection, cleaning and maintenance according to guidance in *Stormwater Manual*	☐
☐	Pesticide and Fertilizer Management application and management according to guidance in *Stormwater Manual*	☐
☐	Decommissioning water wells in accordance with WAC 173-160-381	☐
☐	Operation closure shall include removal and proper disposal of all hazardous materials	☐
☐	Mobile washing and pressure cleaning shall be performed according to guidance in *Stormwater Manual.* Wastewater from such operations shall be captured and directed to an approved discharge location.	☐

C. PRELIMINARY SOILS EVALUATION

The site soils are mapped as 3 to 8 percent slope Newberg Silt Loam, mapped as Nobbs. These soil well drained and permeability is generally moderate to rapid. The available water capacity is high and surface runoff is very slow, and there is no erosion hazard.

D. SOURCE CONTROL

All development activities shall apply the Minimum Standards of VMC 14.26.120 as follows

A. Operational Best Management Practices (BMPs): All operations shall adopt the following best management practices to ensure their operations minimize potential risks to water resources.

- Precautions: The owner/operator shall take precautions to prevent accidental releases of hazardous materials. Hazardous materials shall be separated and prevented from entering Stormwater Drainage Systems, septic systems, and drywells.

- Hazardous Materials Management: Hazardous materials shall be managed so that they do not threaten human health or the environment or enter water resources.

- Hazardous Material Releases: All hazardous materials that have been released shall be contained and abated immediately, and the hazardous materials recycled or disposed of properly. The City shall be notified of any release of hazardous materials that clearly impact water resources, as soon as possible but no later than 24 hours after the release. The Stormwater Manual provides applicable operational BMPs for spills of oils and hazardous substances.

- Oil/Water Separators: Oil/water separators shall be inspected, cleaned and maintained as stipulated in the Stormwater Manual. The City may allow an operation to modify the regularity of cleanouts if the operation can demonstrate to the City's satisfaction that the separator operates effectively at less frequent cleaning intervals.

- Pesticide and Fertilizer Management. All pesticides, herbicides, fungicides and fertilizers shall be applied and managed according to the applicable BMPs for landscaping and lawn/vegetation management in the Stormwater Manual, VMC 20.760 Shoreline Management Area, and VMC 20.740 Critical Areas Protection.

- Stormwater Treatment Systems: Stormwater drainage systems and treatment facilities, including, but not limited to, catch basins, wetponds and vaults, biofilters, settling basins, bioretention, pervious pavements, and infiltration systems, shall be cleaned and maintained by the responsible party designated in VMC 14.25.209 according to the applicable operational BMPs for the maintenance of stormwater, drainage and treatment systems in the Stormwater Manual.

E. ON-SITE STORMWATER MANAGEMENT BMPs

It is proposed to install a bioretention planter to treat the proposed driveway. A construction entrance, and sediment fencing is proposed to be installed with home building. The planter and roof drain will both outfall to a rip rap line spreader basin installed with a 10' long 2"x 12" cedar flow spreader ±6' the river bank. 30' of grass buffer is to remain between the home site and the river bank.

F. RUNOFF TREATMENT ANALYSIS AND DESIGN

Refer to the WWHM2012 analysis report attached
indicating that the facility treats 99.95 percent of the

runoff from the driveway and meets the treatment requirements.

G. FLOW CONTROL ANALYSIS AND DESIGN

N/A – Site runoff flows directly to a flow control exempt waterbody

H. WETLAND PROTECTION

N/A no wetland is within or near the boundaries of this site

I. OTHER PERMITS

N/A No other permits required.

J. CONVEYANCE SYSTEM ANALYISIS AND DESIGN

All conveyance pipes meet City design requirements.

