Drainage Report for:

Grandview North LLC – Zahradnik

February 2023

5-22-23

KIMBERLY E. BUSTEED
STATE OF WASHINGTON
20100400
REGISTERED
PROFESSIONAL ENGINEER

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#22867

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Executive Summary

The property is located in the City of Arlington at the northwest quadrant of the intersection of SR 9 and SR 531. The proposal is to construct a multi-use development onsite. There will be mixed used buildings, apartment buildings, townhomes, and additional commercial use building sites. The project will implement a design to meet the minimum requirements as outlined below:

Compliance with Minimum Requirements:

1	*Prepare Stormwater Site Plan*	A stormwater site plan report and drawings are presented in this document.
2	*SWPPP*	A separate SWPPP report is submitted with this document.
3	*Water Pollution Source Control*	BMPs for source control will be noted in the SWPPP.
4	*Preserve Natural Drainage*	The proposed drainage basins match the existing drainage basins as much as possible.
5	*On-site Stormwater Management*	All stormwater runoff from the proposed development will be collected and detained.
6	*Runoff Treatment*	Runoff treatment for the proposed parking lot areas will be provided through Contech stormfilters.
7	*Flow Control*	Flow control for the proposed development will be met using a detention system.
8	*Stormwater Discharge to Wetland*	No stormwater will discharge to wetlands.
9	*Inspection, Operation and Maintenance*	Operation & Maintenance Manual is provided in the appendix.

Vicinity Map

PROPERTY DESCRIPTION

The project site is in a portion of Section 24, Township 31 North, Range 05 East W.M. More specifically the site is located at the northeast quadrant of the intersection of 172nd St NE and 85th Ave NE Arlington WA 98223. The property is identified by tax parcel #31052400302000 as shown below in Figure 1, highlighted in blue.

Not to scale (Source PDS Mapper) **Figure 1: Vicinity Map.**

DRAINAGE INFORMATION SUMMARY FORM

Project Total Area: **16.80± acres**

Area of Disturbance: **11.92± acres**

Number of Lots (if applies): N/A

Summary Table

Drainage Basin Information	**Individual Basin Information**
	A
On-site Sub-basin Area (acres)	11.92
Type of Storage Proposed	N/A
Appx. Dead Storage Vol (cf)	N/A
Appx. Live Storage Vol (cf)	N/A
Soil Type(s) (Natural Resource Conservation Service)	Tokul Gravelly Medial Loam
Pre-developed Discharge Rates	
Q (cfs.)	
2 yr.	0.4214
10 yr.	0.8428
50 yr./100 yr.	1.3530/1.6157
Redevelopment Area (acres)	
Post-development Runoff Rates (without quantity controls)	
Q (cfs.)	
2 yr.	1.0048
10 yr.	1.6195
50 yr./100 yr.	2.2647/2.5720
Post-development Runoff Rates (with quantity controls)	
Q (cfs.)	
2 yr.	0.2570
10 yr.	0.4294
50 yr./100 yr.	0.6344/0.7393
Offsite Upstream Area	
Number of acres	0

MR #1 Stormwater Site Plan Narrative

PROJECT DESCRIPTION

The proposal is to construct a multi-use development onsite. There will be two mixed use buildings, four apartment buildings, 23 townhomes, and three sites for commercial use. A parking area for 553 outside spaces, 23 garage spaces, drive aisles, sidewalks, landscaping, and open space will be constructed as part of the project. Access will be provided to the site through the existing driveway entrance on 172nd St NE and at two proposed driveway entrances on 85th Ave NE at the existing intersections of 84th Ave NE and 175th St NE. A traffic circle is proposed at the site entrance on 85th Ave NE at 84th Ave NE. The site is currently has thick brush throughout the property with four wetlands onsite.

METHODOLOGY

Drainage calculations for the on-site area have been prepared using the 2019 Department of Ecology Stormwater Management Manual for Western Washington (DOE SMMWW). The proposed impervious surface will be approximately 381,013 sq ft, the development will be required to meet minimum requirements (MRs) 1-9 according to Volume I of the Department of Ecology Stormwater Management Manual for Western Washington (DOE SMMWW).

EXISTING CONDITIONS

The 16.80 acre parcel is in the general commercial with mixed use overlay zoning district in Arlington. The site is bounded by 85th Ave NE to the west, single family residences to the north, 172nd St NE to the south and State Highway Route 9 to the east. There is an existing driveway entrance located on 172nd St NE. Existing frontage improvements in the form of curb, gutter, sidewalk, and landscaping are located along 172nd St NE and 85th Ave NE.

There are two threshold discharge basins (TBDs) located onsite (See Appendix A).
TBD A is located in the south and west of the property and will contain the proposed development. TBD A slopes to the southwest corner of the site with elevations ranging from 396 feet to 422 feet. TBD A contains two category II wetlands (A, B). The U.S. Army Corps of Engineers determined these wetlands are not waters of the U.S. TBD A consists primarily of scrub-shrub type vegetation with some moderate slopes across it.
TBD B is located in the northeast portion of the property and is mostly comprised of two category II wetlands (C, D). TBD B is relatively flat, gently sloping towards the two wetlands; which outlet to the ditch on the west side of SR9 in the northeast corner of the property. Elevations range from 408 feet to 422 feet. TBD B is heavily forested and will remain largely undisturbed.

A geotechnical engineering report was prepared by Materials Testing and Consulting, Inc. (See separate report). They excavated 15 test pits across the site. Their test pits found a 0.5 to 1 ft topsoil layer, above a layer of silty sand subsoil to a maximum depth of 2.3 feet. Weathered glacial till was encountered below this with unweathered glacial till encountered in all test pits between 3 to 4 feet deep. Groundwater was not encountered in any of the test pits. Washington

Department Ecology Well Log Viewer indicates a regional water table in the recessional outwash to be at a depth of 144 to 169 BGS in the vicinity of the site.

According to NRCS the soils onsite are classified as Tokul Gravelly Medial Loam. (Appendix B). Tokul Gravelly Medial Loam is moderately deep, moderately well drained soil. surface layer is dark brown gravelly loam about 4 inches thick. The subsoil is brown, strong brown, and dark yellowish brown gravelly loam about 18 inches thick. The substratum is light olive brown gravelly fine sandy loam about 9 inches thick. A hardpan is at a depth of about 31 inches. Depth to the hardpan ranges from 20 to 40 inches. Tokul Gravelly Medial Loam is considered a hydraulic soil group B soil. Wetlands are located onsite and the geotechnical engineer recommends an infiltration rate of 0.76 in/hr for shallow facilities.

DEVELOPED CONDITIONS

The proposal is to construct a multi-use development onsite. There will be two 3-story mixed used buildings with commercial on the ground floor and residential units on the upper floors, four 3-story apartment buildings, 23 townhomes, and building site for 3 additional commercial lots. This will result in 51,500 sf of commercial space and a total of 334 residential units. A parking area for 553 outside spaces, 23 garage spaces, drive aisles, sidewalks, landscaping, and open space will be constructed as part of the project. Frontage improvements will be required in the form of a traffic circle located at the intersection of 85th Ave NE and 84th Ave NE and a traffic light installation at the intersection of 172nd St NE and 85th Ave NE. See Table 1 below for the breakdown of areas onsite.

Table 1: Proposed Onsite Surfaces

Area Description	Area (square feet)
Roof Area	140,749 sq ft
Asphalt Parking/Drive	206,954 sq ft
Concrete Sidewalk	33,310 sq ft
Landscaping & Pervious Open Space	138,428 sq ft
Total	**519,441 sq ft**

UPSTREAM ANALYSIS

The site is bounded by roads with existing stormwater infrastructure and developed single family residences with installed mitigation measures so no runoff is anticipated to discharge onto the developed site.

DOWNSTREAM ANALYSIS

The proposed development will occur within TBD A of the drainage basin map. TBD A sheet flows toward the west property line where it then enters several catch basins located in 85th Ave NE. The runoff is conveyed through a series of catch basins to a pond located on 175th St Ne. This pond then discharges to the creek to the west of the pond that flows north into Tex Lake

more than a 1/4 mile offsite. A small portion of the property along the south property line may sheet flow onto 172nd St NE and flow into the existing catch basins where it is conveyed to the creek previously discussed creek that flows into Tex Lake.
TBD B contains the onsite wetlands C, and D located in the northeast portion of the property. Runoff will flow into these wetlands and the outlets discharge to the roadside ditch along SR 9 where it will cross under SR9 through a culvert and then flows north parallel to SR 9 in a fish habit stream for more than 1/4 mile offsite.

FLOW CONTROL

Flow control has been met through multiple detention systems utilizing Stormtank modules. Specifics about the proposed detention systems are further discussed in MR 7.

RUNOFF TREATMENT

Runoff treatment will be provided though Contech Stormfilter cartridges located either in a vault post-detention or in catch basins pre-detention.

MR #2 Stormwater Pollution Prevention Plan Narrative

SWPP Report is submitted independent to this report.

MR #3 Water Pollution Source Control

No known pollution generating activities described in volume IV, chapters 3 and 4 of the DOE SMMWW will be performed on-site during construction, or are proposed for the developed site following construction. Any sources of pollution that may result from the construction activity will be controlled according to SWPPP Element #9, Control Pollutants.

MR #4 Preservation of Natural Drainage Patterns

The sites existing threshold discharge basins will be maintained as much as possible.

MR #5 On-Site Stormwater Management

The parcel is located within the City of Arlington Urban Growth Area. Minimum Requirement #5 requires projects within an UGA to either implement LID BMPs from List #2 or meet LID performance standard and flow control requirements. The project will analyze LID BMP's from List #2 for their feasibility.

- Roof Surface:
  - BMP T5.30 full dispersion or BMP T5.10A Downspout Full Infiltration
    - The developed basin does not have sufficient flowpath to implement full dispersion and the natural drainage patterns do not allow the developed basin to disperse towards the northern basin containing the wetland.
    - Geotechnical report determined the site was infeasible for infiltration.
    - INFEASIBLE
  - BMP T7.30 Bioretention
    - Geotechnical report determined the site was infeasible for infiltration.
    - INFEASIBLE
  - BMP T5.10B Downspout Dispersion Systems
    - Unable to meet minimum required flow path due to the developed conditions of the site. The wetland buffer with potential for dispersion is in a different threshold discharge basin.
    - INFEASIBLE
  - BMP T5.10C Perforated Stub-Out Connections
    - Geotechnical report determined the site was infeasible for infiltration.

        - INFEASIBLE
- Other Hard Surfaces:
    - BMP T5.30 full dispersion
        - The developed basin does not have sufficient flowpath to implement full dispersion and the natural drainage patterns do not allow the developed basin to disperse towards the northern basin containing the wetland.
        - INFEASIBLE
    - BMP T5.15 Permeable pavement
        - The applicant has concerns about the lifespan of these and does not want to use them.
        - INFEASIBLE
    - BMP T7.30 Bioretention
        - Geotechnical report determined the site was infeasible for infiltration.
        - INFEASIBLE
    - BMP T5.12 Sheet Flow Dispersion or BMP T5.11 Concentrated Flow Dispersion
        - Unable to meet minimum required flow path due to the developed conditions of the site. The wetland buffer with potential for dispersion is in a different threshold discharge basin.
        - INFEASIBLE

Conclusion
It has been determined that all BMPs listed under List #2 are infeasible for this project. A detention system utilizing "StormTank" modules is proposed to meet flow control requirements and comply with MR#5. Refer to MR 7 Flow Control for more information on the Stormtank detention system proposed.

BMP T5.13 Post Construction Soil Quality and Depth:
Post Construction Soil Quality and Depth will be used on site to recondition those areas that were impacted due to construction activities. Those areas to be reconditioned have been identified on the construction plans. The existing on-site topsoil will be stockpiled for use to meet the post construction soil standard. If the quantity or quality of the stockpiled on-site topsoil is insufficient, the soil amendment areas can be tilled, and compost added to the soil prior to final seeding. The intent of this BMP is to restore the pre-developed drainage characteristics of the soil. The specific requirements for the post construction soil quality and depth will be detailed on the construction plans.

MR #6 Runoff Treatment

Runoff treatment for the proposed pollution generating hard surfaces will be provided through Contech Stormfilter systems. A Stormfilter Vault will be located downstream of Vault B and will treat runoff from the drainage basins of Vault A and Vault B. The remaining pollution generating hard surfaces will implement stormfilter catch basins to treat runoff prior to entering the detention system. The location and number of Stormfilters required are shown on the construction plans.

MR #7 Flow Control

Stormtank Detention System

The runoff from the developed area will be mitigated through a detention system consisting of Stormtank modules.

There are four Stormtank detention vaults located on the property. Vaults A,B, and C will be a stepped detention system with a control structure separating each system. Vault C will discharge to the existing catch basin located on 85th Ave NE. These vaults will mitigate for the majority of the site except the area south of future building 2A and future lot 4. Vault D will detain runoff from the access road south of future building 2A. Vault E will mitigate for the future lot 4 improvements and will be constructed when lot 4 improvements are constructed. Vaults D, and E will discharge runoff to the existing catch basin on 85th Ave NE. The size of detention systems were determined by modelling the systems as vaults with the riser height equal to the height of installed modules to determine the required capacity and outlet structure in WWHM (Appendix D). The outlet is located at the base of the module and the top of the riser is located at the top of the module. The 0.5 ft levelling pad beneath the modules with 40% porosity will be the "dead storage" and the 1 ft of stone above the modules with 40% porosity will be the freeboard. The required capacity at the top of riser was used to size the StormTank system. The size and configuration of modules are shown on the plans. A cross section can be seen in Figure 2 below.

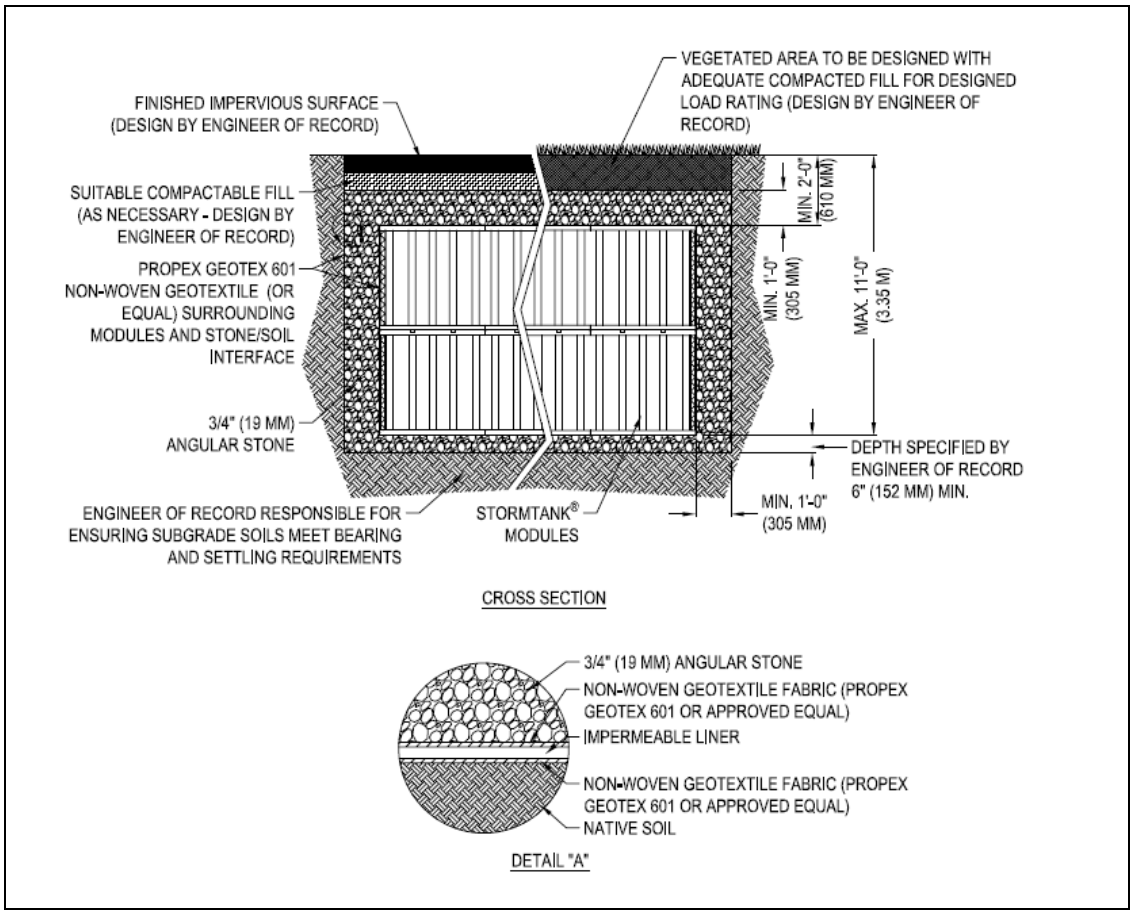


Figure 2: StormTank Detail

MR #8 Wetland Protection

There are four wetlands on site (A,B,C,D) as identified in the Critical Area Study and Mitigation Plan prepared by Wetland Resources (See separate report). Wetlands A and B are located within the proposed developed area. The U.S. Army Corps of Engineers determined that wetlands A and B are not waters of the U.S. There is an agreement between the applicant and City of Arlington to mitigate for these two wetlands offsite. Wetlands C and D will be outside of the proposed development area Due to the drainage patterns and proposed grading, no runoff is anticipated to disperse towards the wetlands.

MR #9 Operations & Maintenance

An operation and maintenance manual is provided in the appendix.

Appendices

Appendix A - NRCS Soils Report

Appendix B - Drainage Maps

Appendix C - WWHM Report

Appendix D - Operations and Maintenance Manual

APPENDIX A – NRCS SOILS REPORT

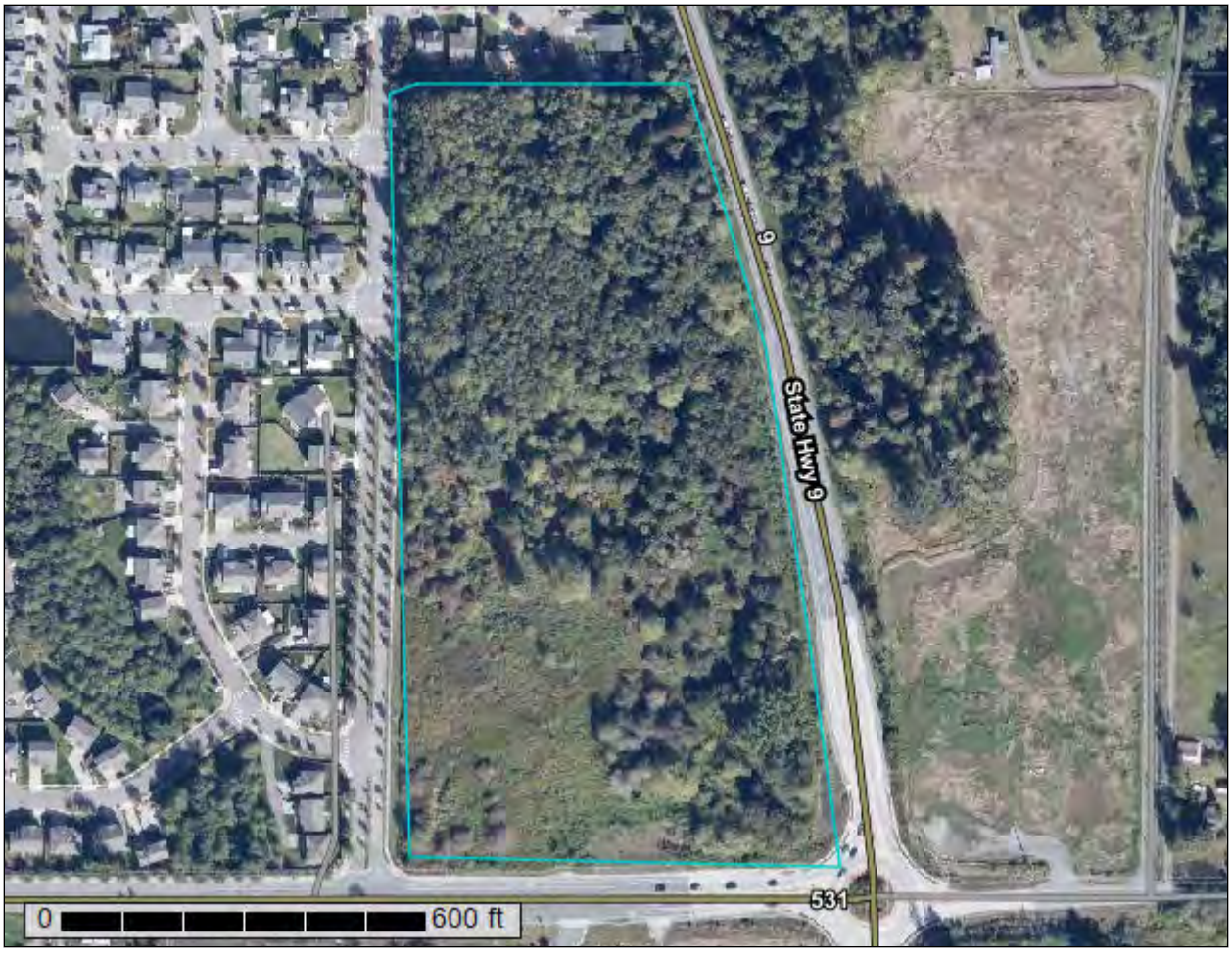
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Snohomish County Area, Washington



June 1, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,290 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 22, Jun 4, 2020

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

Date(s) aerial images were photographed: Sep 26, 2018—Oct 16, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
72	Tokul gravelly medial loam, 0 to 8 percent slopes	18.3	100.0%
Totals for Area of Interest		**18.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Snohomish County Area, Washington

72—Tokul gravelly medial loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t61k
Elevation: 160 to 1,150 feet
Mean annual precipitation: 45 to 70 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 140 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Tokul and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tokul

Setting

Landform: Hillslopes, till plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash mixed with loess over glacial till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oa - 1 to 2 inches: highly decomposed plant material
A - 2 to 6 inches: gravelly medial loam
Bs1 - 6 to 9 inches: gravelly medial loam
Bs2 - 9 to 17 inches: gravelly medial loam
Bs3 - 17 to 24 inches: gravelly medial loam
BC - 24 to 33 inches: gravelly medial fine sandy loam
2Bsm - 33 to 62 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 39 inches to cemented horizon; 20 to 39 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Forage suitability group: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)

Other vegetative classification: Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)
Hydric soil rating: No

Minor Components

Pastik
Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Barneston
Percent of map unit: 5 percent
Landform: Kames, eskers, moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Norma
Percent of map unit: 3 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Mckenna
Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

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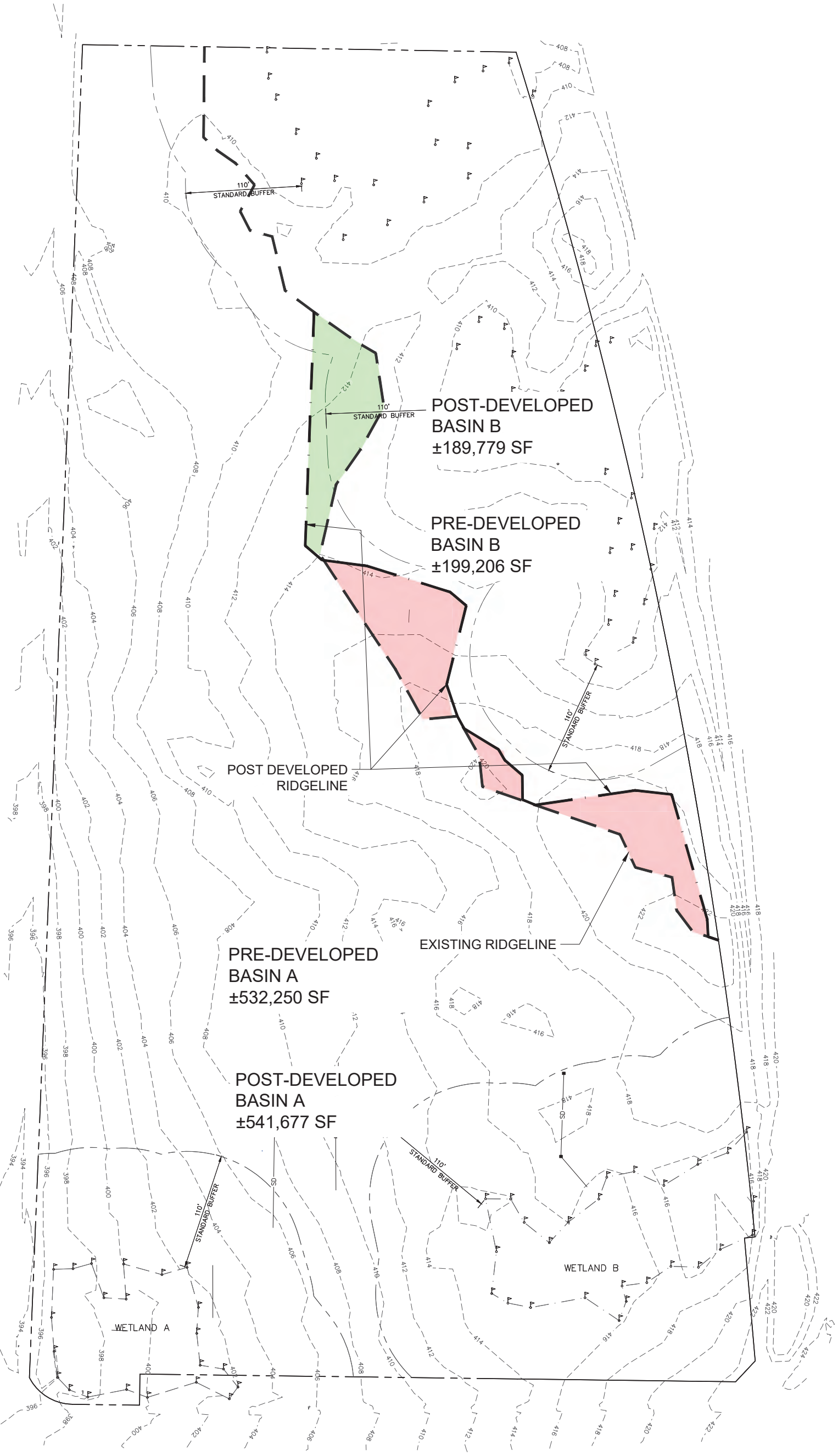
APPENDIX B – DRAINAGE MAPS

LAST SAVED BY: JOSHH



PORTION SW1/4, SW1/4, SEC.24, TWP.31N, RGE.5E, W.M.

X:\22867\DWG\CONSTRUCTION\22867 DRAINAGE BASIN.DWG (LayoutENG) 9/2/2022 10:38 AM

22867

1 OF 1

GRANDVIEW NORTH LLC
ZAHRADNIK
THRESHOLD DISCHARGE BASIN
CITY OF ARLINGTON
CITY FILE NO.: PLN #941

DESIGNED JH DATE 03/22
DRAWN JH DATE 03/22
CHECKED KB DATE 04/22
FIELD BOOK ARL 141
REF:

REVISION	DATE	BY

CASCADE SURVEYING & ENGINEERING, INC.
Engineers Surveyors Planners
P.O. BOX 326
ARLINGTON, WASHINGTON 98223
WWW.CASCADESURVEYING.COM
FAX: (360)435-4012
1-800-593-5551
(360) 435-5551

APPENDIX C – WWHM REPORT

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	22867 Stormtank 4
Site Name:	ZAHRADNIK
Site Address:	
City:	ARLINGTON
Report Date:	1/24/2023
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.000 (adjusted)
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year
Low Flow Threshold for POC3:	50 Percent of the 2 Year
High Flow Threshold for POC3:	50 Year
Low Flow Threshold for POC4:	50 Percent of the 2 Year
High Flow Threshold for POC4:	50 Year
Low Flow Threshold for POC5:	50 Percent of the 2 Year
High Flow Threshold for POC5:	50 Year
Low Flow Threshold for POC6:	50 Percent of the 2 Year
High Flow Threshold for POC6:	50 Year

Landuse Basin Data

Predeveloped Land Use

BASIN 1,2,3

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Flat	4.834
C, Forest, Mod	4.201
C, Forest, Steep	0.183
SAT, Forest, Flat	0.515
Pervious Total	9.733

Impervious Land Use	acre
Impervious Total	0
Basin Total	9.733

Element Flows To:

Surface	Interflow	Groundwater

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Flat	2.282
C, Forest, Mod	2.197
C, Forest, Steep	0.096
SAT, Forest, Flat	0.515
Pervious Total	5.09

Impervious Land Use	acre
Impervious Total	0
Basin Total	5.09

Element Flows To:

Surface	Interflow	Groundwater

Basin 1&2

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Flat	3.998
C, Forest, Mod	3.544
C, Forest, Steep	0.183
SAT, Forest, Flat	0.515
Pervious Total	8.24

Impervious Land Use	acre
Impervious Total	0
Basin Total	8.24

Element Flows To:

Surface	Interflow	Groundwater

Basin 4

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Flat	0.227
C, Forest, Mod	0.178
C, Forest, Steep	0.008
Pervious Total	0.413

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.413

Element Flows To:

Surface	Interflow	Groundwater

Basin 5

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Flat	0.323
C, Forest, Mod	0.215
C, Forest, Steep	0.017
SAT, Forest, Flat	0.361
Pervious Total	0.916

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.916

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

BASIN 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	1.099
Pervious Total	1.099

Impervious Land Use	acre
ROADS FLAT	2.201
ROOF TOPS FLAT	1.543
SIDEWALKS FLAT	0.248
Impervious Total	3.992
Basin Total	5.091

Element Flows To:

Surface	Interflow	Groundwater
Vault A	Vault A	

Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.682
Pervious Total	0.682

Impervious Land Use	acre
ROADS FLAT	1.663
ROOF TOPS FLAT	0.585
SIDEWALKS FLAT	0.191
Impervious Total	2.439
Basin Total	3.121

Element Flows To:

Surface	Interflow	Groundwater
Vault B	Vault B	

Basin 3

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.62
Pervious Total	0.62

Impervious Land Use	acre
ROADS FLAT	0.303
ROOF TOPS FLAT	0.581
SIDEWALKS FLAT	0.018
Impervious Total	0.902
Basin Total	1.522

Element Flows To:

Surface	Interflow	Groundwater
Vault C	Vault C	

Basin 4

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.166
Pervious Total	0.166

Impervious Land Use	acre
ROADS FLAT	0.209
SIDEWALKS FLAT	0.037
Impervious Total	0.246
Basin Total	0.412

Element Flows To:

Surface	Interflow	Groundwater
Vault D	Vault D	

Basin 5

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Flat	0.221
Pervious Total	0.221

Impervious Land Use	acre
ROADS FLAT	0.407
ROOF TOPS FLAT	0.26
SIDEWALKS FLAT	0.027
Impervious Total	0.694
Basin Total	0.915

Element Flows To:

Surface	Interflow	Groundwater
Vault E	Vault E	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault A

Width: 125 ft.
Length: 125 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 1.56 in. Elevation:0 ft.
Orifice 2 Diameter: 2.62 in. Elevation:3.99 ft.
Orifice 3 Diameter: 1.5 in. Elevation:4.85 ft.
Element Flows To:
Outlet 1 Outlet 2
Vault B

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.358	0.000	0.000	0.000
0.0778	0.358	0.027	0.018	0.000
0.1556	0.358	0.055	0.026	0.000
0.2333	0.358	0.083	0.031	0.000
0.3111	0.358	0.111	0.036	0.000
0.3889	0.358	0.139	0.041	0.000
0.4667	0.358	0.167	0.045	0.000
0.5444	0.358	0.195	0.048	0.000
0.6222	0.358	0.223	0.052	0.000
0.7000	0.358	0.251	0.055	0.000
0.7778	0.358	0.279	0.058	0.000
0.8556	0.358	0.306	0.061	0.000
0.9333	0.358	0.334	0.063	0.000
1.0111	0.358	0.362	0.066	0.000
1.0889	0.358	0.390	0.068	0.000
1.1667	0.358	0.418	0.071	0.000
1.2444	0.358	0.446	0.073	0.000
1.3222	0.358	0.474	0.075	0.000
1.4000	0.358	0.502	0.078	0.000
1.4778	0.358	0.530	0.080	0.000
1.5556	0.358	0.558	0.082	0.000
1.6333	0.358	0.585	0.084	0.000
1.7111	0.358	0.613	0.086	0.000
1.7889	0.358	0.641	0.088	0.000
1.8667	0.358	0.669	0.090	0.000
1.9444	0.358	0.697	0.092	0.000
2.0222	0.358	0.725	0.093	0.000
2.1000	0.358	0.753	0.095	0.000
2.1778	0.358	0.781	0.097	0.000
2.2556	0.358	0.809	0.099	0.000
2.3333	0.358	0.837	0.100	0.000
2.4111	0.358	0.864	0.102	0.000
2.4889	0.358	0.892	0.104	0.000
2.5667	0.358	0.920	0.105	0.000
2.6444	0.358	0.948	0.107	0.000
2.7222	0.358	0.976	0.109	0.000
2.8000	0.358	1.004	0.110	0.000
2.8778	0.358	1.032	0.112	0.000

2.9556	0.358	1.060	0.113	0.000
3.0333	0.358	1.088	0.115	0.000
3.1111	0.358	1.116	0.116	0.000
3.1889	0.358	1.143	0.117	0.000
3.2667	0.358	1.171	0.119	0.000
3.3444	0.358	1.199	0.120	0.000
3.4222	0.358	1.227	0.122	0.000
3.5000	0.358	1.255	0.123	0.000
3.5778	0.358	1.283	0.124	0.000
3.6556	0.358	1.311	0.126	0.000
3.7333	0.358	1.339	0.127	0.000
3.8111	0.358	1.367	0.128	0.000
3.8889	0.358	1.394	0.130	0.000
3.9667	0.358	1.422	0.131	0.000
4.0444	0.358	1.450	0.176	0.000
4.1222	0.358	1.478	0.201	0.000
4.2000	0.358	1.506	0.220	0.000
4.2778	0.358	1.534	0.236	0.000
4.3556	0.358	1.562	0.250	0.000
4.4333	0.358	1.590	0.263	0.000
4.5111	0.358	1.618	0.274	0.000
4.5889	0.358	1.646	0.285	0.000
4.6667	0.358	1.673	0.295	0.000
4.7444	0.358	1.701	0.305	0.000
4.8222	0.358	1.729	0.315	0.000
4.9000	0.358	1.757	0.337	0.000
4.9778	0.358	1.785	0.354	0.000
5.0556	0.358	1.813	0.368	0.000
5.1333	0.358	1.841	0.381	0.000
5.2111	0.358	1.869	0.393	0.000
5.2889	0.358	1.897	0.404	0.000
5.3667	0.358	1.925	0.415	0.000
5.4444	0.358	1.952	0.425	0.000
5.5222	0.358	1.980	0.435	0.000
5.6000	0.358	2.008	0.445	0.000
5.6778	0.358	2.036	0.454	0.000
5.7556	0.358	2.064	0.464	0.000
5.8333	0.358	2.092	0.473	0.000
5.9111	0.358	2.120	0.481	0.000
5.9889	0.358	2.148	0.490	0.000
6.0667	0.358	2.176	0.680	0.000
6.1444	0.358	2.204	1.079	0.000
6.2222	0.358	2.231	1.560	0.000
6.3000	0.358	2.259	2.032	0.000
6.3778	0.358	2.287	2.409	0.000
6.4556	0.358	2.315	2.651	0.000
6.5333	0.358	2.343	2.845	0.000
6.6111	0.358	2.371	3.014	0.000
6.6889	0.358	2.399	3.173	0.000
6.7667	0.358	2.427	3.324	0.000
6.8444	0.358	2.455	3.468	0.000
6.9222	0.358	2.483	3.605	0.000
7.0000	0.358	2.510	3.737	0.000
7.0778	0.358	2.538	3.864	0.000
7.1556	0.000	0.000	3.986	0.000

Vault B

Width: 72 ft.
Length: 72 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 1.9 in. Elevation:0 ft.
Orifice 2 Diameter: 3.02 in. Elevation:3.09 ft.
Orifice 3 Diameter: 1.87 in. Elevation:4.02 ft.
Element Flows To:
Outlet 1 Outlet 2
Vault C

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.119	0.000	0.000	0.000
0.0778	0.119	0.009	0.027	0.000
0.1556	0.119	0.018	0.038	0.000
0.2333	0.119	0.027	0.047	0.000
0.3111	0.119	0.037	0.054	0.000
0.3889	0.119	0.046	0.061	0.000
0.4667	0.119	0.055	0.066	0.000
0.5444	0.119	0.064	0.072	0.000
0.6222	0.119	0.074	0.077	0.000
0.7000	0.119	0.083	0.082	0.000
0.7778	0.119	0.092	0.086	0.000
0.8556	0.119	0.101	0.090	0.000
0.9333	0.119	0.111	0.094	0.000
1.0111	0.119	0.120	0.098	0.000
1.0889	0.119	0.129	0.102	0.000
1.1667	0.119	0.138	0.105	0.000
1.2444	0.119	0.148	0.109	0.000
1.3222	0.119	0.157	0.112	0.000
1.4000	0.119	0.166	0.115	0.000
1.4778	0.119	0.175	0.119	0.000
1.5556	0.119	0.185	0.122	0.000
1.6333	0.119	0.194	0.125	0.000
1.7111	0.119	0.203	0.128	0.000
1.7889	0.119	0.212	0.131	0.000
1.8667	0.119	0.222	0.133	0.000
1.9444	0.119	0.231	0.136	0.000
2.0222	0.119	0.240	0.139	0.000
2.1000	0.119	0.249	0.142	0.000
2.1778	0.119	0.259	0.144	0.000
2.2556	0.119	0.268	0.147	0.000
2.3333	0.119	0.277	0.149	0.000
2.4111	0.119	0.286	0.152	0.000
2.4889	0.119	0.296	0.154	0.000
2.5667	0.119	0.305	0.156	0.000
2.6444	0.119	0.314	0.159	0.000
2.7222	0.119	0.324	0.161	0.000
2.8000	0.119	0.333	0.163	0.000
2.8778	0.119	0.342	0.166	0.000
2.9556	0.119	0.351	0.168	0.000
3.0333	0.119	0.361	0.170	0.000