K. SPECIAL REPORTS AND STUDIES

N/A. No other reports are included

L. MAINTENANCE AND OPERATIONS MANUAL

See content worksheet on page 6 that is to be followed to complete the O&M Manual

WWHM2012

PROJECT REPORT

HALEY SHORT PLAT
PRELIMINARY STORMWATER REPORT

02/19/2019

General Model Information

Project Name:	Haley SP-Preliminary Storm
Site Name:	Haley Short Plat
Site Address:	4550 SE 5th Ave
City:	Camas
Report Date:	2/19/2019
Gage:	Troutdale
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	1.370
Version Date:	2018/03/02
Version:	4.2.14

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

Existing Basin Condition

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG2, Lawn, Steep	0.279
Pervious Total	0.279

Impervious Land Use	acre
ROADS FLAT	0.033
Impervious Total	0.033
Basin Total	0.312

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Developed Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
SG2, Lawn, Steep	0.235
Pervious Total	0.235

Impervious Land Use	acre
ROADS FLAT	0.033
DRIVEWAYS STEEP	0.044
Impervious Total	0.077
Basin Total	0.312

Element Flows To:

Surface	Interflow	Groundwater
Surface ion Planterl	Surface ion Planterl	

Routing Elements
Predeveloped Routing

Bioretention Planterl Mitigated

Facility Name Bioretention Planterl

	Outlet 1	Outlet 2	Outlet 3
Downstream Connection	0	0	0

☐ **Use simple Bioretention** | Quick Swale | Size Water Quality | Size Facility

☑ **Underdrain Used**

Underdrain Diameter(ft) 0.5 **Offset(in)**

Orifice Diameter(in) 0.5 0

Bioretention Bottom Elevation 0

Bioretention Dimensions

Bioretention Length (ft)	20.000
Bioretention Bottom Width (ft)	6.000
Freeboard (ft)	0.500
Over-road Flooding (ft)	0.000
Effective Total Depth (ft)	3
Bottom slope of bioretention.(0-1)	0.000

Flow Through Underdrain (ac-ft)	9.427
Total Outflow (ac-ft)	26.05
Percent Through Underdrain	36.19
WQ Percent Filtered	99.41

Facility Dimension Diagram

☐ **Sidewall Invert Location.**

Front and Back side slope (H/V)	4.000
Left Side Slope (H/V)	4.000
Right Side Slope (H/V)	4.000

Riser Outlet Structure

Outlet Structure Data

Riser Height Above bioretention surface (ft) 0.5

Riser Diameter (in) 12

Riser Type Flat

Material Layers for

	Layer 1	Layer 2	Layer 3
Depth (ft)	1.500	0.500	0.000
Soil Layer 1	SMMWW 12 in/hr		
Soil Layer 2	GRAVEL		
Soil Layer 3	GRAVEL		

Edit Soil Types

KSat Safety Factor: ○ None ◉ 2 ○ 4

Orifice Number	Diameter (in)	Height (ft)
1	0	0
2	0	0
3	0	0

Bioretention Volume at Riser Head (ac-ft) .032

Show Bioretention Open Table

Native Infiltration Yes

Measured Infiltration Rate (in/hr)	0.6
Reduction Factor (infilt*factor)	1
Use Wetted Surface Area (sidewalls)	Yes
Total Inflow ac-ft	26.69

Total Volume Infiltrated (ac-ft)	16.47
Total Volume Through Riser (ac-ft)	0.153
Total Volume Through Facility(ac-ft)	26.05
Percent Infiltrated	63.22
Precipitation on Facility (acre-ft)	1.049
Evaporation from Facility (acre-ft)	0.64

Mitigated Routing

Bioretention Planterl

Bottom Length:	20.00 ft.
Bottom Width:	6.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	0.5
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Infiltration On	
Infiltration rate:	0.6
Infiltration safety factor:	1
Wetted surface area On	
Total Volume Infiltrated (ac-ft.):	16.47
Total Volume Through Riser (ac-ft.):	0.153
Total Volume Through Facility (ac-ft.):	26.05
Percent Infiltrated:	63.22
Total Precip Applied to Facility:	1.049
Total Evap From Facility:	0.64
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	0.5
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	9.427
Total Outflow (ac-ft.):	26.05
Percent Through Underdrain:	36.19
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Element Flows To:	
Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0182	0.0000	0.0000	0.0000
0.0330	0.0179	0.0000	0.0000	0.0000
0.0659	0.0176	0.0001	0.0000	0.0000
0.0989	0.0173	0.0001	0.0000	0.0000
0.1319	0.0169	0.0002	0.0001	0.0004
0.1648	0.0166	0.0002	0.0003	0.0009
0.1978	0.0162	0.0003	0.0009	0.0016
0.2308	0.0159	0.0004	0.0013	0.0021
0.2637	0.0156	0.0004	0.0018	0.0025
0.2967	0.0153	0.0005	0.0020	0.0026
0.3297	0.0149	0.0005	0.0022	0.0027
0.3626	0.0146	0.0006	0.0024	0.0028
0.3956	0.0143	0.0007	0.0025	0.0029
0.4286	0.0140	0.0008	0.0027	0.0031
0.4615	0.0137	0.0008	0.0028	0.0032
0.4945	0.0134	0.0009	0.0029	0.0033
0.5275	0.0131	0.0010	0.0031	0.0034
0.5604	0.0128	0.0011	0.0032	0.0036
0.5934	0.0125	0.0012	0.0033	0.0037

0.6264	0.0122	0.0013	0.0034	0.0038
0.6593	0.0119	0.0014	0.0035	0.0040
0.6923	0.0116	0.0015	0.0037	0.0041
0.7253	0.0113	0.0016	0.0038	0.0042
0.7582	0.0110	0.0017	0.0039	0.0044
0.7912	0.0108	0.0018	0.0040	0.0045
0.8242	0.0105	0.0019	0.0041	0.0047
0.8571	0.0102	0.0020	0.0042	0.0048
0.8901	0.0100	0.0021	0.0043	0.0049
0.9231	0.0097	0.0023	0.0044	0.0051
0.9560	0.0094	0.0024	0.0044	0.0052
0.9890	0.0092	0.0025	0.0045	0.0054
1.0220	0.0089	0.0027	0.0046	0.0055
1.0549	0.0087	0.0028	0.0048	0.0057
1.0879	0.0084	0.0030	0.0049	0.0059
1.1209	0.0082	0.0031	0.0050	0.0060
1.1538	0.0079	0.0033	0.0051	0.0062
1.1868	0.0077	0.0034	0.0052	0.0063
1.2198	0.0075	0.0036	0.0052	0.0065
1.2527	0.0072	0.0037	0.0053	0.0067
1.2857	0.0070	0.0039	0.0054	0.0069
1.3187	0.0068	0.0041	0.0054	0.0070
1.3516	0.0065	0.0043	0.0055	0.0072
1.3846	0.0063	0.0044	0.0056	0.0074
1.4176	0.0061	0.0046	0.0056	0.0075
1.4505	0.0059	0.0048	0.0057	0.0077
1.4835	0.0057	0.0050	0.0058	0.0079
1.5165	0.0055	0.0052	0.0058	0.0081
1.5495	0.0053	0.0054	0.0059	0.0083
1.5824	0.0051	0.0056	0.0060	0.0085
1.6154	0.0049	0.0058	0.0060	0.0087
1.6484	0.0047	0.0059	0.0061	0.0088
1.6813	0.0045	0.0062	0.0062	0.0090
1.7143	0.0043	0.0064	0.0062	0.0092
1.7473	0.0041	0.0066	0.0063	0.0094
1.7802	0.0039	0.0068	0.0063	0.0096
1.8132	0.0038	0.0070	0.0064	0.0098
1.8462	0.0036	0.0072	0.0065	0.0100
1.8791	0.0034	0.0075	0.0065	0.0102
1.9121	0.0032	0.0077	0.0066	0.0104
1.9451	0.0031	0.0079	0.0066	0.0106
1.9780	0.0029	0.0082	0.0067	0.0109
2.0000	0.0028	0.0083	0.0067	0.0110