3.1111	0.119	0.370	0.208	0.000
3.1889	0.119	0.379	0.252	0.000
3.2667	0.119	0.388	0.281	0.000
3.3444	0.119	0.398	0.304	0.000
3.4222	0.119	0.407	0.323	0.000
3.5000	0.119	0.416	0.341	0.000
3.5778	0.119	0.425	0.358	0.000
3.6556	0.119	0.435	0.373	0.000
3.7333	0.119	0.444	0.387	0.000
3.8111	0.119	0.453	0.401	0.000
3.8889	0.119	0.462	0.414	0.000
3.9667	0.119	0.472	0.426	0.000
4.0444	0.119	0.481	0.453	0.000
4.1222	0.119	0.490	0.480	0.000
4.2000	0.119	0.499	0.501	0.000
4.2778	0.119	0.509	0.520	0.000
4.3556	0.119	0.518	0.537	0.000
4.4333	0.119	0.527	0.554	0.000
4.5111	0.119	0.536	0.569	0.000
4.5889	0.119	0.546	0.584	0.000
4.6667	0.119	0.555	0.598	0.000
4.7444	0.119	0.564	0.612	0.000
4.8222	0.119	0.573	0.625	0.000
4.9000	0.119	0.583	0.638	0.000
4.9778	0.119	0.592	0.651	0.000
5.0556	0.119	0.601	0.663	0.000
5.1333	0.119	0.610	0.675	0.000
5.2111	0.119	0.620	0.687	0.000
5.2889	0.119	0.629	0.699	0.000
5.3667	0.119	0.638	0.710	0.000
5.4444	0.119	0.647	0.721	0.000
5.5222	0.119	0.657	0.732	0.000
5.6000	0.119	0.666	0.743	0.000
5.6778	0.119	0.675	0.753	0.000
5.7556	0.119	0.685	0.764	0.000
5.8333	0.119	0.694	0.774	0.000
5.9111	0.119	0.703	0.784	0.000
5.9889	0.119	0.712	0.794	0.000
6.0667	0.119	0.722	0.986	0.000
6.1444	0.119	0.731	1.386	0.000
6.2222	0.119	0.740	1.869	0.000
6.3000	0.119	0.749	2.342	0.000
6.3778	0.119	0.759	2.721	0.000
6.4556	0.119	0.768	2.965	0.000
6.5333	0.119	0.777	3.160	0.000
6.6111	0.119	0.786	3.331	0.000
6.6889	0.119	0.796	3.492	0.000
6.7667	0.119	0.805	3.644	0.000
6.8444	0.119	0.814	3.789	0.000
6.9222	0.119	0.823	3.928	0.000
7.0000	0.119	0.833	4.062	0.000
7.0778	0.119	0.842	4.190	0.000
7.1556	0.000	0.000	4.314	0.000

Vault C

Width: 60 ft.
Length: 60 ft.
Depth: 5.5 ft.
Discharge Structure
Riser Height: 4.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 1.4 in. Elevation:0 ft.
Orifice 2 Diameter: 3.31 in. Elevation:3.26 ft.
Orifice 3 Diameter: 5.43 in. Elevation:3.94 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.082	0.000	0.000	0.000
0.0611	0.082	0.005	0.013	0.000
0.1222	0.082	0.010	0.018	0.000
0.1833	0.082	0.015	0.022	0.000
0.2444	0.082	0.020	0.026	0.000
0.3056	0.082	0.025	0.029	0.000
0.3667	0.082	0.030	0.032	0.000
0.4278	0.082	0.035	0.034	0.000
0.4889	0.082	0.040	0.037	0.000
0.5500	0.082	0.045	0.039	0.000
0.6111	0.082	0.050	0.041	0.000
0.6722	0.082	0.055	0.043	0.000
0.7333	0.082	0.060	0.045	0.000
0.7944	0.082	0.065	0.047	0.000
0.8556	0.082	0.070	0.049	0.000
0.9167	0.082	0.075	0.050	0.000
0.9778	0.082	0.080	0.052	0.000
1.0389	0.082	0.085	0.054	0.000
1.1000	0.082	0.090	0.055	0.000
1.1611	0.082	0.096	0.057	0.000
1.2222	0.082	0.101	0.058	0.000
1.2833	0.082	0.106	0.060	0.000
1.3444	0.082	0.111	0.061	0.000
1.4056	0.082	0.116	0.063	0.000
1.4667	0.082	0.121	0.064	0.000
1.5278	0.082	0.126	0.065	0.000
1.5889	0.082	0.131	0.067	0.000
1.6500	0.082	0.136	0.068	0.000
1.7111	0.082	0.141	0.069	0.000
1.7722	0.082	0.146	0.070	0.000
1.8333	0.082	0.151	0.072	0.000
1.8944	0.082	0.156	0.073	0.000
1.9556	0.082	0.161	0.074	0.000
2.0167	0.082	0.166	0.075	0.000
2.0778	0.082	0.171	0.076	0.000
2.1389	0.082	0.176	0.077	0.000
2.2000	0.082	0.181	0.078	0.000
2.2611	0.082	0.186	0.080	0.000
2.3222	0.082	0.191	0.081	0.000
2.3833	0.082	0.197	0.082	0.000

2.4444	0.082	0.202	0.083	0.000
2.5056	0.082	0.207	0.084	0.000
2.5667	0.082	0.212	0.085	0.000
2.6278	0.082	0.217	0.086	0.000
2.6889	0.082	0.222	0.087	0.000
2.7500	0.082	0.227	0.088	0.000
2.8111	0.082	0.232	0.089	0.000
2.8722	0.082	0.237	0.090	0.000
2.9333	0.082	0.242	0.091	0.000
2.9944	0.082	0.247	0.092	0.000
3.0556	0.082	0.252	0.093	0.000
3.1167	0.082	0.257	0.093	0.000
3.1778	0.082	0.262	0.094	0.000
3.2389	0.082	0.267	0.095	0.000
3.3000	0.082	0.272	0.156	0.000
3.3611	0.082	0.277	0.192	0.000
3.4222	0.082	0.282	0.218	0.000
3.4833	0.082	0.287	0.239	0.000
3.5444	0.082	0.292	0.258	0.000
3.6056	0.082	0.298	0.275	0.000
3.6667	0.082	0.303	0.291	0.000
3.7278	0.082	0.308	0.306	0.000
3.7889	0.082	0.313	0.319	0.000
3.8500	0.082	0.318	0.332	0.000
3.9111	0.082	0.323	0.345	0.000
3.9722	0.082	0.328	0.500	0.000
4.0333	0.082	0.333	0.612	0.000
4.0944	0.082	0.338	0.693	0.000
4.1556	0.082	0.343	0.761	0.000
4.2167	0.082	0.348	0.820	0.000
4.2778	0.082	0.353	0.875	0.000
4.3389	0.082	0.358	0.925	0.000
4.4000	0.082	0.363	0.971	0.000
4.4611	0.082	0.368	1.015	0.000
4.5222	0.082	0.373	1.092	0.000
4.5833	0.082	0.378	1.351	0.000
4.6444	0.082	0.383	1.708	0.000
4.7056	0.082	0.388	2.115	0.000
4.7667	0.082	0.393	2.526	0.000
4.8278	0.082	0.399	2.899	0.000
4.8889	0.082	0.404	3.197	0.000
4.9500	0.082	0.409	3.410	0.000
5.0111	0.082	0.414	3.592	0.000
5.0722	0.082	0.419	3.754	0.000
5.1333	0.082	0.424	3.908	0.000
5.1944	0.082	0.429	4.055	0.000
5.2556	0.082	0.434	4.197	0.000
5.3167	0.082	0.439	4.334	0.000
5.3778	0.082	0.444	4.466	0.000
5.4389	0.082	0.449	4.594	0.000
5.5000	0.082	0.454	4.718	0.000
5.5611	0.082	0.459	4.839	0.000
5.6222	0.000	0.000	4.957	0.000

Vault D

Width: 28.5859459946763 ft.
Length: 28.5859459946763 ft.
Depth: 5.5 ft.
Discharge Structure
Riser Height: 4.5 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.48 in. Elevation:0 ft.
Orifice 2 Diameter: 0.67 in. Elevation:1.9515 ft.
Orifice 3 Diameter: 0.43 in. Elevation:2.87208333333336 ft.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.018	0.000	0.000	0.000
0.0611	0.018	0.001	0.001	0.000
0.1222	0.018	0.002	0.002	0.000
0.1833	0.018	0.003	0.002	0.000
0.2444	0.018	0.004	0.003	0.000
0.3056	0.018	0.005	0.003	0.000
0.3667	0.018	0.006	0.003	0.000
0.4278	0.018	0.008	0.004	0.000
0.4889	0.018	0.009	0.004	0.000
0.5500	0.018	0.010	0.004	0.000
0.6111	0.018	0.011	0.004	0.000
0.6722	0.018	0.012	0.005	0.000
0.7333	0.018	0.013	0.005	0.000
0.7944	0.018	0.014	0.005	0.000
0.8556	0.018	0.016	0.005	0.000
0.9167	0.018	0.017	0.006	0.000
0.9778	0.018	0.018	0.006	0.000
1.0389	0.018	0.019	0.006	0.000
1.1000	0.018	0.020	0.006	0.000
1.1611	0.018	0.021	0.006	0.000
1.2222	0.018	0.022	0.006	0.000
1.2833	0.018	0.024	0.007	0.000
1.3444	0.018	0.025	0.007	0.000
1.4056	0.018	0.026	0.007	0.000
1.4667	0.018	0.027	0.007	0.000
1.5278	0.018	0.028	0.007	0.000
1.5889	0.018	0.029	0.007	0.000
1.6500	0.018	0.031	0.008	0.000
1.7111	0.018	0.032	0.008	0.000
1.7722	0.018	0.033	0.008	0.000
1.8333	0.018	0.034	0.008	0.000
1.8944	0.018	0.035	0.008	0.000
1.9556	0.018	0.036	0.009	0.000
2.0167	0.018	0.037	0.012	0.000
2.0778	0.018	0.039	0.013	0.000
2.1389	0.018	0.040	0.014	0.000
2.2000	0.018	0.041	0.015	0.000
2.2611	0.018	0.042	0.016	0.000
2.3222	0.018	0.043	0.016	0.000
2.3833	0.018	0.044	0.017	0.000

2.4444	0.018	0.045	0.018	0.000
2.5056	0.018	0.047	0.019	0.000
2.5667	0.018	0.048	0.019	0.000
2.6278	0.018	0.049	0.020	0.000
2.6889	0.018	0.050	0.020	0.000
2.7500	0.018	0.051	0.021	0.000
2.8111	0.018	0.052	0.021	0.000
2.8722	0.018	0.053	0.022	0.000
2.9333	0.018	0.055	0.024	0.000
2.9944	0.018	0.056	0.025	0.000
3.0556	0.018	0.057	0.025	0.000
3.1167	0.018	0.058	0.026	0.000
3.1778	0.018	0.059	0.027	0.000
3.2389	0.018	0.060	0.028	0.000
3.3000	0.018	0.061	0.028	0.000
3.3611	0.018	0.063	0.029	0.000
3.4222	0.018	0.064	0.030	0.000
3.4833	0.018	0.065	0.030	0.000
3.5444	0.018	0.066	0.031	0.000
3.6056	0.018	0.067	0.031	0.000
3.6667	0.018	0.068	0.032	0.000
3.7278	0.018	0.069	0.032	0.000
3.7889	0.018	0.071	0.033	0.000
3.8500	0.018	0.072	0.034	0.000
3.9111	0.018	0.073	0.034	0.000
3.9722	0.018	0.074	0.035	0.000
4.0333	0.018	0.075	0.035	0.000
4.0944	0.018	0.076	0.036	0.000
4.1556	0.018	0.078	0.036	0.000
4.2167	0.018	0.079	0.037	0.000
4.2778	0.018	0.080	0.037	0.000
4.3389	0.018	0.081	0.037	0.000
4.4000	0.018	0.082	0.038	0.000
4.4611	0.018	0.083	0.038	0.000
4.5222	0.018	0.084	0.074	0.000
4.5833	0.018	0.086	0.294	0.000
4.6444	0.018	0.087	0.612	0.000
4.7056	0.018	0.088	0.982	0.000
4.7667	0.018	0.089	1.359	0.000
4.8278	0.018	0.090	1.697	0.000
4.8889	0.018	0.091	1.962	0.000
4.9500	0.018	0.092	2.143	0.000
5.0111	0.018	0.094	2.294	0.000
5.0722	0.018	0.095	2.425	0.000
5.1333	0.018	0.096	2.550	0.000
5.1944	0.018	0.097	2.668	0.000
5.2556	0.018	0.098	2.782	0.000
5.3167	0.018	0.099	2.890	0.000
5.3778	0.018	0.100	2.995	0.000
5.4389	0.018	0.102	3.097	0.000
5.5000	0.018	0.103	3.195	0.000
5.5611	0.018	0.104	3.290	0.000
5.6222	0.000	0.000	3.383	0.000

Vault E

Width: 41.9566636385983 ft.
Length: 41.9566636385983 ft.
Depth: 7 ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 12 in.
Orifice 1 Diameter: 0.76 in. Elevation:0 ft.
Orifice 2 Diameter: 1.2 in. Elevation:4.212 ft.
Orifice 3 Diameter: 0.76 in. Elevation:4.87958333333336 ft.
Element Flows To:
Outlet 1 Outlet 2

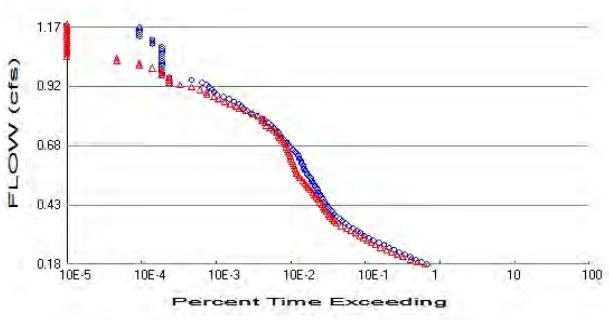
Vault Hydraulic Table

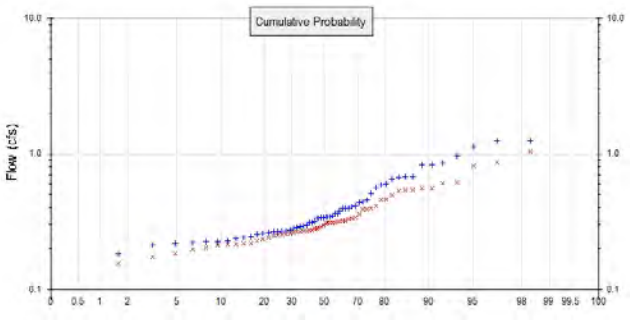
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.040	0.000	0.000	0.000
0.0778	0.040	0.003	0.004	0.000
0.1556	0.040	0.006	0.006	0.000
0.2333	0.040	0.009	0.007	0.000
0.3111	0.040	0.012	0.008	0.000
0.3889	0.040	0.015	0.009	0.000
0.4667	0.040	0.018	0.010	0.000
0.5444	0.040	0.022	0.011	0.000
0.6222	0.040	0.025	0.012	0.000
0.7000	0.040	0.028	0.013	0.000
0.7778	0.040	0.031	0.013	0.000
0.8556	0.040	0.034	0.014	0.000
0.9333	0.040	0.037	0.015	0.000
1.0111	0.040	0.040	0.015	0.000
1.0889	0.040	0.044	0.016	0.000
1.1667	0.040	0.047	0.016	0.000
1.2444	0.040	0.050	0.017	0.000
1.3222	0.040	0.053	0.018	0.000
1.4000	0.040	0.056	0.018	0.000
1.4778	0.040	0.059	0.019	0.000
1.5556	0.040	0.062	0.019	0.000
1.6333	0.040	0.066	0.020	0.000
1.7111	0.040	0.069	0.020	0.000
1.7889	0.040	0.072	0.021	0.000
1.8667	0.040	0.075	0.021	0.000
1.9444	0.040	0.078	0.021	0.000
2.0222	0.040	0.081	0.022	0.000
2.1000	0.040	0.084	0.022	0.000
2.1778	0.040	0.088	0.023	0.000
2.2556	0.040	0.091	0.023	0.000
2.3333	0.040	0.094	0.023	0.000
2.4111	0.040	0.097	0.024	0.000
2.4889	0.040	0.100	0.024	0.000
2.5667	0.040	0.103	0.025	0.000
2.6444	0.040	0.106	0.025	0.000
2.7222	0.040	0.110	0.025	0.000
2.8000	0.040	0.113	0.026	0.000
2.8778	0.040	0.116	0.026	0.000
2.9556	0.040	0.119	0.026	0.000
3.0333	0.040	0.122	0.027	0.000

3.1111	0.040	0.125	0.027	0.000
3.1889	0.040	0.128	0.028	0.000
3.2667	0.040	0.132	0.028	0.000
3.3444	0.040	0.135	0.028	0.000
3.4222	0.040	0.138	0.029	0.000
3.5000	0.040	0.141	0.029	0.000
3.5778	0.040	0.144	0.029	0.000
3.6556	0.040	0.147	0.030	0.000
3.7333	0.040	0.150	0.030	0.000
3.8111	0.040	0.154	0.030	0.000
3.8889	0.040	0.157	0.030	0.000
3.9667	0.040	0.160	0.031	0.000
4.0444	0.040	0.163	0.031	0.000
4.1222	0.040	0.166	0.031	0.000
4.2000	0.040	0.169	0.032	0.000
4.2778	0.040	0.172	0.042	0.000
4.3556	0.040	0.176	0.047	0.000
4.4333	0.040	0.179	0.051	0.000
4.5111	0.040	0.182	0.054	0.000
4.5889	0.040	0.185	0.057	0.000
4.6667	0.040	0.188	0.060	0.000
4.7444	0.040	0.191	0.062	0.000
4.8222	0.040	0.194	0.064	0.000
4.9000	0.040	0.198	0.069	0.000
4.9778	0.040	0.201	0.074	0.000
5.0556	0.040	0.204	0.077	0.000
5.1333	0.040	0.207	0.080	0.000
5.2111	0.040	0.210	0.083	0.000
5.2889	0.040	0.213	0.086	0.000
5.3667	0.040	0.216	0.089	0.000
5.4444	0.040	0.220	0.091	0.000
5.5222	0.040	0.223	0.094	0.000
5.6000	0.040	0.226	0.096	0.000
5.6778	0.040	0.229	0.098	0.000
5.7556	0.040	0.232	0.100	0.000
5.8333	0.040	0.235	0.102	0.000
5.9111	0.040	0.238	0.105	0.000
5.9889	0.040	0.242	0.107	0.000
6.0667	0.040	0.245	0.291	0.000
6.1444	0.040	0.248	0.683	0.000
6.2222	0.040	0.251	1.158	0.000
6.3000	0.040	0.254	1.624	0.000
6.3778	0.040	0.257	1.995	0.000
6.4556	0.040	0.260	2.232	0.000
6.5333	0.040	0.264	2.419	0.000
6.6111	0.040	0.267	2.583	0.000
6.6889	0.040	0.270	2.737	0.000
6.7667	0.040	0.273	2.882	0.000
6.8444	0.040	0.276	3.020	0.000
6.9222	0.040	0.279	3.152	0.000
7.0000	0.040	0.282	3.279	0.000
7.0778	0.040	0.286	3.400	0.000
7.1556	0.000	0.000	3.518	0.000