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
2.0000	0.0182	0.0083	0.0000	0.2292	0.0002
2.0330	0.0185	0.0089	0.0000	0.2292	0.0004
2.0659	0.0189	0.0096	0.0000	0.2386	0.0006
2.0989	0.0192	0.0102	0.0000	0.2483	0.0009
2.1319	0.0196	0.0108	0.0000	0.2582	0.0011
2.1648	0.0200	0.0115	0.0000	0.2683	0.0013
2.1978	0.0203	0.0121	0.0000	0.2787	0.0015
2.2308	0.0207	0.0128	0.0000	0.2893	0.0018
2.2637	0.0211	0.0135	0.0000	0.3001	0.0020
2.2967	0.0215	0.0142	0.0000	0.3112	0.0022
2.3297	0.0219	0.0149	0.0000	0.3225	0.0025
2.3626	0.0222	0.0157	0.0000	0.3341	0.0027

2.3956	0.0226	0.0164	0.0000	0.3460	0.0029
2.4286	0.0230	0.0171	0.0000	0.3581	0.0032
2.4615	0.0234	0.0179	0.0000	0.3704	0.0034
2.4945	0.0238	0.0187	0.0000	0.3831	0.0036
2.5275	0.0242	0.0195	0.0483	0.3959	0.0039
2.5604	0.0246	0.0203	0.1574	0.4091	0.0041
2.5934	0.0250	0.0211	0.3014	0.4225	0.0044
2.6264	0.0254	0.0219	0.4712	0.4362	0.0046
2.6593	0.0258	0.0228	0.6597	0.4502	0.0049
2.6923	0.0263	0.0236	0.8600	0.4644	0.0051
2.7253	0.0267	0.0245	1.0650	0.4789	0.0054
2.7582	0.0271	0.0254	1.2676	0.4937	0.0057
2.7912	0.0275	0.0263	1.4606	0.5088	0.0059
2.8242	0.0280	0.0272	1.6378	0.5242	0.0062
2.8571	0.0284	0.0281	1.7939	0.5398	0.0064
2.8901	0.0288	0.0291	1.9255	0.5558	0.0067
2.9231	0.0293	0.0300	2.0318	0.5720	0.0070
2.9560	0.0297	0.0310	2.1153	0.5886	0.0072
2.9890	0.0302	0.0320	2.1826	0.6054	0.0073
3.0000	0.0303	0.0323	2.2755	0.6111	0.0000

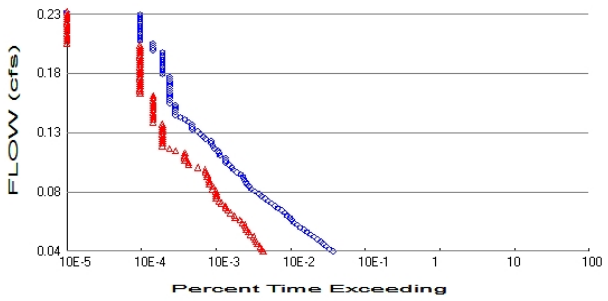
Surface ion Planterl

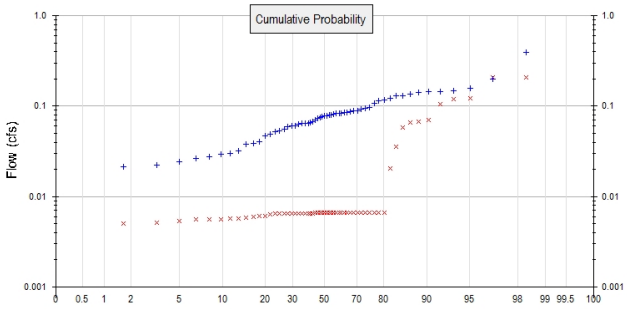
Element Flows To:

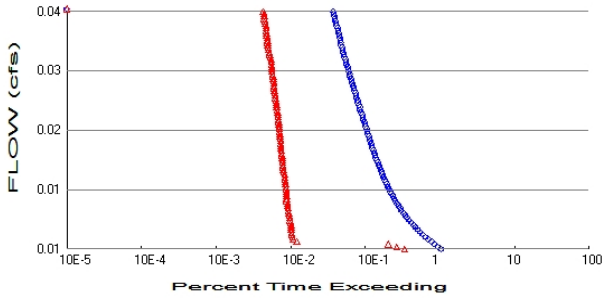
Outlet 1	Outlet 2
	Bioretention Planterl

Analysis Results

POC 1







\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.279
Total Impervious Area: 0.033

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.235
Total Impervious Area: 0.077

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.071365
5 year	0.11692
10 year	0.150504
25 year	0.196191
50 year	0.232309
100 year	0.270036

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.008749
5 year	0.022508
10 year	0.040068
25 year	0.07913
50 year	0.127439
100 year	0.200647

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.055	0.007
1950	0.054	0.007
1951	0.086	0.007
1952	0.117	0.007
1953	0.080	0.007
1954	0.087	0.007
1955	0.065	0.006
1956	0.144	0.121
1957	0.067	0.007
1958	0.066	0.007
1959	0.047	0.005
1960	0.038	0.006
1961	0.079	0.035
1962	0.061	0.007
1963	0.075	0.007
1964	0.090	0.007
1965	0.083	0.007
1966	0.086	0.007
1967	0.060	0.007
1968	0.092	0.007
1969	0.084	0.007
1970	0.398	0.208
1971	0.039	0.006
1972	0.053	0.007
1973	0.081	0.007
1974	0.122	0.104
1975	0.080	0.007
1976	0.145	0.007
1977	0.021	0.005
1978	0.098	0.071
1979	0.074	0.007
1980	0.065	0.006
1981	0.114	0.066
1982	0.108	0.058
1983	0.136	0.007
1984	0.090	0.007
1985	0.070	0.007
1986	0.029	0.006
1987	0.076	0.007
1988	0.026	0.006
1989	0.024	0.006
1990	0.032	0.006
1991	0.060	0.007
1992	0.049	0.006
1993	0.157	0.007
1994	0.065	0.007
1995	0.041	0.021
1996	0.201	0.207
1997	0.148	0.119
1998	0.130	0.007
1999	0.063	0.007
2000	0.030	0.005
2001	0.019	0.005
2002	0.142	0.007
2003	0.095	0.007
2004	0.028	0.006

2005	0.022	0.006
2006	0.131	0.007
2007	0.079	0.067
2008	0.083	0.006

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3979	0.2084
2	0.2010	0.2075
3	0.1574	0.1212
4	0.1480	0.1194
5	0.1453	0.1043
6	0.1439	0.0710
7	0.1422	0.0670
8	0.1361	0.0660
9	0.1310	0.0580
10	0.1300	0.0354
11	0.1219	0.0206
12	0.1170	0.0067
13	0.1144	0.0067
14	0.1075	0.0067
15	0.0975	0.0067
16	0.0949	0.0067
17	0.0925	0.0067
18	0.0896	0.0066
19	0.0895	0.0066
20	0.0869	0.0066
21	0.0859	0.0066
22	0.0857	0.0066
23	0.0839	0.0066
24	0.0835	0.0066
25	0.0829	0.0066
26	0.0813	0.0066
27	0.0804	0.0066
28	0.0797	0.0066
29	0.0788	0.0066
30	0.0786	0.0066
31	0.0762	0.0066
32	0.0754	0.0066
33	0.0741	0.0066
34	0.0698	0.0066
35	0.0667	0.0066
36	0.0664	0.0065
37	0.0650	0.0065
38	0.0649	0.0065
39	0.0648	0.0065
40	0.0631	0.0065
41	0.0611	0.0065
42	0.0601	0.0065
43	0.0598	0.0065
44	0.0552	0.0065
45	0.0536	0.0065
46	0.0525	0.0065
47	0.0493	0.0064
48	0.0468	0.0061
49	0.0406	0.0061
50	0.0391	0.0059

51	0.0378	0.0059
52	0.0320	0.0057
53	0.0300	0.0057
54	0.0294	0.0056
55	0.0275	0.0056
56	0.0265	0.0056
57	0.0242	0.0054
58	0.0223	0.0052
59	0.0214	0.0050
60	0.0191	0.0049