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 9.733
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.401
Total Impervious Area: 7.333

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.359452
5 year	0.562471
10 year	0.724935
25 year	0.964831
50 year	1.170455
100 year	1.400675

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.306184
5 year	0.443727
10 year	0.549771
25 year	0.70198
50 year	0.829372
100 year	0.96944

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.345	0.273
1950	0.362	0.286
1951	0.332	0.197
1952	0.260	0.270
1953	0.218	0.184
1954	1.253	0.288
1955	0.511	0.536
1956	0.396	0.336
1957	0.566	0.542
1958	0.414	0.217

1959	0.341	0.267
1960	0.343	0.455
1961	0.677	0.329
1962	0.336	0.228
1963	0.587	0.255
1964	0.395	0.174
1965	0.296	0.269
1966	0.185	0.240
1967	0.392	0.249
1968	0.407	0.495
1969	1.129	0.305
1970	0.244	0.257
1971	0.437	0.319
1972	0.317	0.557
1973	0.273	0.273
1974	0.665	0.280
1975	0.289	0.202
1976	0.266	0.311
1977	0.238	0.250
1978	0.270	0.254
1979	0.823	0.267
1980	0.347	0.216
1981	0.254	0.219
1982	0.361	0.617
1983	0.598	0.233
1984	0.332	0.460
1985	0.453	0.358
1986	0.961	0.819
1987	0.444	0.530
1988	0.229	0.411
1989	0.266	0.212
1990	0.293	0.334
1991	0.339	0.316
1992	0.258	0.261
1993	0.223	0.154
1994	0.220	0.298
1995	0.309	0.391
1996	0.650	0.396
1997	1.255	1.042
1998	0.212	0.214
1999	0.281	0.310
2000	0.223	0.389
2001	0.089	0.120
2002	0.312	0.312
2003	0.240	0.279
2004	0.377	0.551
2005	0.287	0.317
2006	0.852	0.606
2007	0.678	0.321
2008	0.831	0.861
2009	0.270	0.309

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.2550	1.0420
2	1.2527	0.8612
3	1.1294	0.8188

4	0.9613	0.6166
5	0.8516	0.6057
6	0.8314	0.5571
7	0.8231	0.5513
8	0.6775	0.5416
9	0.6771	0.5361
10	0.6649	0.5299
11	0.6499	0.4950
12	0.5978	0.4600
13	0.5874	0.4553
14	0.5659	0.4111
15	0.5106	0.3960
16	0.4534	0.3907
17	0.4445	0.3890
18	0.4372	0.3581
19	0.4145	0.3357
20	0.4073	0.3344
21	0.3961	0.3293
22	0.3951	0.3212
23	0.3924	0.3194
24	0.3769	0.3168
25	0.3618	0.3156
26	0.3612	0.3116
27	0.3468	0.3107
28	0.3447	0.3101
29	0.3427	0.3086
30	0.3412	0.3055
31	0.3395	0.2976
32	0.3357	0.2884
33	0.3321	0.2861
34	0.3317	0.2804
35	0.3167	0.2792
36	0.3121	0.2735
37	0.3089	0.2733
38	0.2958	0.2699
39	0.2927	0.2693
40	0.2886	0.2674
41	0.2870	0.2673
42	0.2811	0.2608
43	0.2733	0.2571
44	0.2702	0.2555
45	0.2697	0.2539
46	0.2657	0.2503
47	0.2657	0.2488
48	0.2601	0.2402
49	0.2576	0.2327
50	0.2535	0.2281
51	0.2441	0.2191
52	0.2397	0.2171
53	0.2381	0.2159
54	0.2287	0.2145
55	0.2234	0.2123
56	0.2229	0.2022
57	0.2197	0.1972
58	0.2180	0.1837
59	0.2124	0.1740
60	0.1848	0.1543
61	0.0885	0.1199

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1797	14345	13379	93	Pass
0.1897	12027	10761	89	Pass
0.1997	10083	8600	85	Pass
0.2097	8515	6851	80	Pass
0.2198	7214	5668	78	Pass
0.2298	6130	4772	77	Pass
0.2398	5200	4107	78	Pass
0.2498	4419	3426	77	Pass
0.2598	3803	2926	76	Pass
0.2698	3249	2582	79	Pass
0.2798	2755	2248	81	Pass
0.2898	2387	2036	85	Pass
0.2998	2079	1821	87	Pass
0.3098	1844	1578	85	Pass
0.3198	1637	1358	82	Pass
0.3298	1459	1201	82	Pass
0.3398	1291	1012	78	Pass
0.3499	1150	873	75	Pass
0.3599	1048	817	77	Pass
0.3699	964	774	80	Pass
0.3799	885	727	82	Pass
0.3899	824	688	83	Pass
0.3999	761	642	84	Pass
0.4099	707	607	85	Pass
0.4199	669	581	86	Pass
0.4299	641	566	88	Pass
0.4399	611	531	86	Pass
0.4499	585	495	84	Pass
0.4599	558	466	83	Pass
0.4699	529	444	83	Pass
0.4799	508	422	83	Pass
0.4900	487	395	81	Pass
0.5000	470	369	78	Pass
0.5100	447	349	78	Pass
0.5200	423	331	78	Pass
0.5300	408	308	75	Pass
0.5400	392	285	72	Pass
0.5500	369	271	73	Pass
0.5600	349	258	73	Pass
0.5700	336	251	74	Pass
0.5800	322	245	76	Pass
0.5900	315	237	75	Pass
0.6000	301	229	76	Pass
0.6100	295	223	75	Pass
0.6201	281	217	77	Pass
0.6301	270	211	78	Pass
0.6401	261	206	78	Pass
0.6501	244	200	81	Pass
0.6601	227	193	85	Pass
0.6701	214	189	88	Pass
0.6801	200	182	91	Pass
0.6901	189	173	91	Pass
0.7001	173	163	94	Pass

0.7101	163	154	94	Pass
0.7201	156	145	92	Pass
0.7301	144	138	95	Pass
0.7401	137	126	91	Pass
0.7501	127	112	88	Pass
0.7602	119	101	84	Pass
0.7702	107	97	90	Pass
0.7802	96	88	91	Pass
0.7902	88	87	98	Pass
0.8002	76	79	103	Pass
0.8102	63	66	104	Pass
0.8202	55	53	96	Pass
0.8302	50	43	86	Pass
0.8402	46	40	86	Pass
0.8502	43	33	76	Pass
0.8602	37	28	75	Pass
0.8702	32	23	71	Pass
0.8802	27	20	74	Pass
0.8902	22	16	72	Pass
0.9003	20	16	80	Pass
0.9103	19	13	68	Pass
0.9203	17	10	58	Pass
0.9303	16	7	43	Pass
0.9403	14	5	35	Pass
0.9503	10	5	50	Pass
0.9603	5	5	100	Pass
0.9703	4	4	100	Pass
0.9803	4	4	100	Pass
0.9903	4	4	100	Pass
1.0003	4	3	75	Pass
1.0103	4	2	50	Pass
1.0203	4	2	50	Pass
1.0304	4	1	25	Pass
1.0404	4	1	25	Pass
1.0504	4	0	0	Pass
1.0604	4	0	0	Pass
1.0704	4	0	0	Pass
1.0804	4	0	0	Pass
1.0904	4	0	0	Pass
1.1004	3	0	0	Pass
1.1104	3	0	0	Pass
1.1204	3	0	0	Pass
1.1304	2	0	0	Pass
1.1404	2	0	0	Pass
1.1504	2	0	0	Pass
1.1604	2	0	0	Pass
1.1705	2	0	0	Pass

Water Quality

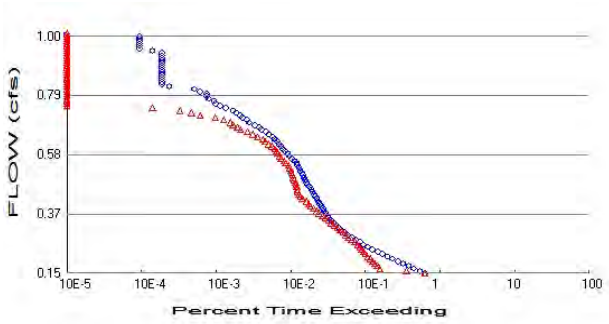
Water Quality BMP Flow and Volume for POC #1

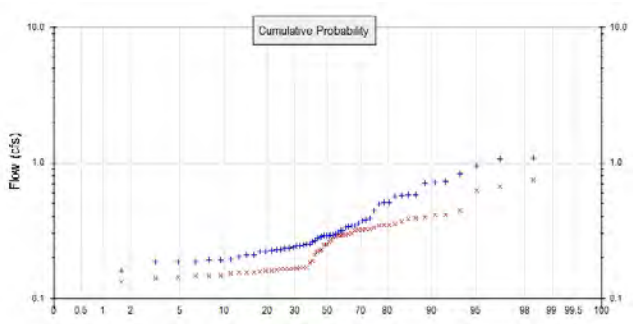
On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault C POC	☐	1294.87			☐	0.00			
Vault B	☐	1135.53			☐	0.00			
Vault A	☐	704.90			☐	0.00			
Total Volume Infiltrated		3135.30	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 8.24
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 1.781
Total Impervious Area: 6.431

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.30831
5 year	0.48141
10 year	0.619708
25 year	0.823654
50 year	0.998265
100 year	1.193591

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.238249
5 year	0.347326
10 year	0.428275
25 year	0.540665
50 year	0.631872
100 year	0.729624

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1949	0.290	0.189
1950	0.306	0.208
1951	0.283	0.159
1952	0.221	0.143
1953	0.186	0.147
1954	1.065	0.222
1955	0.445	0.366
1956	0.340	0.319
1957	0.493	0.392
1958	0.355	0.162
1959	0.289	0.260

1960	0.296	0.350
1961	0.579	0.298
1962	0.288	0.168
1963	0.507	0.159
1964	0.335	0.156
1965	0.252	0.248
1966	0.159	0.154
1967	0.342	0.166
1968	0.345	0.387
1969	0.954	0.164
1970	0.208	0.156
1971	0.375	0.270
1972	0.278	0.320
1973	0.233	0.168
1974	0.568	0.170
1975	0.251	0.152
1976	0.226	0.285
1977	0.210	0.164
1978	0.233	0.141
1979	0.712	0.335
1980	0.295	0.147
1981	0.220	0.163
1982	0.315	0.444
1983	0.508	0.166
1984	0.283	0.350
1985	0.391	0.345
1986	0.821	0.620
1987	0.378	0.411
1988	0.195	0.323
1989	0.227	0.132
1990	0.246	0.295
1991	0.292	0.302
1992	0.223	0.224
1993	0.191	0.156
1994	0.187	0.290
1995	0.260	0.324
1996	0.562	0.346
1997	1.081	0.744
1998	0.185	0.147
1999	0.243	0.285
2000	0.192	0.316
2001	0.078	0.133
2002	0.267	0.289
2003	0.204	0.249
2004	0.317	0.397
2005	0.246	0.295
2006	0.726	0.412
2007	0.581	0.228
2008	0.708	0.664
2009	0.237	0.182

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	1.0814	0.7442
2	1.0649	0.6636
3	0.9539	0.6196
4	0.8207	0.4438

5	0.7259	0.4122
6	0.7119	0.4108
7	0.7079	0.3974
8	0.5814	0.3916
9	0.5790	0.3866
10	0.5676	0.3656
11	0.5625	0.3504
12	0.5076	0.3499
13	0.5075	0.3462
14	0.4927	0.3450
15	0.4454	0.3354
16	0.3911	0.3236
17	0.3777	0.3228
18	0.3754	0.3203
19	0.3553	0.3190
20	0.3445	0.3164
21	0.3419	0.3018
22	0.3401	0.2984
23	0.3349	0.2954
24	0.3169	0.2948
25	0.3147	0.2901
26	0.3057	0.2888
27	0.2963	0.2850
28	0.2947	0.2850
29	0.2917	0.2700
30	0.2899	0.2603
31	0.2890	0.2490
32	0.2878	0.2475
33	0.2834	0.2277
34	0.2828	0.2239
35	0.2776	0.2219
36	0.2670	0.2084
37	0.2601	0.1891
38	0.2525	0.1824
39	0.2514	0.1698
40	0.2459	0.1685
41	0.2455	0.1685
42	0.2429	0.1662
43	0.2370	0.1659
44	0.2334	0.1637
45	0.2329	0.1637
46	0.2271	0.1629
47	0.2258	0.1616
48	0.2230	0.1589
49	0.2210	0.1585
50	0.2197	0.1562
51	0.2098	0.1556
52	0.2080	0.1555
53	0.2041	0.1540
54	0.1952	0.1523
55	0.1920	0.1474
56	0.1909	0.1467
57	0.1873	0.1467
58	0.1857	0.1426
59	0.1853	0.1409
60	0.1593	0.1333
61	0.0782	0.1325

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1542	13509	13321	98	Pass
0.1627	11437	7584	66	Pass
0.1712	9522	3369	35	Pass
0.1797	8138	3097	38	Pass
0.1883	6825	2851	41	Pass
0.1968	5867	2667	45	Pass
0.2053	4947	2488	50	Pass
0.2138	4239	2291	54	Pass
0.2224	3628	2139	58	Pass
0.2309	3114	2024	64	Pass
0.2394	2624	1901	72	Pass
0.2479	2306	1798	77	Pass
0.2565	1993	1680	84	Pass
0.2650	1793	1543	86	Pass
0.2735	1584	1405	88	Pass
0.2821	1414	1264	89	Pass
0.2906	1243	1167	93	Pass
0.2991	1104	1072	97	Pass
0.3076	1014	991	97	Pass
0.3162	930	901	96	Pass
0.3247	867	816	94	Pass
0.3332	801	748	93	Pass
0.3417	739	687	92	Pass
0.3503	696	617	88	Pass
0.3588	661	567	85	Pass
0.3673	630	512	81	Pass
0.3758	602	472	78	Pass
0.3844	580	431	74	Pass
0.3929	552	393	71	Pass
0.4014	525	371	70	Pass
0.4099	502	346	68	Pass
0.4185	478	304	63	Pass
0.4270	457	289	63	Pass
0.4355	439	277	63	Pass
0.4441	415	265	63	Pass
0.4526	403	260	64	Pass
0.4611	379	256	67	Pass
0.4696	359	251	69	Pass
0.4782	346	247	71	Pass
0.4867	331	238	71	Pass
0.4952	319	232	72	Pass
0.5037	310	226	72	Pass
0.5123	301	220	73	Pass
0.5208	286	214	74	Pass
0.5293	276	208	75	Pass
0.5378	263	199	75	Pass
0.5464	256	183	71	Pass
0.5549	239	173	72	Pass
0.5634	222	159	71	Pass
0.5719	207	151	72	Pass
0.5805	195	142	72	Pass
0.5890	179	138	77	Pass
0.5975	168	130	77	Pass

0.6061	159	120	75	Pass
0.6146	148	109	73	Pass
0.6231	139	97	69	Pass
0.6316	129	90	69	Pass
0.6402	123	77	62	Pass
0.6487	109	67	61	Pass
0.6572	100	56	56	Pass
0.6657	86	45	52	Pass
0.6743	81	41	50	Pass
0.6828	70	36	51	Pass
0.6913	59	33	55	Pass
0.6998	55	27	49	Pass
0.7084	48	21	43	Pass
0.7169	45	13	28	Pass
0.7254	40	10	25	Pass
0.7339	36	7	19	Pass
0.7425	29	3	10	Pass
0.7510	24	0	0	Pass
0.7595	21	0	0	Pass
0.7681	20	0	0	Pass
0.7766	17	0	0	Pass
0.7851	16	0	0	Pass
0.7936	16	0	0	Pass
0.8022	13	0	0	Pass
0.8107	11	0	0	Pass
0.8192	5	0	0	Pass
0.8277	4	0	0	Pass
0.8363	4	0	0	Pass
0.8448	4	0	0	Pass
0.8533	4	0	0	Pass
0.8618	4	0	0	Pass
0.8704	4	0	0	Pass
0.8789	4	0	0	Pass
0.8874	4	0	0	Pass
0.8959	4	0	0	Pass
0.9045	4	0	0	Pass
0.9130	4	0	0	Pass
0.9215	4	0	0	Pass
0.9301	4	0	0	Pass
0.9386	4	0	0	Pass
0.9471	3	0	0	Pass
0.9556	2	0	0	Pass
0.9642	2	0	0	Pass
0.9727	2	0	0	Pass
0.9812	2	0	0	Pass
0.9897	2	0	0	Pass
0.9983	2	0	0	Pass

Water Quality

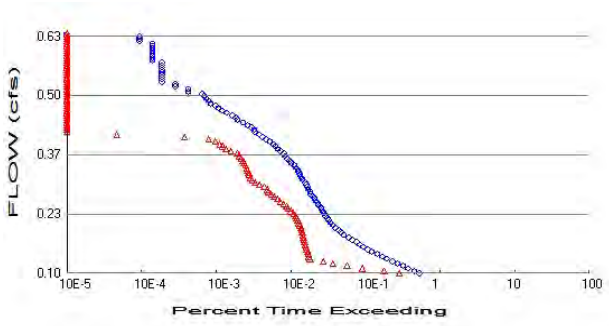
Water Quality BMP Flow and Volume for POC #2