LID Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0057	21670	7027	32	Pass
0.0060	19562	5512	28	Pass
0.0063	17723	4281	24	Pass
0.0066	16094	252	1	Pass
0.0069	14674	226	1	Pass
0.0072	13467	223	1	Pass
0.0075	12385	217	1	Pass
0.0078	11481	216	1	Pass
0.0081	10587	214	2	Pass
0.0084	9869	214	2	Pass
0.0087	9240	212	2	Pass
0.0090	8634	211	2	Pass
0.0093	8117	206	2	Pass
0.0096	7629	203	2	Pass
0.0099	7204	200	2	Pass
0.0103	6810	198	2	Pass
0.0106	6444	195	3	Pass
0.0109	6128	194	3	Pass
0.0112	5836	190	3	Pass
0.0115	5539	189	3	Pass
0.0118	5295	186	3	Pass
0.0121	5089	186	3	Pass
0.0124	4904	185	3	Pass
0.0127	4708	184	3	Pass
0.0130	4532	184	4	Pass
0.0133	4376	183	4	Pass
0.0136	4220	181	4	Pass
0.0139	4081	180	4	Pass
0.0142	3949	177	4	Pass
0.0145	3825	176	4	Pass
0.0148	3682	175	4	Pass
0.0151	3585	174	4	Pass
0.0154	3473	170	4	Pass
0.0157	3368	168	4	Pass
0.0160	3274	166	5	Pass
0.0163	3173	165	5	Pass
0.0166	3086	164	5	Pass
0.0169	2994	164	5	Pass
0.0172	2908	162	5	Pass
0.0175	2836	161	5	Pass
0.0178	2769	158	5	Pass
0.0181	2684	157	5	Pass
0.0184	2630	154	5	Pass
0.0187	2567	154	5	Pass
0.0190	2487	154	6	Pass
0.0193	2432	154	6	Pass
0.0196	2379	153	6	Pass
0.0199	2333	151	6	Pass
0.0202	2281	150	6	Pass
0.0205	2228	149	6	Pass
0.0208	2192	148	6	Pass
0.0211	2133	147	6	Pass
0.0215	2084	146	7	Pass

0.0218	2027	145	7	Pass
0.0221	1979	144	7	Pass
0.0224	1933	142	7	Pass
0.0227	1892	142	7	Pass
0.0230	1837	140	7	Pass
0.0233	1800	137	7	Pass
0.0236	1761	136	7	Pass
0.0239	1714	136	7	Pass
0.0242	1677	135	8	Pass
0.0245	1643	133	8	Pass
0.0248	1612	131	8	Pass
0.0251	1580	130	8	Pass
0.0254	1540	128	8	Pass
0.0257	1508	127	8	Pass
0.0260	1473	126	8	Pass
0.0263	1436	125	8	Pass
0.0266	1406	125	8	Pass
0.0269	1375	124	9	Pass
0.0272	1340	123	9	Pass
0.0275	1318	122	9	Pass
0.0278	1292	119	9	Pass
0.0281	1268	117	9	Pass
0.0284	1242	117	9	Pass
0.0287	1212	117	9	Pass
0.0290	1182	116	9	Pass
0.0293	1159	116	10	Pass
0.0296	1137	116	10	Pass
0.0299	1106	112	10	Pass
0.0302	1080	110	10	Pass
0.0305	1057	109	10	Pass
0.0308	1042	106	10	Pass
0.0311	1015	104	10	Pass
0.0314	998	103	10	Pass
0.0317	983	103	10	Pass
0.0320	968	103	10	Pass
0.0324	954	102	10	Pass
0.0327	937	100	10	Pass
0.0330	919	99	10	Pass
0.0333	906	98	10	Pass
0.0336	883	98	11	Pass
0.0339	866	98	11	Pass
0.0342	848	95	11	Pass
0.0345	829	95	11	Pass
0.0348	814	93	11	Pass
0.0351	802	93	11	Pass
0.0354	790	92	11	Pass
0.0357	780	90	11	Pass

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0357	780	90	11	Pass
0.0377	692	86	12	Pass
0.0397	632	82	12	Pass
0.0416	576	75	13	Pass
0.0436	526	72	13	Pass
0.0456	476	70	14	Pass
0.0476	430	67	15	Pass
0.0496	390	60	15	Pass
0.0516	346	57	16	Pass
0.0536	317	53	16	Pass
0.0555	282	52	18	Pass
0.0575	257	51	19	Pass
0.0595	231	47	20	Pass
0.0615	216	44	20	Pass
0.0635	205	38	18	Pass
0.0655	186	37	19	Pass
0.0675	174	33	18	Pass
0.0694	160	30	18	Pass
0.0714	141	28	19	Pass
0.0734	128	28	21	Pass
0.0754	115	25	21	Pass
0.0774	105	23	21	Pass
0.0794	95	21	22	Pass
0.0814	85	21	24	Pass
0.0833	79	21	26	Pass
0.0853	70	21	30	Pass
0.0873	63	19	30	Pass
0.0893	58	19	32	Pass
0.0913	55	17	30	Pass
0.0933	53	17	32	Pass
0.0953	50	17	34	Pass
0.0973	48	16	33	Pass
0.0992	45	16	35	Pass
0.1012	40	15	37	Pass
0.1032	36	15	41	Pass
0.1052	34	12	35	Pass
0.1072	31	9	29	Pass
0.1092	28	9	32	Pass
0.1112	28	8	28	Pass
0.1131	28	8	28	Pass
0.1151	24	8	33	Pass
0.1171	23	8	34	Pass
0.1191	22	6	27	Pass
0.1211	20	5	25	Pass
0.1231	19	4	21	Pass
0.1251	18	4	22	Pass
0.1270	18	4	22	Pass
0.1290	15	4	26	Pass
0.1310	14	4	28	Pass
0.1330	13	4	30	Pass
0.1350	12	4	33	Pass
0.1370	10	4	40	Pass
0.1390	10	4	40	Pass

0.1409	10	4	40	Pass
0.1429	9	3	33	Pass
0.1449	8	3	37	Pass
0.1469	7	3	42	Pass
0.1489	6	3	50	Pass
0.1509	6	3	50	Pass
0.1529	6	3	50	Pass
0.1549	6	3	50	Pass
0.1568	6	3	50	Pass
0.1588	5	3	60	Pass
0.1608	5	3	60	Pass
0.1628	5	3	60	Pass
0.1648	5	3	60	Pass
0.1668	5	2	40	Pass
0.1688	5	2	40	Pass
0.1707	5	2	40	Pass
0.1727	5	2	40	Pass
0.1747	5	2	40	Pass
0.1767	5	2	40	Pass
0.1787	5	2	40	Pass
0.1807	5	2	40	Pass
0.1827	4	2	50	Pass
0.1846	4	2	50	Pass
0.1866	4	2	50	Pass
0.1886	4	2	50	Pass
0.1906	4	2	50	Pass
0.1926	4	2	50	Pass
0.1946	4	2	50	Pass
0.1966	4	2	50	Pass
0.1985	4	2	50	Pass
0.2005	4	2	50	Pass
0.2025	3	2	66	Pass
0.2045	3	2	66	Pass
0.2065	3	2	66	Pass
0.2085	3	0	0	Pass
0.2105	2	0	0	Pass
0.2124	2	0	0	Pass
0.2144	2	0	0	Pass
0.2164	2	0	0	Pass
0.2184	2	0	0	Pass
0.2204	2	0	0	Pass
0.2224	2	0	0	Pass
0.2244	2	0	0	Pass
0.2264	2	0	0	Pass
0.2283	2	0	0	Pass
0.2303	2	0	0	Pass
0.2323	2	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.0096 acre-feet
On-line facility target flow:	0.006 cfs.
Adjusted for 15 min:	0.006 cfs.
Off-line facility target flow:	0.0038 cfs.
Adjusted for 15 min:	0.0038 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
ion Planterl POC	☑	23.70	26.05	16.47	☐	63.23	25.90	99.41	Treat. Credit
Total Volume Infiltrated		23.70	26.05	16.47		63.23	25.90	26 / 26 = 99%	Treat. Credit = 99%
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