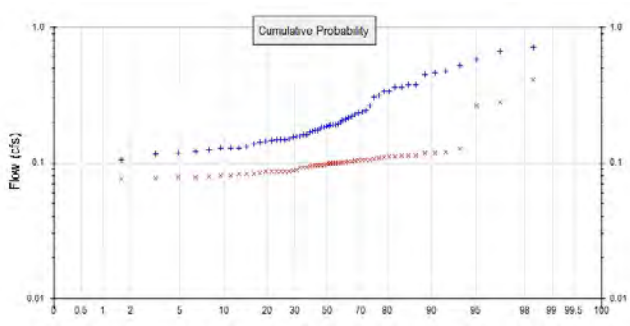
On-line facility volume:	0.2268 acre-feet
On-line facility target flow:	0.1145 cfs.
Adjusted for 15 min:	0.1145 cfs.
Off-line facility target flow:	0.0754 cfs.
Adjusted for 15 min:	0.0754 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault B POC	☐	1135.53			☐	0.00			
Vault A	☐	704.90			☐	0.00			
Total Volume Infiltrated		1840.43	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 3





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 5.09
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 1.099
Total Impervious Area: 3.992

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	0.199189
5 year	0.309132
10 year	0.396565
25 year	0.525026
50 year	0.634657
100 year	0.756982

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	0.097854
5 year	0.127521
10 year	0.149456
25 year	0.179872
50 year	0.204569
100 year	0.231084

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	**Predeveloped**	**Mitigated**
1949	0.173	0.092
1950	0.185	0.097
1951	0.179	0.083
1952	0.137	0.078
1953	0.116	0.080
1954	0.663	0.096
1955	0.306	0.105
1956	0.221	0.112
1957	0.336	0.107
1958	0.226	0.086
1959	0.182	0.097

1960	0.200	0.104
1961	0.364	0.103
1962	0.190	0.089
1963	0.336	0.084
1964	0.206	0.080
1965	0.160	0.097
1966	0.105	0.086
1967	0.234	0.087
1968	0.210	0.106
1969	0.579	0.086
1970	0.131	0.086
1971	0.243	0.111
1972	0.194	0.098
1973	0.147	0.093
1974	0.359	0.094
1975	0.171	0.083
1976	0.141	0.097
1977	0.149	0.092
1978	0.155	0.078
1979	0.475	0.096
1980	0.184	0.076
1981	0.147	0.086
1982	0.215	0.113
1983	0.315	0.086
1984	0.190	0.117
1985	0.266	0.105
1986	0.521	0.265
1987	0.235	0.126
1988	0.125	0.112
1989	0.144	0.076
1990	0.147	0.106
1991	0.190	0.100
1992	0.149	0.100
1993	0.121	0.082
1994	0.118	0.099
1995	0.156	0.113
1996	0.375	0.108
1997	0.711	0.413
1998	0.128	0.079
1999	0.161	0.102
2000	0.128	0.118
2001	0.056	0.071
2002	0.172	0.101
2003	0.128	0.100
2004	0.189	0.119
2005	0.157	0.099
2006	0.458	0.111
2007	0.376	0.101
2008	0.444	0.279
2009	0.167	0.097

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.7109	0.4131
2	0.6626	0.2792
3	0.5793	0.2651
4	0.5207	0.1264

5	0.4748	0.1189
6	0.4583	0.1176
7	0.4442	0.1174
8	0.3763	0.1133
9	0.3750	0.1131
10	0.3637	0.1121
11	0.3592	0.1121
12	0.3363	0.1108
13	0.3359	0.1105
14	0.3148	0.1082
15	0.3058	0.1069
16	0.2657	0.1056
17	0.2434	0.1055
18	0.2355	0.1047
19	0.2337	0.1047
20	0.2258	0.1039
21	0.2208	0.1027
22	0.2150	0.1021
23	0.2098	0.1012
24	0.2061	0.1007
25	0.1998	0.1001
26	0.1939	0.1000
27	0.1900	0.0995
28	0.1898	0.0993
29	0.1897	0.0988
30	0.1892	0.0981
31	0.1849	0.0973
32	0.1836	0.0972
33	0.1825	0.0971
34	0.1786	0.0969
35	0.1726	0.0969
36	0.1718	0.0960
37	0.1710	0.0958
38	0.1670	0.0940
39	0.1614	0.0931
40	0.1602	0.0922
41	0.1569	0.0921
42	0.1562	0.0890
43	0.1548	0.0874
44	0.1491	0.0864
45	0.1488	0.0863
46	0.1472	0.0860
47	0.1469	0.0859
48	0.1466	0.0857
49	0.1438	0.0857
50	0.1408	0.0843
51	0.1369	0.0829
52	0.1311	0.0825
53	0.1282	0.0824
54	0.1278	0.0803
55	0.1275	0.0799
56	0.1246	0.0793
57	0.1211	0.0782
58	0.1183	0.0780
59	0.1163	0.0765
60	0.1048	0.0757
61	0.0558	0.0706

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0996	11334	6117	53	Pass
0.1050	9685	3807	39	Pass
0.1104	8008	1960	24	Pass
0.1158	6855	1212	17	Pass
0.1212	5736	788	13	Pass
0.1266	4947	584	11	Pass
0.1320	4156	391	9	Pass
0.1374	3600	371	10	Pass
0.1428	3074	366	11	Pass
0.1482	2592	358	13	Pass
0.1536	2297	351	15	Pass
0.1590	2011	343	17	Pass
0.1645	1806	334	18	Pass
0.1699	1621	326	20	Pass
0.1753	1419	320	22	Pass
0.1807	1268	315	24	Pass
0.1861	1103	308	27	Pass
0.1915	1015	304	29	Pass
0.1969	935	300	32	Pass
0.2023	851	293	34	Pass
0.2077	791	285	36	Pass
0.2131	735	273	37	Pass
0.2185	695	266	38	Pass
0.2239	662	257	38	Pass
0.2293	625	246	39	Pass
0.2347	598	234	39	Pass
0.2401	573	217	37	Pass
0.2455	548	197	35	Pass
0.2509	526	188	35	Pass
0.2563	496	172	34	Pass
0.2617	475	155	32	Pass
0.2671	446	141	31	Pass
0.2725	424	128	30	Pass
0.2779	400	118	29	Pass
0.2834	388	109	28	Pass
0.2888	368	104	28	Pass
0.2942	357	94	26	Pass
0.2996	344	81	23	Pass
0.3050	331	71	21	Pass
0.3104	311	65	20	Pass
0.3158	299	62	20	Pass
0.3212	286	59	20	Pass
0.3266	276	58	21	Pass
0.3320	266	56	21	Pass
0.3374	252	55	21	Pass
0.3428	241	53	21	Pass
0.3482	216	50	23	Pass
0.3536	206	49	23	Pass
0.3590	193	46	23	Pass
0.3644	179	44	24	Pass
0.3698	171	41	23	Pass
0.3752	155	34	21	Pass
0.3806	143	29	20	Pass

0.3860	134	26	19	Pass
0.3914	125	24	19	Pass
0.3969	112	21	18	Pass
0.4023	100	17	17	Pass
0.4077	89	8	8	Pass
0.4131	80	1	1	Pass
0.4185	71	0	0	Pass
0.4239	69	0	0	Pass
0.4293	64	0	0	Pass
0.4347	56	0	0	Pass
0.4401	49	0	0	Pass
0.4455	41	0	0	Pass
0.4509	39	0	0	Pass
0.4563	35	0	0	Pass
0.4617	30	0	0	Pass
0.4671	26	0	0	Pass
0.4725	23	0	0	Pass
0.4779	21	0	0	Pass
0.4833	18	0	0	Pass
0.4887	17	0	0	Pass
0.4941	16	0	0	Pass
0.4995	15	0	0	Pass
0.5049	14	0	0	Pass
0.5103	9	0	0	Pass
0.5158	9	0	0	Pass
0.5212	6	0	0	Pass
0.5266	6	0	0	Pass
0.5320	4	0	0	Pass
0.5374	4	0	0	Pass
0.5428	4	0	0	Pass
0.5482	4	0	0	Pass
0.5536	4	0	0	Pass
0.5590	4	0	0	Pass
0.5644	4	0	0	Pass
0.5698	4	0	0	Pass
0.5752	4	0	0	Pass
0.5806	3	0	0	Pass
0.5860	3	0	0	Pass
0.5914	3	0	0	Pass
0.5968	3	0	0	Pass
0.6022	3	0	0	Pass
0.6076	3	0	0	Pass
0.6130	3	0	0	Pass
0.6184	3	0	0	Pass
0.6238	2	0	0	Pass
0.6293	2	0	0	Pass
0.6347	2	0	0	Pass

Water Quality

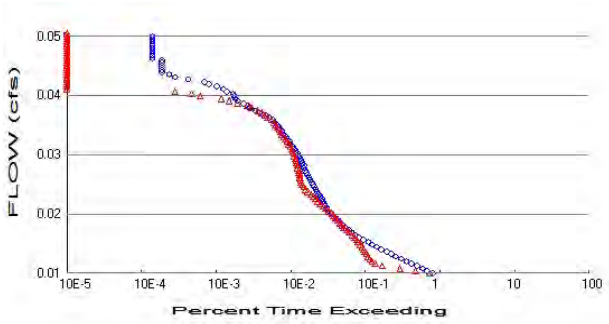
Water Quality BMP Flow and Volume for POC #3

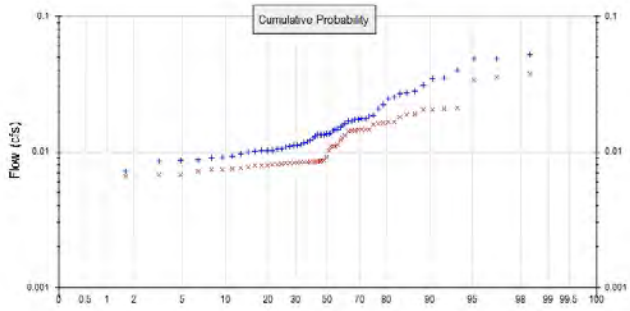
On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault APOC	☐	704.90			☐	0.00			
Total Volume Infiltrated		704.90	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 4





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #4
Total Pervious Area: 0.413
Total Impervious Area: 0

Mitigated Landuse Totals for POC #4
Total Pervious Area: 0.166
Total Impervious Area: 0.246

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #4

Return Period	**Flow(cfs)**
2 year	0.014623
5 year	0.022869
10 year	0.029321
25 year	0.038658
50 year	0.046511
100 year	0.055166

Flow Frequency Return Periods for Mitigated. POC #4

Return Period	**Flow(cfs)**
2 year	0.010813
5 year	0.016052
10 year	0.020253
25 year	0.026484
50 year	0.031857
100 year	0.03791

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #4

Year	**Predeveloped**	**Mitigated**
1949	0.015	0.008
1950	0.016	0.008
1951	0.014	0.008
1952	0.011	0.007
1953	0.009	0.007
1954	0.053	0.009
1955	0.018	0.015
1956	0.016	0.014
1957	0.021	0.019
1958	0.018	0.008
1959	0.015	0.011

1960	0.013	0.016
1961	0.028	0.012
1962	0.013	0.009
1963	0.022	0.008
1964	0.017	0.008
1965	0.012	0.009
1966	0.007	0.008
1967	0.014	0.008
1968	0.018	0.019
1969	0.049	0.008
1970	0.010	0.008
1971	0.017	0.013
1972	0.012	0.014
1973	0.011	0.008
1974	0.027	0.008
1975	0.010	0.007
1976	0.011	0.014
1977	0.009	0.008
1978	0.010	0.007
1979	0.031	0.016
1980	0.015	0.007
1981	0.010	0.008
1982	0.013	0.021
1983	0.025	0.008
1984	0.014	0.016
1985	0.017	0.017
1986	0.040	0.034
1987	0.019	0.021
1988	0.010	0.015
1989	0.011	0.006
1990	0.013	0.013
1991	0.013	0.015
1992	0.010	0.008
1993	0.009	0.008
1994	0.009	0.011
1995	0.014	0.015
1996	0.024	0.018
1997	0.048	0.038
1998	0.009	0.007
1999	0.011	0.011
2000	0.009	0.017
2001	0.003	0.007
2002	0.013	0.010
2003	0.010	0.009
2004	0.017	0.020
2005	0.012	0.011
2006	0.035	0.020
2007	0.027	0.009
2008	0.034	0.036
2009	0.010	0.008

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #4

Rank	Predeveloped	Mitigated
1	0.0525	0.0377
2	0.0489	0.0356
3	0.0484	0.0335
4	0.0400	0.0212

5	0.0350	0.0209
6	0.0345	0.0205
7	0.0310	0.0205
8	0.0279	0.0190
9	0.0272	0.0188
10	0.0268	0.0180
11	0.0252	0.0167
12	0.0245	0.0166
13	0.0224	0.0164
14	0.0207	0.0161
15	0.0186	0.0158
16	0.0182	0.0147
17	0.0176	0.0146
18	0.0176	0.0146
19	0.0174	0.0145
20	0.0172	0.0145
21	0.0168	0.0143
22	0.0167	0.0143
23	0.0160	0.0132
24	0.0157	0.0126
25	0.0153	0.0123
26	0.0145	0.0113
27	0.0145	0.0110
28	0.0145	0.0109
29	0.0137	0.0109
30	0.0136	0.0103
31	0.0136	0.0091
32	0.0134	0.0086
33	0.0134	0.0086
34	0.0134	0.0085
35	0.0134	0.0085
36	0.0130	0.0084
37	0.0127	0.0084
38	0.0121	0.0084
39	0.0117	0.0084
40	0.0116	0.0084
41	0.0112	0.0083
42	0.0111	0.0083
43	0.0111	0.0082
44	0.0110	0.0082
45	0.0108	0.0082
46	0.0105	0.0082
47	0.0105	0.0081
48	0.0103	0.0080
49	0.0103	0.0080
50	0.0102	0.0079
51	0.0101	0.0079
52	0.0099	0.0077
53	0.0097	0.0076
54	0.0093	0.0075
55	0.0091	0.0074
56	0.0090	0.0073
57	0.0087	0.0072
58	0.0086	0.0068
59	0.0085	0.0067
60	0.0071	0.0066
61	0.0034	0.0062

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0073	17092	15635	91	Pass
0.0077	14523	10027	69	Pass
0.0081	12397	6271	50	Pass
0.0085	10476	3589	34	Pass
0.0089	8906	2883	32	Pass
0.0093	7604	2627	34	Pass
0.0097	6474	2464	38	Pass
0.0101	5508	2327	42	Pass
0.0105	4774	2207	46	Pass
0.0109	4102	2112	51	Pass
0.0113	3521	2015	57	Pass
0.0117	3069	1944	63	Pass
0.0121	2674	1848	69	Pass
0.0125	2340	1728	73	Pass
0.0129	2028	1637	80	Pass
0.0133	1753	1529	87	Pass
0.0136	1555	1421	91	Pass
0.0140	1397	1307	93	Pass
0.0144	1269	1203	94	Pass
0.0148	1156	1100	95	Pass
0.0152	1063	1030	96	Pass
0.0156	991	969	97	Pass
0.0160	926	912	98	Pass
0.0164	857	850	99	Pass
0.0168	798	800	100	Pass
0.0172	753	758	100	Pass
0.0176	690	694	100	Pass
0.0180	650	631	97	Pass
0.0184	623	580	93	Pass
0.0188	600	533	88	Pass
0.0192	576	497	86	Pass
0.0196	555	461	83	Pass
0.0200	530	434	81	Pass
0.0204	502	398	79	Pass
0.0208	479	364	75	Pass
0.0212	465	335	72	Pass
0.0216	443	320	72	Pass
0.0220	426	304	71	Pass
0.0224	408	293	71	Pass
0.0228	387	289	74	Pass
0.0231	376	285	75	Pass
0.0235	357	281	78	Pass
0.0239	346	277	80	Pass
0.0243	337	274	81	Pass
0.0247	325	266	81	Pass
0.0251	320	262	81	Pass
0.0255	306	257	83	Pass
0.0259	295	251	85	Pass
0.0263	285	246	86	Pass
0.0267	276	239	86	Pass
0.0271	264	234	88	Pass
0.0275	248	226	91	Pass
0.0279	235	222	94	Pass

0.0283	227	214	94	Pass
0.0287	215	202	93	Pass
0.0291	204	191	93	Pass
0.0295	193	183	94	Pass
0.0299	184	171	92	Pass
0.0303	173	163	94	Pass
0.0307	165	157	95	Pass
0.0311	155	149	96	Pass
0.0315	148	141	95	Pass
0.0319	141	134	95	Pass
0.0323	131	127	96	Pass
0.0327	122	117	95	Pass
0.0330	111	103	92	Pass
0.0334	100	95	95	Pass
0.0338	82	88	107	Pass
0.0342	72	78	108	Pass
0.0346	60	64	106	Pass
0.0350	57	56	98	Pass
0.0354	50	41	82	Pass
0.0358	42	32	76	Pass
0.0362	39	25	64	Pass
0.0366	37	13	35	Pass
0.0370	36	10	27	Pass
0.0374	30	6	20	Pass
0.0378	27	0	0	Pass
0.0382	22	0	0	Pass
0.0386	17	0	0	Pass
0.0390	15	0	0	Pass
0.0394	9	0	0	Pass
0.0398	6	0	0	Pass
0.0402	5	0	0	Pass
0.0406	4	0	0	Pass
0.0410	4	0	0	Pass
0.0414	4	0	0	Pass
0.0418	4	0	0	Pass
0.0422	4	0	0	Pass
0.0426	4	0	0	Pass
0.0429	3	0	0	Pass
0.0433	3	0	0	Pass
0.0437	3	0	0	Pass
0.0441	3	0	0	Pass
0.0445	3	0	0	Pass
0.0449	3	0	0	Pass
0.0453	3	0	0	Pass
0.0457	3	0	0	Pass
0.0461	3	0	0	Pass
0.0465	3	0	0	Pass

Water Quality

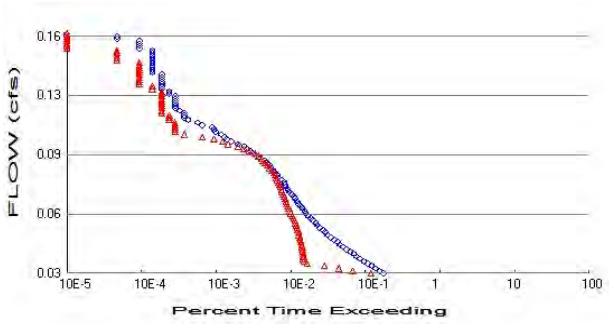
Water Quality BMP Flow and Volume for POC #4

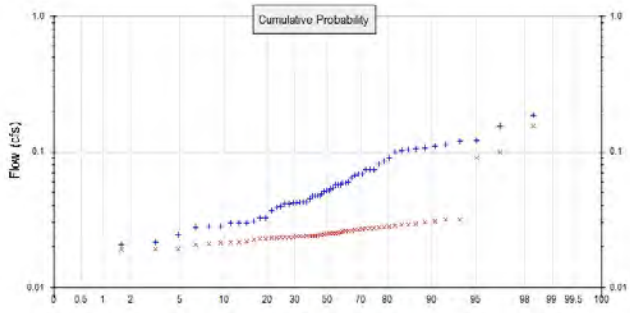
On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault D POC	☐	43.52			☐	0.00			
Total Volume Infiltrated		43.52	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 5





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #5
Total Pervious Area: 0.916
Total Impervious Area: 0

Mitigated Landuse Totals for POC #5
Total Pervious Area: 0.221
Total Impervious Area: 0.694

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #5

Return Period	**Flow(cfs)**
2 year	0.05258
5 year	0.081915
10 year	0.104298
25 year	0.135963
50 year	0.162038
100 year	0.190272

Flow Frequency Return Periods for Mitigated. POC #5

Return Period	**Flow(cfs)**
2 year	0.025479
5 year	0.035159
10 year	0.042643
25 year	0.053417
50 year	0.062464
100 year	0.072442

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #5

Year	**Predeveloped**	**Mitigated**
1949	0.021	0.024
1950	0.041	0.024
1951	0.042	0.023
1952	0.030	0.019
1953	0.024	0.021
1954	0.121	0.025
1955	0.107	0.026
1956	0.064	0.027
1957	0.104	0.029
1958	0.069	0.023
1959	0.047	0.025

1960	0.069	0.028
1961	0.073	0.026
1962	0.052	0.024
1963	0.090	0.023
1964	0.049	0.023
1965	0.045	0.024
1966	0.028	0.022
1967	0.074	0.023
1968	0.048	0.029
1969	0.086	0.024
1970	0.042	0.022
1971	0.059	0.026
1972	0.082	0.026
1973	0.051	0.023
1974	0.074	0.023
1975	0.052	0.021
1976	0.039	0.027
1977	0.054	0.024
1978	0.042	0.019
1979	0.154	0.027
1980	0.037	0.021
1981	0.042	0.023
1982	0.067	0.031
1983	0.057	0.024
1984	0.057	0.028
1985	0.099	0.028
1986	0.119	0.090
1987	0.057	0.032
1988	0.031	0.027
1989	0.032	0.018
1990	0.019	0.026
1991	0.047	0.027
1992	0.042	0.024
1993	0.033	0.023
1994	0.030	0.025
1995	0.028	0.028
1996	0.105	0.029
1997	0.185	0.154
1998	0.041	0.021
1999	0.059	0.025
2000	0.053	0.029
2001	0.020	0.019
2002	0.048	0.025
2003	0.030	0.024
2004	0.028	0.032
2005	0.040	0.025
2006	0.110	0.030
2007	0.102	0.024
2008	0.114	0.100
2009	0.058	0.024

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #5

Rank	Predeveloped	Mitigated
1	0.1854	0.1544
2	0.1543	0.0996
3	0.1208	0.0902
4	0.1193	0.0317

5	0.1136	0.0315
6	0.1104	0.0307
7	0.1069	0.0303
8	0.1048	0.0293
9	0.1039	0.0291
10	0.1024	0.0288
11	0.0992	0.0285
12	0.0898	0.0280
13	0.0856	0.0278
14	0.0820	0.0276
15	0.0741	0.0275
16	0.0740	0.0273
17	0.0735	0.0272
18	0.0690	0.0270
19	0.0687	0.0266
20	0.0671	0.0266
21	0.0636	0.0262
22	0.0594	0.0261
23	0.0588	0.0260
24	0.0584	0.0258
25	0.0574	0.0256
26	0.0570	0.0253
27	0.0570	0.0252
28	0.0537	0.0252
29	0.0528	0.0252
30	0.0520	0.0251
31	0.0515	0.0248
32	0.0512	0.0245
33	0.0488	0.0244
34	0.0476	0.0244
35	0.0476	0.0241
36	0.0475	0.0241
37	0.0472	0.0241
38	0.0451	0.0240
39	0.0423	0.0239
40	0.0423	0.0238
41	0.0422	0.0238
42	0.0420	0.0236
43	0.0419	0.0235
44	0.0415	0.0235
45	0.0413	0.0234
46	0.0397	0.0233
47	0.0389	0.0231
48	0.0370	0.0229
49	0.0326	0.0226
50	0.0324	0.0226
51	0.0307	0.0225
52	0.0299	0.0219
53	0.0299	0.0216
54	0.0298	0.0214
55	0.0283	0.0211
56	0.0282	0.0209
57	0.0277	0.0206
58	0.0243	0.0193
59	0.0214	0.0192
60	0.0205	0.0188
61	0.0193	0.0177

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0263	3779	2532	67	Pass
0.0277	3313	1438	43	Pass
0.0290	2939	946	32	Pass
0.0304	2607	606	23	Pass
0.0318	2293	354	15	Pass
0.0331	2038	321	15	Pass
0.0345	1829	318	17	Pass
0.0359	1648	315	19	Pass
0.0373	1498	311	20	Pass
0.0386	1344	308	22	Pass
0.0400	1198	307	25	Pass
0.0414	1072	304	28	Pass
0.0427	973	299	30	Pass
0.0441	898	291	32	Pass
0.0455	817	288	35	Pass
0.0469	743	282	37	Pass
0.0482	669	277	41	Pass
0.0496	619	272	43	Pass
0.0510	573	267	46	Pass
0.0523	527	261	49	Pass
0.0537	482	254	52	Pass
0.0551	460	249	54	Pass
0.0565	423	243	57	Pass
0.0578	393	235	59	Pass
0.0592	363	225	61	Pass
0.0606	340	217	63	Pass
0.0619	326	208	63	Pass
0.0633	306	201	65	Pass
0.0647	287	194	67	Pass
0.0661	272	188	69	Pass
0.0674	263	184	69	Pass
0.0688	244	179	73	Pass
0.0702	234	174	74	Pass
0.0715	220	170	77	Pass
0.0729	206	164	79	Pass
0.0743	194	160	82	Pass
0.0757	182	155	85	Pass
0.0770	178	151	84	Pass
0.0784	175	147	84	Pass
0.0798	160	142	88	Pass
0.0811	147	137	93	Pass
0.0825	140	132	94	Pass
0.0839	130	129	99	Pass
0.0853	125	119	95	Pass
0.0866	116	111	95	Pass
0.0880	110	103	93	Pass
0.0894	103	97	94	Pass
0.0907	96	90	93	Pass
0.0921	84	87	103	Pass
0.0935	74	79	106	Pass
0.0948	66	71	107	Pass
0.0962	62	59	95	Pass
0.0976	55	51	92	Pass

0.0990	51	42	82	Pass
0.1003	42	31	73	Pass
0.1017	34	26	76	Pass
0.1031	30	20	66	Pass
0.1044	28	14	50	Pass
0.1058	25	8	32	Pass
0.1072	21	6	28	Pass
0.1086	20	6	30	Pass
0.1099	19	6	31	Pass
0.1113	14	6	42	Pass
0.1127	12	6	50	Pass
0.1140	9	5	55	Pass
0.1154	8	5	62	Pass
0.1168	8	5	62	Pass
0.1182	8	4	50	Pass
0.1195	7	4	57	Pass
0.1209	6	4	66	Pass
0.1223	6	4	66	Pass
0.1236	6	4	66	Pass
0.1250	6	4	66	Pass
0.1264	6	4	66	Pass
0.1278	6	4	66	Pass
0.1291	5	4	80	Pass
0.1305	5	4	80	Pass
0.1319	4	3	75	Pass
0.1332	4	3	75	Pass
0.1346	4	2	50	Pass
0.1360	4	2	50	Pass
0.1374	4	2	50	Pass
0.1387	4	2	50	Pass
0.1401	4	2	50	Pass
0.1415	3	2	66	Pass
0.1428	3	2	66	Pass
0.1442	3	2	66	Pass
0.1456	3	2	66	Pass
0.1470	3	2	66	Pass
0.1483	3	1	33	Pass
0.1497	3	1	33	Pass
0.1511	3	1	33	Pass
0.1524	3	1	33	Pass
0.1538	3	1	33	Pass
0.1552	2	0	0	Pass
0.1566	2	0	0	Pass
0.1579	2	0	0	Pass
0.1593	2	0	0	Pass
0.1607	1	0	0	Pass
0.1620	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #5

On-line facility volume:	0.8176 acre-feet
On-line facility target flow:	1.2405 cfs.
Adjusted for 15 min:	1.2405 cfs.
Off-line facility target flow:	0.7026 cfs.
Adjusted for 15 min:	0.7026 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault E POC	☐	122.55			☐	0.00			
Total Volume Infiltrated		122.55	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

POC 6

POC #6 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 7

POC #7 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 8

POC #8 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 9

POC #9 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

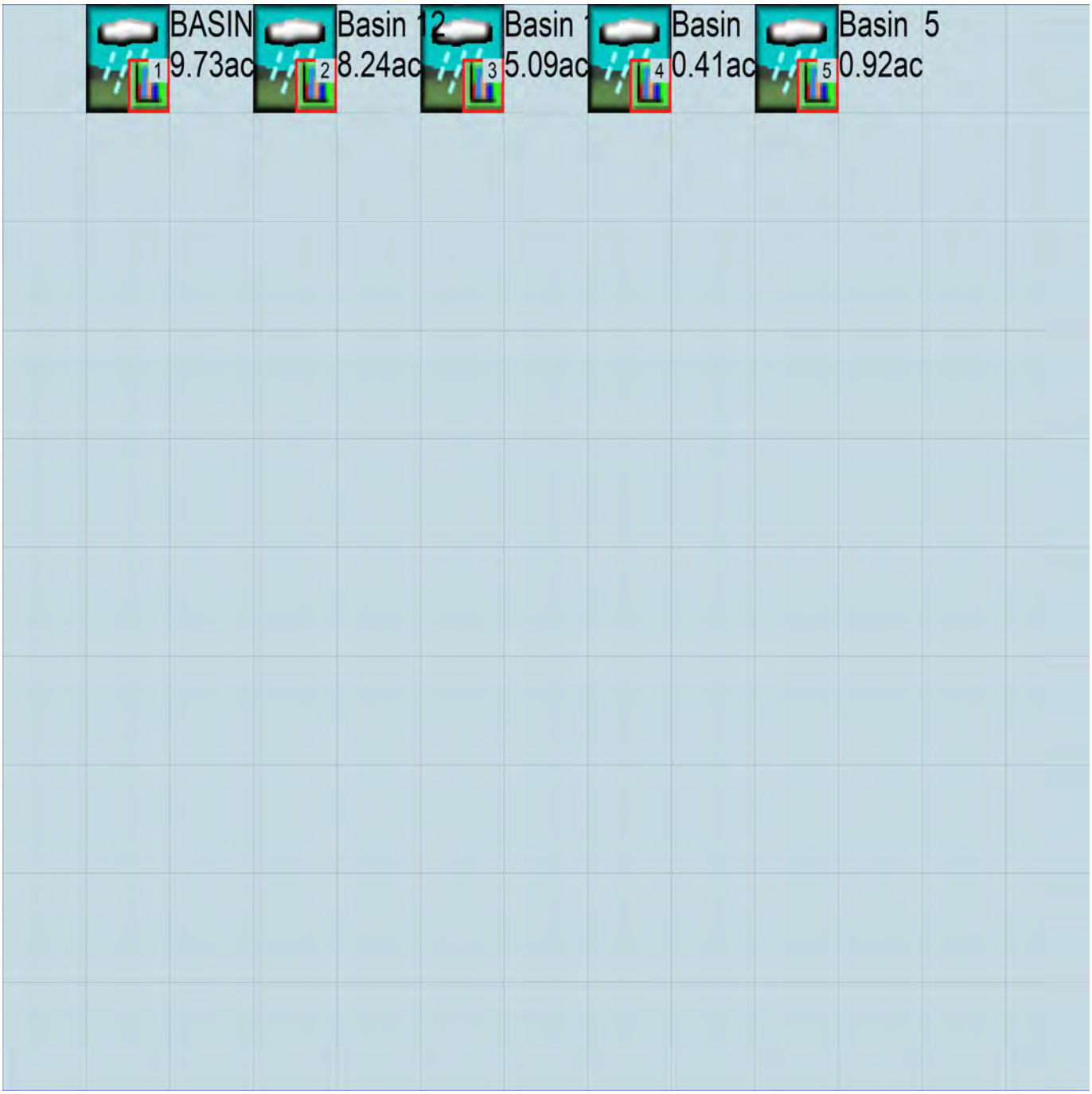
No PERLND changes have been made.

IMPLND Changes

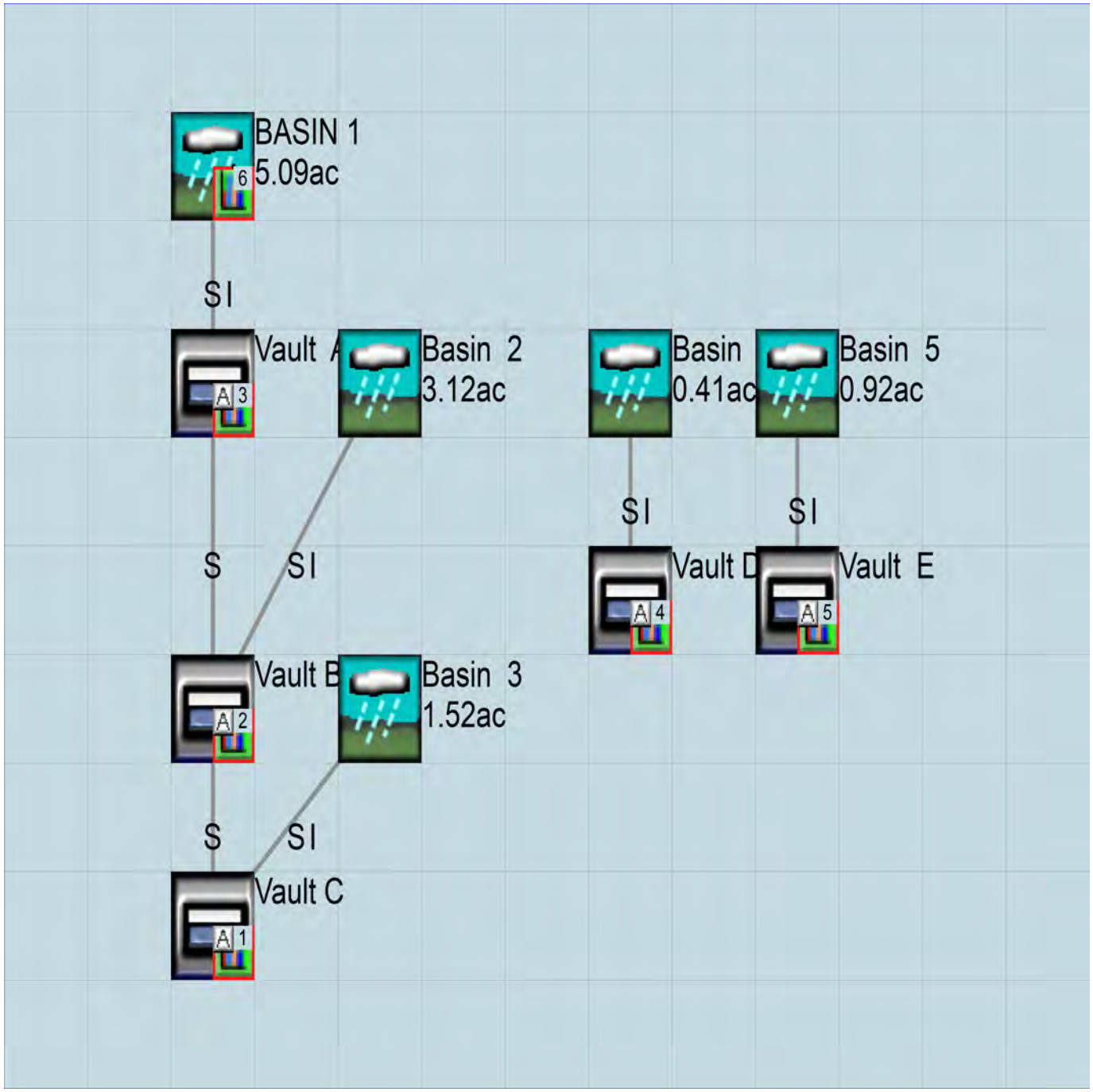
No IMPLND changes have been made.

Appendix

Predeveloped Schematic

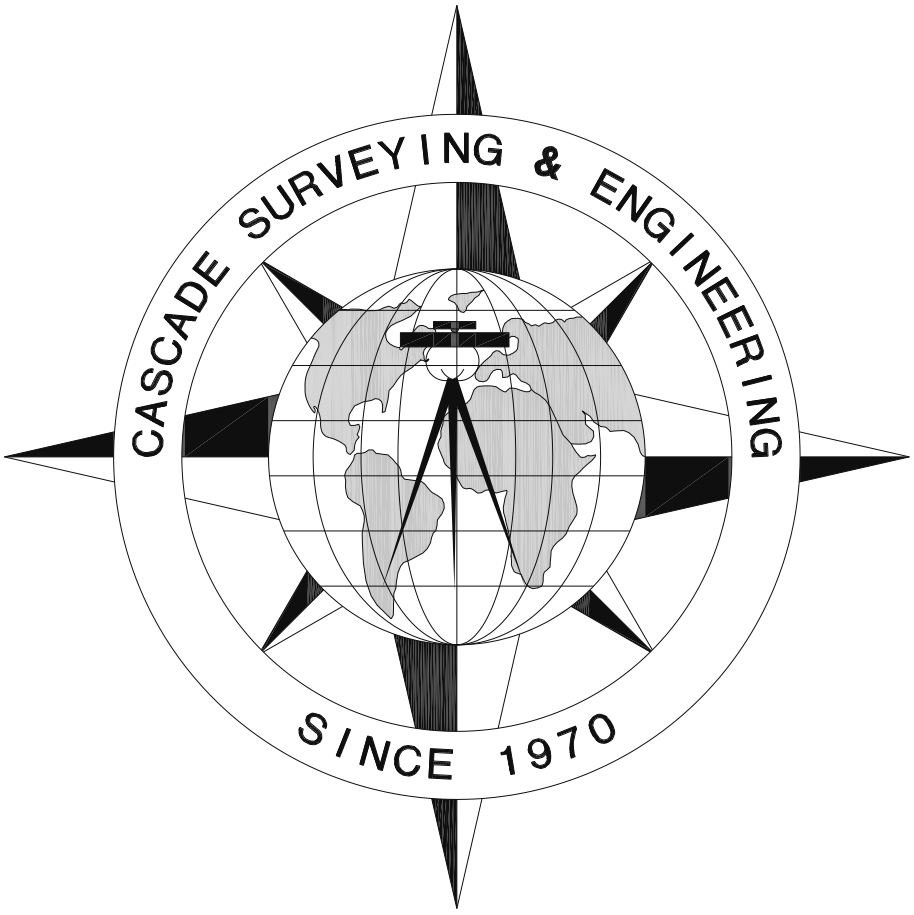


Mitigated Schematic



APPENDIX D – OPERATION AND MAINTENANCE MANUAL

STORMWATER FACILITY MAINTENANCE MANUAL



FOR PUBLIC & PRIVATELY OWNED STORMWATER FACILITIES

PREPARED BY:
CASCADE SURVEYING & ENGINEERING, INC.

February 2023

TABLE OF CONTENTS

INTRODUCTION

Background

All residential, commercial, and industrial developments have some form of stormwater drainage facilities. Stormwater facilities generally drain to roadside ditches, underground storm pipe systems, streams, lakes, or to groundwater from infiltration facilities. Stormwater facilities generally consist of pipes, catch basins, swales, ditches, ponds, oil/water separators, underground infiltration trenches, and any other structure that collects, conveys, controls, and treats stormwater.

Stormwater facilities are either privately owned or publicly owned. Private stormwater facility owners consist of individual residential property owners, a home owners' association, commercial and industrial land owners. Privately owned stormwater facilities are generally installed on private property within the bounds of the private land, in a separate tract, or in an easement on land owned by others.

Publicly owned stormwater facilities are usually owned and operated by a city, county, state, or federal entities. In either case, the owner of the system is responsible for operating and maintaining all elements of the facility.

Purpose

The objective of this manual is to ensure that stormwater control facilities are adequately maintained and operated properly.

This manual is intended to meet all storm system operation and maintenance requirements listed under the 2012 City of Arlington Engineering Design and Development Standards.

Storm system maintenance is necessary to protect streams, lakes, wetlands, and groundwater. Proper maintenance assures that storm systems operate as they were designed, and that they are cleaned of pollutants that they trap, such as sediment and oils, so that the storm system is not overwhelmed and becomes a pollutant source.

Stormwater System Inspection Schedule

The drainage system should be monitored periodically. For the first year after completion of construction, the system should be monitored after every large storm event (> 1-in in 24-hrs), and, during the period Oct. 1- Mar. 31 inspections should be conducted monthly. From April 1- Sept. 30, the facility should be monitored on a quarterly basis. Once the performance characteristics of the facility have been verified, the monitoring schedule can be reduced to an annual basis unless the performance data indicate that a more frequent schedule is required.

Catch Basin

A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

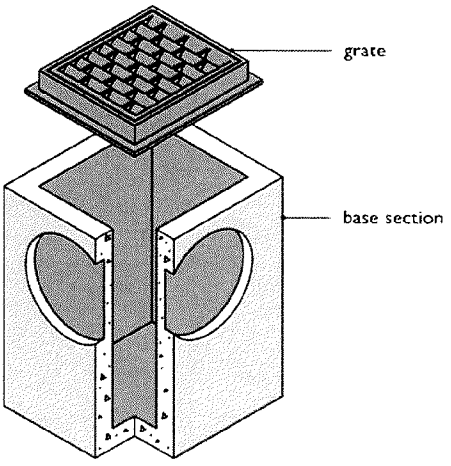
A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

Type 2 catch basins, also commonly referred to as storm manholes, are round concrete structures ranging in diameter from 4 feet to 8 feet. Type 2 catch basins are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Type 2 catch basins typically have manhole steps mounted on the side of the structure to allow access.

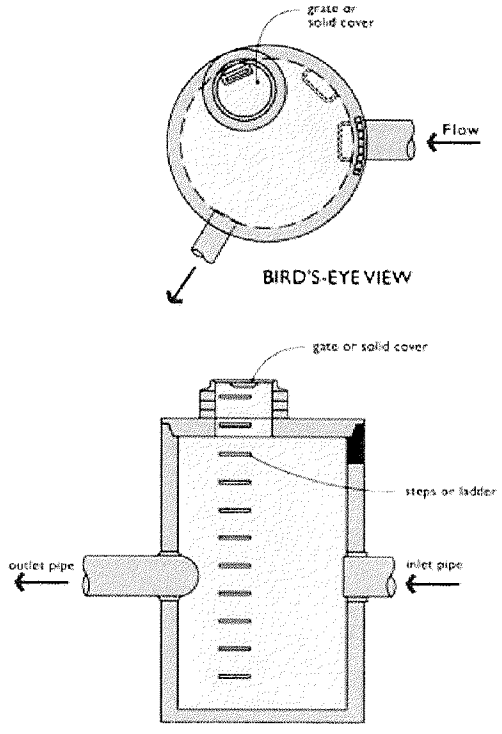
Both types typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

The most common tool for cleaning catch basins is a truck with a tank and vacuum hose (vactor truck) to remove sediment and debris from the sump. A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch basins are typically associated with all stormwater facilities.



Type 1



Type 2

Catch Basins			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.

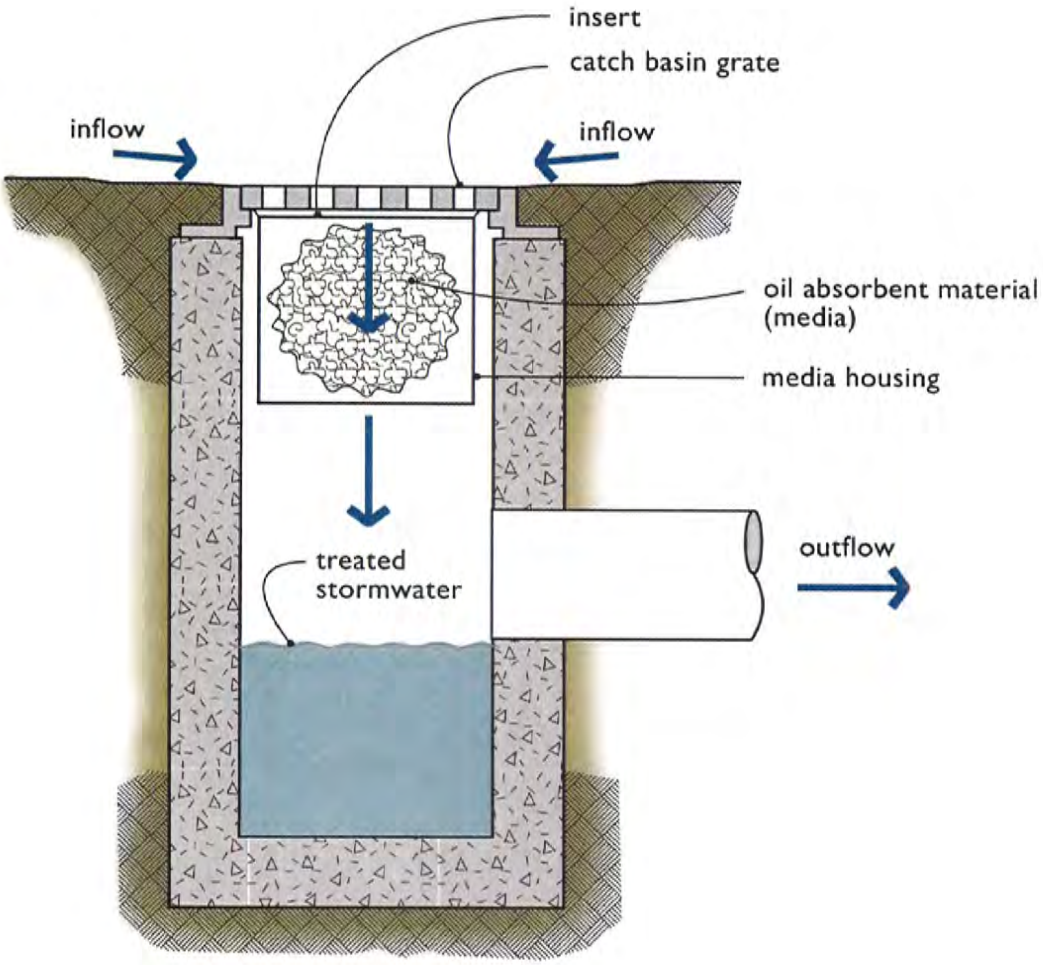
Catch Basins (Continued)			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Catch Basin Insert

Catch basin inserts are becoming more widely used to trap sediment and oil entering catch basins. Most involve some type of filter media and oil-absorbent pads. Filters avoid flooding by overflowing when they become clogged or when there are high storm flows.

Catch basin inserts typically consist of the following components:

- A structure (screened box, brackets, etc.) which contains a pollutant removal medium
- A means of suspending the structure in a catch basin
- A filter medium such as sand, carbon, fabric, etc.
- A primary inlet and outlet for the stormwater
- A secondary outlet for bypassing flows that exceed design flow



Catch Basin Insert			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Conveyance Stormwater Pipe

Inlet and outlet stormwater pipes convey stormwater in, through, and out of stormwater facilities.

Storm sewer pipes convey stormwater. Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Stormwater pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.

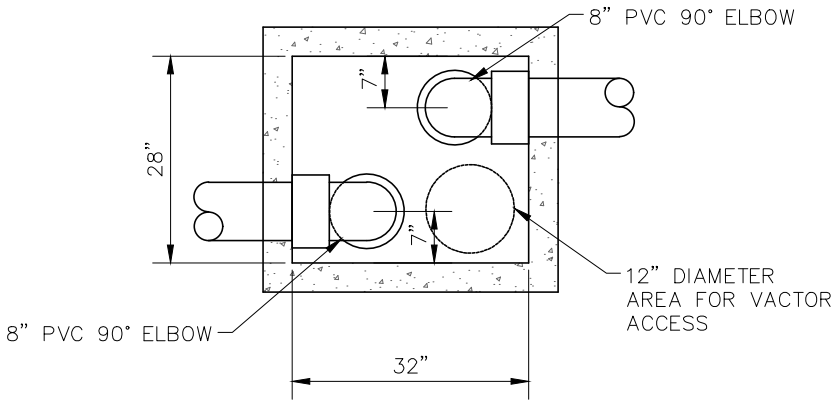
Conveyance Storm Pipe			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root. Do not put root-dissolving chemicals in storm sewer pipes. If necessary, remove the vegetation over the line.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Install upstream debris traps (where applicable) then clean pipe and remove material
	Debris barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier	Debris barrier present on all stormwater pipes 18 inches and greater

Oil/Water Separator (CATCH BASIN)

An oil/water separator is an underground vault that treats stormwater by mechanically separating oil from water. The oil rises to the surface and floats on the water and sediment settles to the bottom. Oil/water separators are typically utilized in locations where high oil concentrations in the stormwater runoff are anticipated (e.g. service and fuel stations). Oil/water separators are most commonly used as the first pre-treatment facility in a series of stormwater management facilities.

Facility objects that are typically associated with an oil/water separator include:

- access road or easement
- control structure/flow restrictor



NOTE:
REFER TO
ARLINGTON
STANDARD DETAIL
SD-120 FOR
VARIATION OF OIL/
WATER SEPARATOR

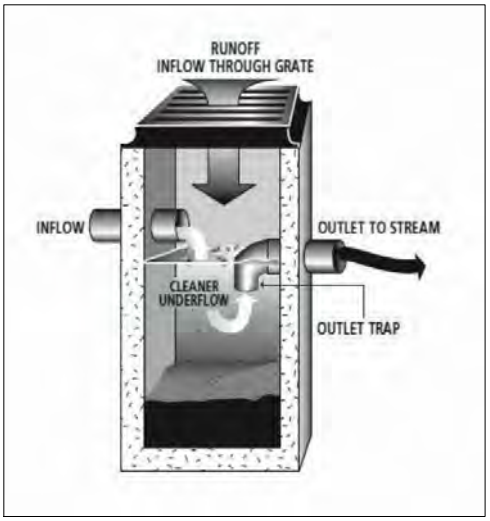


IMAGE FROM KING COUNTY STORMWATER POLLUTION PREVENTION MANUAL

Baffle Oil/Water Separator (API Type)

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance is Performed Or Not Needed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality (i.e. obvious oil or other contaminants present)	Effluent discharge from vault should be clear with out thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1-inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local rules and regulations.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab		
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
		Maintenance person judges that structure is unsound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Yard Drain & Cleanout

What is a Yard Drain?

A Yard Drain is similar to a Type 1 Catch Basin but smaller (most are 12 to 18 inches in diameter).

- Currently, the most frequently used type of yard drain is a high density polyethylene (HDPE) pipe:
  - set vertically on end,
  - with the bell end up fitted with a grate, and
  - the bottom end resting on washed drain rock.
- There are older versions which are made of either polyvinylchloride (PVC) or Concrete Pipe.

How does a Yard Drain work?

Yard Drain systems usually consist of several yard drains and 6”-8” diameter HDPE pipe between them. They are designed for use in private residential or commercial property and not for use in public or private streets and roads.

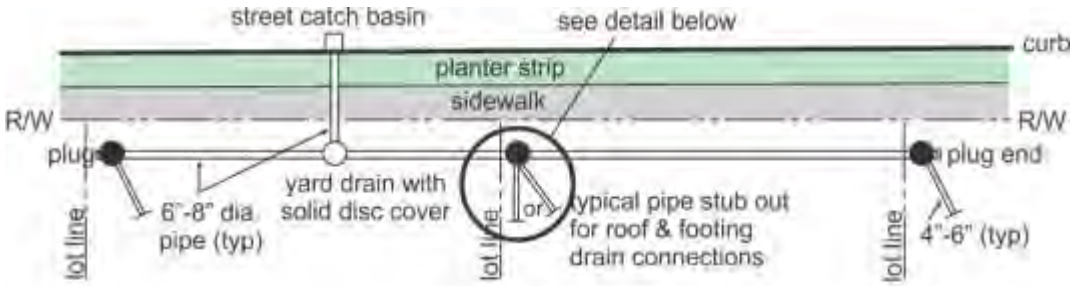
- They function as an intermediary stormwater conveyance system that connects roof and building foundation footing drains (4”-6” diameter HDPE pipe) to the main stormwater conveyance system of:
  - **Type 1 or 2 Catch Basins**, and
  - 12” and larger diameter HDPE pipe.
- Typically, in residential subdivisions these systems can be located along lot lines.
- Yard Drains also have commercial property applications, often being installed to connect building roof and footing drains To the parking area and driveway drainage systems.

NOTE: If Yard Drains are not visible, it is possible that Cleanouts were installed as a substitute. This is generally the case when the depth from the top of the **Yard Drain** grate to what would be the top of the washed drain rock exceeds 42”. (See drawings below.)

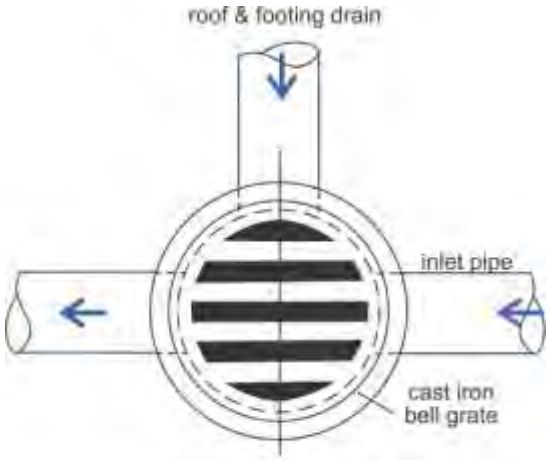
Common maintenance needs

The most common tool for cleaning Yard Drains or Cleanouts is a yard hose. Cleaning by a vactor truck with its very high pressure and volume washing and vacuum system can destroy both the older Yard Drains or Cleanouts and pipe. It is better to use a low pressure washing system and scoop out by hand any mud and debris collecting in the Yard Drains or Cleanouts.

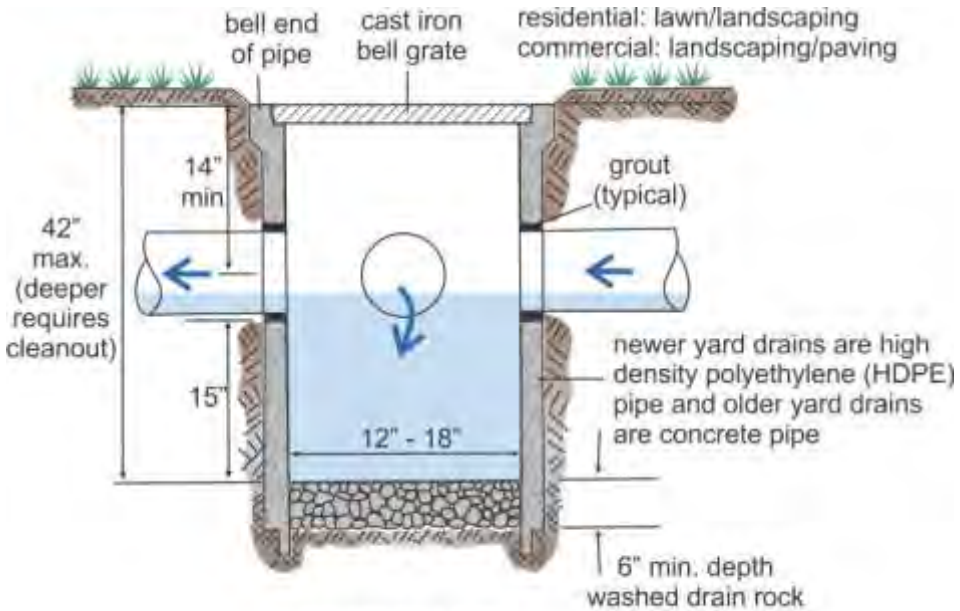
Yard Drain



BIRD'S-EYE VIEW
TYPICAL YARD DRAIN PLACEMENT FOR RESIDENTIAL LOTS

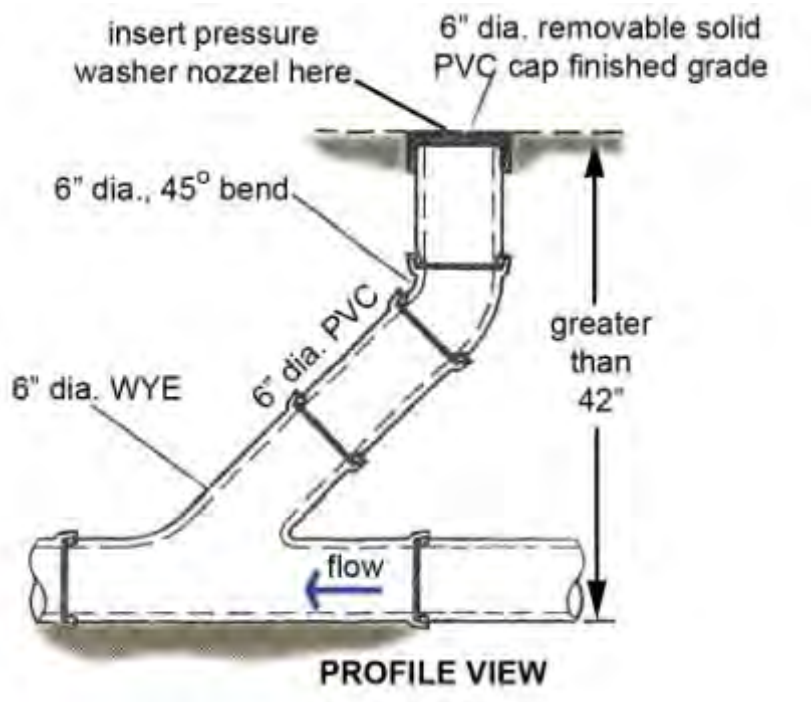


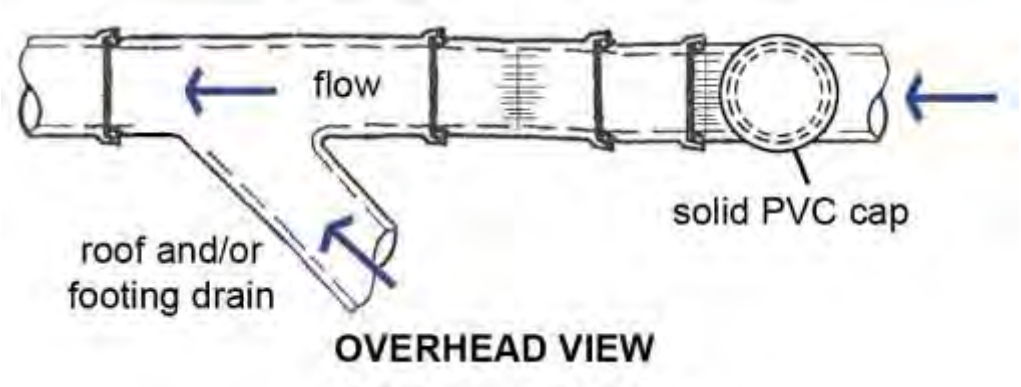
BIRD'S-EYE VIEW



SECTION VIEW

Cleanout


insert pressure
washer nozzel here
6" dia. removable solid
PVC cap finished grade
6" dia., 45° bend
6" dia. PVC
6" dia. WYE
greater
than
42"
flow
PROFILE VIEW


flow
solid PVC cap
roof and/or
footing drain
OVERHEAD VIEW

Yard Drain & Cleanout

Drainage system feature	Potential defect	Conditions when maintenance is needed	Results expected when maintenance is performed or not needed
Metal Grates	Excessive accumulation of trash, debris, sediment and vegetation	• Obstruction Immediately in front of the drain grate or covering it is reducing flow causing ponding or partial flow bypass.	• Obstruction removed.
		• Obstructing more than 1/3 of inlet or outlet pipe diameter.	• Obstruction removed.
		• Decaying and generating odors that could cause complaints or dangerous gases (e.g., methane).	• Vegetation removed.
	Not in place	• Missing or only partially in place.	• Grate in place, repaired or replaced.
	Damaged	• Broken	• Grate repaired or replaced.
Sump	Sediment, accumulation	• Sediment exceeds 60 percent of the sump depth. • Measure from bottom of basin to invert of the lowest, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	• Sediment removed.
Structure	Cracks in wall	• Cracks in wall	• Basin repaired or replaced. • Pipe is re-grouted and secure at basin wall.
	Settlement or misalignment	• Settlement or misalignment	• Basin raised, realigned, repaired or replaced.
	Pollutants in water or sediment	• Most commonly occurring are herbicides and insecticides. • Identify and remove source.	• Pollutants removed.

Stormwater Management StormFilter®

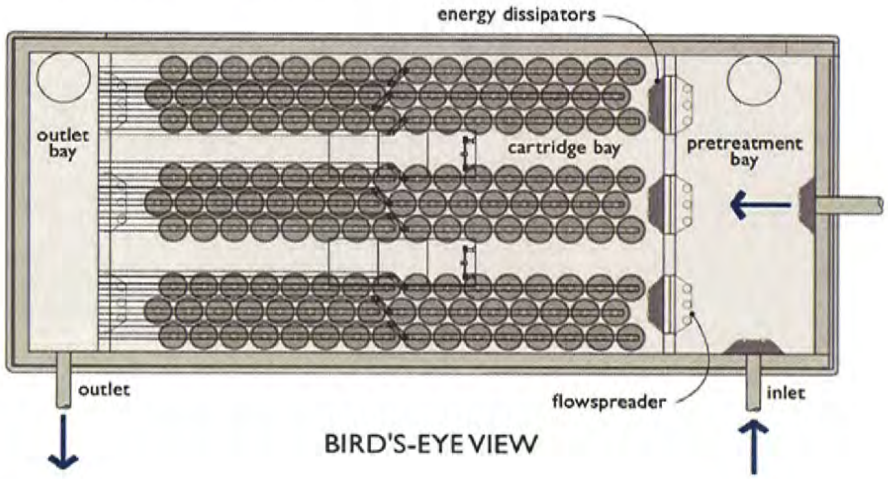
The Stormwater Management StormFilter® is a passive, flow-through, stormwater filtration system. The system is comprised of one or more vaults that house rechargeable, media-filled filter cartridges. The StormFilter works by passing stormwater through the filtering medium, which traps particulates and/or adsorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way.

The filter media can be housed in cartridge filters enclosed in concrete vaults or catch basin-like structures. Various types of filter media are available from the manufacturer.

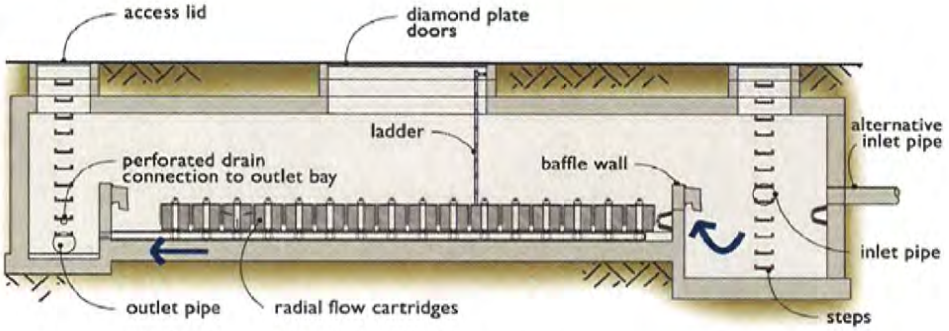
StormFilter units are a proprietary manufactured system. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a StormFilter® system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe



BIRD'S-EYE VIEW



SIDE PROFILE

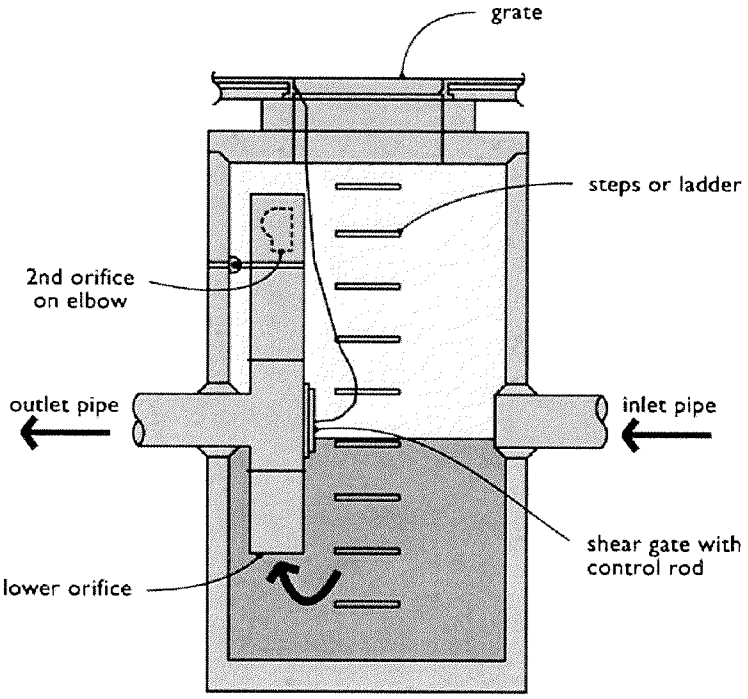
StormFilter® (leaf compost filter)			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
Fore bay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 1/3 of available sump.	Sediment accumulation less than 6 inches.
Media Filter Vault	Sediment Accumulation on Top of Filter Cartridges.	Sediment depth exceeds 0.25-inches on top of filter cartridges.	No sediment deposits on top of cartridges. Sediment on cartridges likely indicates that cartridges are plugged and require maintenance. No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 4 inches in first chamber. Look for other indicators of clogged cartridges or overflow.	Sediment in vault should be removed. Cartridges should be checked and replaced or serviced as needed. No sediment deposits in vault bottom of first chamber.
	Trash and Floatable Debris Accumulation	Trash and floatable debris accumulated in vault.	No trash or floatable debris in filter vault.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.
	Filter cartridges Submerged.	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.	Filter media checked and replaced if needed. If cartridges are plugged with oil, additional treatment or source control BMP may be needed.

Control Structure/Flow Restrictor

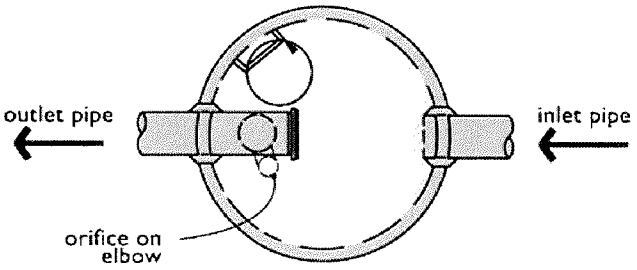
Flow control structures and flow restrictors direct or restrict flow in or out of facility components. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or "V" shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or release water too quickly. This will likely damage streams, habitat, and property.

Facility objects that are typically associated with a control structure/flow restrictor include:

- detention ponds
- CONTECH® StormFilter
- closed detention system
- conveyance stormwater pipe



BIRD'S-EYE VIEW



SECTION PROFILE

Control Structure/Flow Restrictor			
Drainage System Feature	**Potential Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed Or Not Needed**
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	All Potential Defects	**See Catch Basins**	

10.0 Inspection & Maintenance

STORMTANK DETENTION SYSTEM

Description

Proper inspection and maintenance of a subsurface stormwater storage system are vital to ensuring proper product functioning and system longevity. It is recommended that during construction the contractor takes the necessary steps to prevent sediment from entering the subsurface system. This may include the installation of a bypass pipe around the system until the site is stabilized. The contractor should install and maintain all site erosion and sediment per Best Management Practices (BMP) and local, state, and federal regulations.

Once the site is stabilized, the contractor should remove and properly dispose of erosion and sediment per BMP and all local, state, and federal regulations. Care should be taken during removal to prevent collected sediment or debris from entering the stormwater system. Once the controls are removed, the system should be flushed to remove any sediment or construction debris by following the maintenance procedure outlined below.

During the first service year, a visual inspection should be completed during and after each major rainfall event, in addition to semi-annual inspections, to establish a pattern of sediment and debris buildup. Each stormwater system is unique, and multiple criteria can affect maintenance frequency. For example, whether or not a system design includes inlet protection or a pretreatment device has a substantial effect on the system's need for maintenance. Other factors include where the runoff is coming from (hardscape, gravel, soil, etc.) and seasonal changes like autumn leaves and winter salt.

During and after the second year of service, an established annual inspection frequency, based on the information collected during the first year, should be followed. At a minimum, an inspection should be performed semi-annually. Additional inspections may be required at the change of seasons for regions that experience adverse conditions (leaves, cinders, salt, sand, etc).

Maintenance Procedures

Inspection:

1. Inspect all observation ports, inflow and outflow connections, and the discharge area.
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pretreatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident.

General Grounds Keeping and Landscape Plantings Care

Integral part of stormwater facility maintenance program

Establishing a Grounds Keeping and Landscape Plantings Care plan should not only be an integral part of any residential subdivision or commercial property stormwater facility maintenance program, but should be incorporated into the property management program as well.

Depending on a stormwater facility's function and the overall intent of the project design, general grounds keeping ranges from:

- Making a stormwater facility and its surrounding area neat and tidy, to
- Keeping the facility and its surroundings wild and natural.

Required care

Required grounds keeping and maintenance of landscape plantings care includes:

- Cultivating the various desirable plant and tree species essential for a stormwater facility's function
- Eliminating or controlling undesirable species, especially noxious weeds (see below).
- Controlling plant and tree growth is an ongoing process throughout the growing season and into the rainy season especially
    - on earthen berms and
    - around physical structures such as concrete flow and overflow structures.
- It is also important to keep access roads, gates and fences clear of trees and brush.

Control noxious weeds

Noxious weeds need to be eliminated or vigorously controlled.

- Common noxious weeds found in or near stormwater runoff facilities include: Knotweeds, Yellow Archangel, Atlantic and English Ivy, Yellow Flag Iris, Fragrant Water Lily and Purple or garden Loosestrife.
- The less noxious, but still obnoxious plants and trees also need to be vigorously controlled, such as reed canary grass, blackberry and morning glory vines, scotch broom, cottonwood and alder trees.
- For more information about noxious weeds go to the Snohomish County Noxious Weed Board website:
    - http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/Road_Maint/Noxious_Weeds/control_boards.htm
    - http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/Road_Maint/Noxious_Weeds/weeds_list.htm

Maintenance for aesthetic reasons encouraged

Maintenance for aesthetic reasons, ranging from totally "wild and natural" to totally "manicured" is ***strongly encouraged but not required***.

- Going beyond what is only required can not only improve a facility's appearance but also enhance its function as well.
- Taking this approach can help even more to:
    - Reduce the potential for flooding property,
    - Provide for a more healthy fish and critter habitat,
    - Improve residential property values, and
    - Make commercial property more attractive for clients and customers.

General Grounds Keeping and Landscape Plantings Care

Drainage system feature	Potential defect	Conditions when maintenance is needed	Results expected when maintenance is performed or not needed
Facility Site	Poisonous or nuisance Vegetation	• Any vegetation which may constitute a hazard to maintenance personnel or the public. • Evidence of noxious weeds as defined by State or local regulations. NOTE: Apply herbicides in accordance with requirements of Snohomish County Noxious Weed Board.	• Poisonous or nuisance vegetation eliminated. NOTE: Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies is required.
Facility Site	Weeds (nonpoisonous)	• Weeds growing in more than 20% of the landscaped area (trees and shrubs only).	• Weeds present in less than 5% of the landscaped area.
	Insect hazard or poisonous vegetation	• Any presence of poison ivy or other poisonous vegetation or insect nests.	• No poisonous vegetation or insect nests present in landscaped area.
	Trash & debris litter	• See ponds checklist	• See ponds checklist.
	Erosion of ground surface	• Noticeable rills are seen in landscaped areas.	• Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded.
Trees and Shrubs	Dead or damaged	• Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	• Trim trees/shrubs to restore shape. Replace trees/shrubs with severe damage.
		• Trees or shrubs that have been blown down or knocked over.	• Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.

Drainage system feature	Potential defect	Conditions when maintenance is needed	Results expected when maintenance is performed or not needed
		• Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	• Place stakes and rubber coated ties around young trees/shrubs for support.
Visual Buffer Screen	Missing or broken parts in visual screen	• Any gap in screen that permits easy entry to facility	• Shrubs replaced to for a solid screen.
	Unruly shrubbery and vegetation	• Shrubbery is growing out of control or is infested with weeds.	• Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.

Compost-amended Soils

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. Compaction from construction can reduce the soils natural ability to provide these functions. Establishing a minimum soil quality and depth in the post-development landscape can regain some of these stormwater functions including increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals. Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals.

Key Maintenance Considerations

Key maintenance considerations for compost-amended soils include the replenishment of soil media as needed (as a result of erosion) and addressing compacted, poorly draining soils. Site uses should protect vegetation and avoid compaction.

Key Operations to Preserve Facility Function

The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.

Maintenance Standards and Procedures

Table 18 provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Table 18. Maintenance Standards and Procedures for Compost-amended Soils.

Component	Recommended Frequency[a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General				
Soil media (maintain high organic soil content)	A		Vegetation not fully covering ground surface or vegetation health is poor	• Maintain 2 to 3 inches of mulch over bare areas in landscape beds • Add plants if sufficient space • Re-seed bare turf areas until the vegetation fully covers ground surface
		Ongoing	None (routine maintenance)	Return leaf fall and shredded woody materials from the landscape to the site when possible in order to replenish soil nutrients and structure
		Ongoing	None (routine maintenance)	On turf areas, “grasscycle” (mulch-mow or leave the clippings) to build turf health
		Ongoing	None (routine maintenance)	Avoiding use of pesticides (bug and weed killers), like “weed & feed”, which damage the soil
		A	None (routine maintenance)	• Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program should be used which relies on compost, natural fertilizers or slow-release synthetic balanced fertilizers • Follow IPM protocols for fertilization procedures (see “Additional Maintenance Resources” in Bioretention Facilities section for more information on IPM protocols)
Soil media (maintain infiltration)	A[b]		Soils become waterlogged, do not appear to be infiltrating	• To remediate compaction, aerate soil, till to at least 8-inch depth, or further amend soil with compost and re-till • If areas are turf, aerate compacted areas and topdress them with 1/4 to 1/2 inch of compost to renovate them • If drainage is still slow, consider investigating alternative causes (e.g., high wet season groundwater levels, low permeability soils) • Also consider site use and protection from compacting activities

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

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General (cont'd)				
Erosion/ Scouring	A, W, S		Areas of potential erosion are visible	• Identify and address cause of erosion (e.g., concentrate flow entering area, channelization of runoff) and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made.
Grass/ Vegetation		A	Less than 75% of planted vegetation is healthy with a generally good appearance.	• Take appropriate maintenance actions (e.g., remove/ replace plants) • If problem persists, evaluate if vegetation is appropriate for the location (e.g., exposure, soil, soil moisture)
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions

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

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.				
Component	**Recommended Frequency [a]**		**Condition when Maintenance is Needed (Standards)**	**Action Needed (Procedures)**
	Inspection	**Routine Maintenance**		
General (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management(see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)

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

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Equipment and Materials

Table 19 includes recommendations for equipment and materials commonly used to maintain compost-amended soils. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 19. Compost Amended Soils Equipment and Materials List.

General landscaping equipment
☐ **Gloves**
☐ **Pincer-type weeding tool**
☐ **Soil knife**
☐ **Pruners**
☐ **Loppers**
☐ **Hoe**
☐ **Rake**
☐ **Wheelbarrow**
☐ **Shovel**
☐ **Push broom**
☐ **Garbage bags (for disposal of noxious weeds)**
General landscaping materials
☐ **Arborist wood chip mulch (around trees and woody plants)**
☐ **Compost or leaf mulch (around annuals)**
☐ **Fertilizer (natural fertilizers or slow-release synthetic balanced fertilizers)**
Specialized equipment*
☐ **Deep tine aerator and compost (or compost/sand mixture) to fill aeration holes (if necessary to correct overly compacted soil)**
☐ **Flame weeder or hot water weeder**
☐ **Rototiller**
☐ **Soil probe**

* Items not required for routine maintenance

Skills

The skills required for the maintenance of compost-amended soils are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance of compost-amended soils such as: horticulturalists, arborists, erosion control specialists, and soil scientists.

Skills Needed for Maintenance of Compost-amended Soils

- Landscaping skills (e.g., general plant care)
- Landscaper for major maintenance