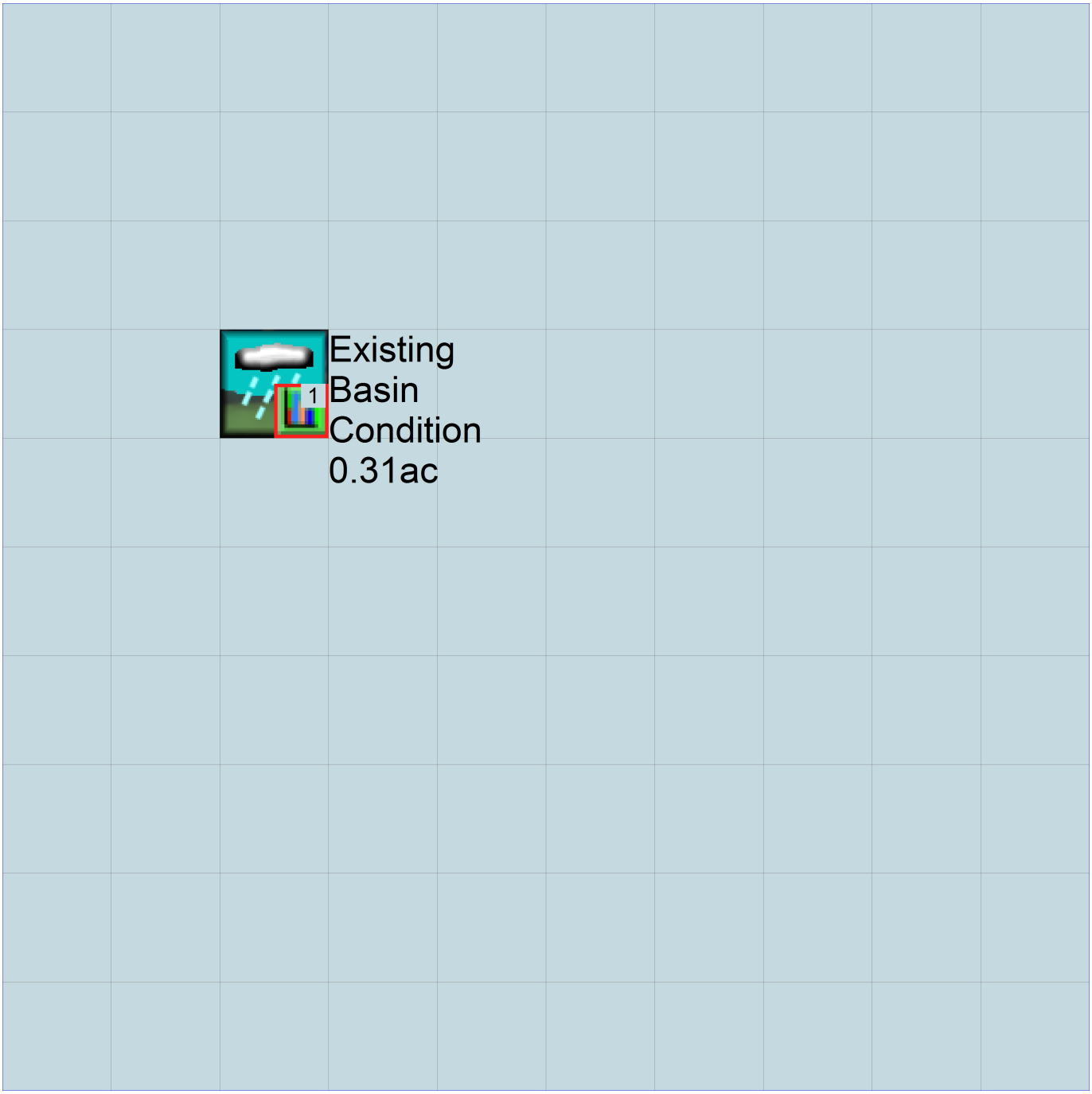
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic