Regional Stormwater Facility

TECHNICAL INFORMATION REPORT

King County, Washington

Prepared For:
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Issued: November 14, 2024

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1 EXECUTIVE SUMMARY

This project proposes a stormwater infiltration and water quality facility that will serve portions of the Ten Trails (F.K.A The Villages) Master Planned Development, The Reserve at Woodlands rural cluster subdivision, and King County's existing management of Horseshoe Lake flood levels. This proposed facility is referred to throughout this report as "the Regional Stormwater Facility" or "the Facility".

The Villages Master Planned Development (The Villages), now referred to as "Ten Trails", proposes to develop a mix of uses including: residential, commercial, office, retail, educational, civic, recreational, trails and open space on 1196 acres (assembled parcels). Ten Trails is comprised of two primary development areas; Parcel B and the Main Property (consisting of Parcels C, D, E, F, G, the Guidetti Parcel and the BDA Parcel). Parcel B is approximately 82 acres in size and lies approximately 2 miles north of the Main Property, to the west of State Route 169 (SR 169) and north of SE 312th street (if it were extended) in Section 11, Township 21 North, Range 6 East, W.M., King County, Washington. The Main Property is approximately 1,114 acres in size and lies west of SR 169 and south of Auburn-Black Diamond Road (approximately 55 acres lies to the north of this road) in Sections 15, 22, 23, and 27, Township 21 North, Range 6 East, W.M., King County, Washington.

The Villages Final Environmental Impact Statement dated December 2009 (FEIS) as well as The Villages MPD Permit Approval set forth in Black Diamond Ordinance No. 10-946 and *The Villages MPD Development Agreement* (Ten Trails MPD DA) dated December 12, 2011 contain stormwater management requirements for the Ten Trails MPD.

The Reserve at Woodlands is a rural residential clustered subdivision encompassing approximately 493 acres located to the west of Ten Trails in Section 21 of unincorporated King County. The Reserve at Woodlands Development Agreement has been approved by King County and includes stormwater management requirements related to this project.

The Regional Stormwater Facility has been designed to comply with the latest adopted stormwater standards of King County's *King County, Washington, Surface Water Design*

Manual dated July 23, 2021 (2021 KCSWDM) as well as the latest stormwater standards adopted by the City of Black Diamond which is the Washington State Department of Ecology's 2019 *Stormwater Management Manual for Western Washington* (2019 DOE Manual).This report has been prepared to demonstrate the Regional Stormwater Facility's compliance with the 2021 KCSWDM, 2019 DOE Manual and the development agreements of Ten Trails and the Reserve at Woodlands.

The Regional Stormwater Facility will be located within the Reserve at Woodlands in unincorporated King County. The Facility will provide flow control and enhanced basic water quality treatment via a treatment train comprised of a pre-settling cell, a large sand filter and an infiltration pond. The Regional Stormwater Facility will serve portions of Phase 2 and Phase 3 of the Ten Trails Master Planned Development (a portion of the Ten Trails main property), and a future Ten Trails MPD expansion area. The Regional Stormwater Facility will also serve a portion of the Reserve at Woodlands including future portions of the King County Regional Trail constructed adjacent to the Regional Stormwater Facility. Another portion of the Regional Stormwater Facility is designed to accommodate a maximum volume of water from Horseshoe Lake that is equivalent to a flow of six cubic feet per second over a period of two weeks assuming wet season ground water conditions. As to this portion of the stormwater flow control component of the Regional Stormwater Facility, The Reserve at Woodlands Development Agreement includes the County's covenant that any water pumped from Horseshoe Lake will meet requirements for direct discharge to an infiltration facility. This portion of the Regional Stormwater Facility will not include water quality treatment and will replace an existing infiltration facility that currently serves as the infiltration point for pumped Horseshoe Lake flows. In total, the Regional Stormwater Facility will have a tributary basin of approximately 346 acres.

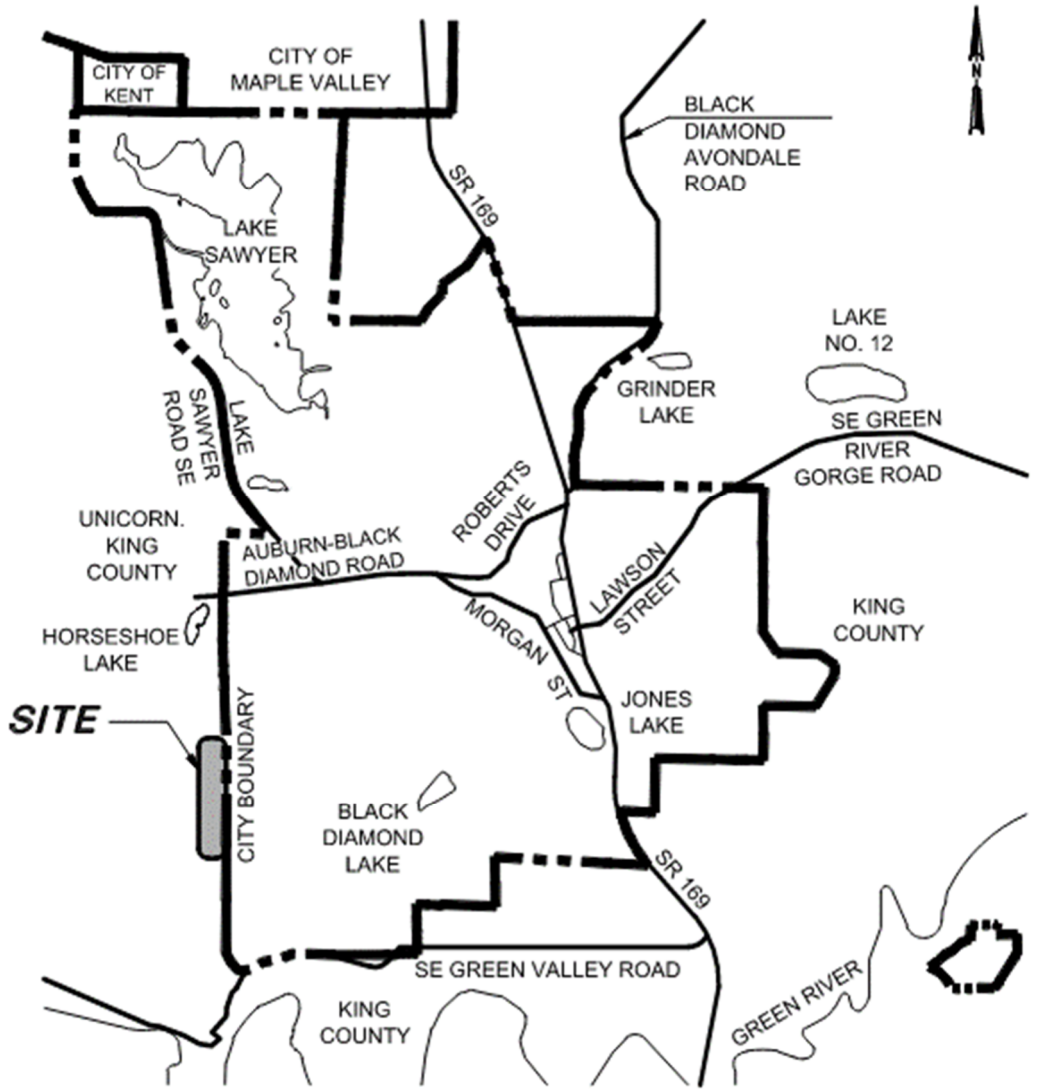
A Vicinity Map at the end of this section shows the general location of the Facility.

Except as described above, the Regional Stormwater Facility will provide enhanced water quality treatment in accordance with the 2021 KCSWDM. The Enhanced Basic Water Quality Menu in Section 6.1.2 of the 2021 KCSWDM lists a Large Sand Filter as the first option for

providing basic stormwater treatment, provided that pre-settling is utilized prior to the sand filtration. The Regional Stormwater Facility has been designed to infiltrate all stormwater runoff up to and including the 100-year storm event as modeled by the Western Washington Hydrology Model 2012 (WWHM), an approved continuous runoff model.

Several conveyance systems will be constructed, both in the current project and during future phases of the Ten Trails MPD and The Reserve at Woodlands, to collect and convey stormwater runoff to the Regional Stormwater Facility. The conveyance systems constructed together with the Regional Stormwater Facility are discussed in Section 5 of this report.

Vicinity Map Scale: 1"=5000'



TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner: CCD Black Diamond Partners LLC

Phone: (425) 898-2100

Address: 3025 112th Ave NE, Suite 100
Bellevue, Washington 98004

Project Engineer: Adam Stricker

Company: David Evans and Associates, Inc.

Phone: 425-415-2000

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name: Reserve at Woodlands Regional Stormwater Management Facility

DLS-Permitting

Permit #

Location Township: 21 North

Range: 6 East

Section: 21

Site Address

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Land use (e.g.,Subdivision / Short Subd. / UPD)
- ☐ Building (e.g.,M/F / Commercial / SFR)
- ☒ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other _____

Part 4 OTHER REVIEWS AND PERMITS[1]

- ☐ DFW HPA
- ☐ COE CWA 404
- ☐ ECY Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☐ Other _____
- ☐ Shoreline Management
- ☐ Structural Rockery/Vault/_____
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (check one):

- ☒ Full
- ☐ Targeted
- ☐ Simplified
- ☐ Large Project
- ☐ Directed

Date (include revision dates): _____

Date of Final: _____

Site Improvement Plan (Engr. Plans)

Plan Type (check one):

- ☒ Full
- ☐ Modified
- ☐ Simplified

Date (include revision dates): _____

Date of Final: _____

Part 6 SWDM ADJUSTMENT APPROVALS

Type (circle one): Standard / Experimental / Blanket

Description: (include conditions in TIR Section 2)

_____

_____

_____

Approved Adjustment No. _____ Date of Approval: _____

[1] DFW: WA State Dept. of Fish and Wildlife. HPA: hydraulic project approval. COE: (Army) Corps of Engineers. CWA: Clean Water Act. ECY: WA State Dept. of Ecology. FEMA: Federal Emergency Management Agency. ESA: Endangered Species Act.

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: (Yes) / No

Start Date: _____

Completion Date: _____

Describe: _____

_____

_____

Re: KCSWDM Adjustment No. _____

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : Reserve at Woodlands and Ten Trails (fka The Villages) Development Agreements

Special District Overlays: _____

Drainage Basin: WRIA 9

Stormwater Requirements: _____

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- ☐ River/Stream _____
- ☐ Lake _____
- ☒ Wetlands _____
- ☐ Closed Depression _____
- ☐ Floodplain _____
- ☐ Other _____

_____

- ☐ Steep Slope _____
- ☐ Erosion Hazard _____
- ☐ Landslide Hazard _____
- ☐ Coal Mine Hazard _____
- ☐ Seismic Hazard _____
- ☐ Habitat Protection _____
- ☐ _____

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Vashon Recessional Outwash	0-5%	Low
Vashon Till	0-25%	Moderate
Vashon Ice Contact	0-25%	Moderate

- ☐ High Groundwater Table (within 5 feet)
- ☐ Other _____
- ☐ Sole Source Aquifer
- ☐ Seeps/Springs

☐ Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS	
REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☒ Sensitive/Critical Areas	Wetlands
☒ SEPA	
☐ LID Infeasibility	
☐ Other	
☐	
☐ Additional Sheets Attached	

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)	
Threshold Discharge Area: (name or description)	
Core Requirements (all 8 apply):	
Discharge at Natural Location	Number of Natural Discharge Locations:
Offsite Analysis	Level: (1) / 2 / 3 dated:
Flow Control (include facility summary sheet)	Level: 1 / 2 / 3 or Exemption Number Flow Control BMPs
Conveyance System	Spill containment located at:
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	CSWPP/CESCL/ESC Site Supervisor: Contact Phone: After Hours Phone:
Maintenance and Operation	Responsibility (circle one): Private / (Public) If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: Yes / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / (Enhanced Basic) / Bog or Exemption No. Landscape Management Plan: Yes / No
For Entire Project: % of Target Impervious that had a feasible FCBMP implemented	Total Replaced Impervious surfaces on the site Total New Pervious Surfaces on the site Repl. Imp. on site mitigated w/flow control facility Repl. Imp. on site mitigated w/water quality facility Repl. Imp. on site mitigated with FCBMP

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)	
Special Requirements (as applicable):	
Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / (None) Name: _____
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / (None) 100-year Base Flood Elevation (or range): _____ Datum:
Flood Protection Facilities	Describe:
Source Control (commercial / industrial land use)	Describe land use: Describe any structural controls:
Oil Control	High-use Site: Yes / No Treatment BMP: _____ Maintenance Agreement: Yes / No with whom? _____
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS	
MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
❑ Clearing Limits ❑ Cover Measures ❑ Perimeter Protection ❑ Traffic Area Stabilization ❑ Sediment Retention ❑ Surface Water Collection ❑ Dewatering Control ❑ Dust Control ❑ Flow Control ❑ Protection of Flow Control BMP Facilities (existing and proposed) ❑ Maintain BMPs / Manage Project	❑ Stabilize exposed surfaces ❑ Remove and restore Temporary ESC Facilities ❑ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary ❑ Flag limits of SAO and open space preservation areas ❑ Other _____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description		Water Quality	Type/Description
☐ Detention			☐ Vegetated Flowpath	
☒ Infiltration	Infiltration Pond		☒ Wetpool	PreSettling
☐ Regional Facility			☒ Filtration	Large Sand Filter
☐ Shared Facility			☐ Oil Control	
☐ Flow Control BMPs			☐ Spill Control	
☐ Other			☐ Flow Control BMPs	
			☐ Other	

Part 15 EASEMENTS/TRACTS		Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement		☐ Cast in Place Vault
☐ Covenant		☐ Retaining Wall
☐ Native Growth Protection Covenant		☐ Rockery > 4' High
☐ Tract		☐ Structural on Steep Slope
☐ Other _____		☐ Other _____

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER

I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.

Adam Swan 11/5/24

Signed/Date

2 CONDITIONS AND REQUIREMENTS SUMMARY

As discussed in the *Executive Summary*, the project is required to comply with the *King County, Washington, Surface Water Design Manual* dated July 23, 2021 (2021 KCSWDM). Core Requirements #1-9 and applicable Special Requirements in Sections 1.2 and 1.3, respectively, of the 2021 KCSWDM are outlined below with a discussion of how these requirements have been addressed for this project. Compliance with the 2021 KCSWDM also assures compliance with the latest stormwater standards adopted by the City of Black Diamond, i.e., the 2019 DOE Manual, and compliance with the 2019 DOE Manual is described in Section 2.3.

2.1 CORE REQUIREMENTS

2.1.1 Core Requirement #1: Discharge at the Natural Location

In the existing conditions stormwater either infiltrates within the Regional Stormwater Facility's tributary area or runs off into surrounding wetlands. In the developed condition, stormwater from newly developed areas will be collected by newly constructed conveyance systems and either discharged to wetlands to maintain wetland hydrology or will be infiltrated on the Ten Trails site to maintain groundwater recharge volumes as required by the Ten Trails Development Agreement (see discussion in Section 4). Once Black Diamond Lake recharge and wetland recharge requirements have been met,excess stormwater will be conveyed to the Regional Stormwater Facility for water quality treatment and infiltration. Per the requirements set forth by the Ten Trails MPD DA in section 7.4, the predeveloped runoff volumes to wetlands in Stormwater Management Zones 3A, 3B and 3D and groundwater recharge for Zone 3C will be maintained as in the existing condition. All stormwater created by development that is not utilized in maintaining critical areas will be conveyed to the Regional Stormwater Facility. There will be no surface outlets from the Facility.

2.1.2 Core Requirement #2: Offsite Analysis

See Section 3 of this report for an offsite analysis and downstream.

2.1.3 Core Requirement #3: Flow Control

The project is required to provide flow control to mitigate the impacts of stormwater runoff generated by new developments tributary to the facility. This project will infiltrate all stormwater that is not required for wetland or groundwater recharge. See Section 4 of this report for more information.

2.1.4 Core Requirement #4: Conveyance System

The proposed stormwater conveyance system for the project site has been designed to safely convey up to the 100-year peak storm flows. For more information, see Section 5 of this report.

2.1.5 Core Requirement #5*:* Erosion and Sediment Control

All proposed erosion and sediment control BMP's have been designed per the requirements and design standards of the 2021 KCSWDM. See Section 8 of this report for more information.

2.1.6 Core Requirement #6: Maintenance and Operations

Maintenance and operations information for the proposed stormwater facilities can be found in Section 10 of this report.

2.1.7 Core Requirement #7: Financial Guarantees and Liability

Bond Quantities, Facility Summaries and the Declaration of Covenant forms will be provided after final engineering review.

2.1.8 Core Requirement #8: Water Quality

All new developments tributary to the Regional Stormwater Facility are required to provide water quality treatment for runoff. All tributary development draining to the Regional Stormwater Facility is within the Basic Water Quality treatment basin and is therefore required to comply with the Basic Water Quality treatment standards per the 2021 KCSWDM. Enhanced basic water quality treatment is not required because all tributary areas will be for residential uses, and although some roads within the developed basins will serve more than 200 lots, these roads make up less than 50% of the total basin. However, even though it is not required, the Regional Stormwater Facility will provide enhanced basic water quality treatment by using a large sand filter. For more information, see Section 4 of this report.

2.1.9 Core Requirement #9: Flow Control BMPs

Typically, projects proposing new impervious surfaces are required to provide onsite flow control BMPs to mitigate the impacts of stormwater runoff. However, per Section 1.2.9.1.A, any impervious surfaces served by an infiltration facility designed in accordance with Sections 1.2.3.1, 1.2.3.2, and 5.2 of the 2021 KCSWDM are exempt from the flow control BMPs requirement. The Regional Storm Facility is designed to meet Sections 1.2.3.1, 1.2.3.2, and 5.2 of the 2021 KCSWDM and, therefore, is exempt from the onsite flow control BMPs.

The project will implement soil amendment for all new and replaced pervious surfaces to mitigate for lost moisture capacity of disturbed and compacted topsoil in accordance with KCC16.82.100 (F) and (G):

> "F. The duff layer and native topsoil shall be retained in an undisturbed state to the maximum extent practicable. Any duff layer or topsoil removed during grading shall be stockpiled onsite in a designated, controlled area not adjacent to public resources and critical areas. The material shall be reapplied to other portions of the site where feasible.

G.1. Except as otherwise provided in subsection G.2. of this section, areas that have been cleared and graded shall have the soil moisture holding capacity restored to that of the original undisturbed soil native to the site to the maximum extent practicable. The soil in any area that has been compacted or that has had some or all of the duff layer or underlying topsoil removed shall be amended to mitigate for lost moisture-holding capacity. The amendment shall take place between May 1 and October 1. The topsoil layer shall be a minimum of eight inches thick, unless the applicant demonstrates that a different thickness will provide conditions equivalent to the soil moisture-holding capacity native to the site. The topsoil layer shall have an organic matter content of between five to ten percent dry weight and a pH suitable for the proposed landscape plants. When feasible, subsoils below the topsoil layer should be scarified at least four inches with some incorporation of the upper material to avoid stratified layers. Compost used to achieve the required soil organic matter content must meet the definition of "composted materials" in WAC 173-350-220.

2. This subsection does not apply to areas that:

a. Are subject to a state surface mine reclamation permit; or

b. At project completion are covered by an impervious surface, incorporated into a drainage facility or engineered as structural fill or slope. (Ord. 16267 § 5, 2008: Ord. 15053 § 10, 2004: Ord. 13190 § 4, 1998: Ord. 3108 § 8, 1977: Ord. 1488 § 11, 1973)."

2.2 SPECIAL REQUIREMENTS

2.2.1 Special Requirement #1: Other Adopted Area-Specific Requirements

The project site is subject to the requirements of the Ten Trails and Reserve at Woodlands development agreements. See Section 4.2.2 for a discussion of Ten Trails development

agreement requirements for stormwater management and their effects on the design of the Facility.

2.2.2 Special Requirement #2: Floodplain/Floodway Delineation

Special Requirement #2 does not apply, as the project is not subject to any flood pains or floodways.

2.2.3 Special Requirement #3: Flood Protection Facilities

While the Facility includes an infiltration cell that will be used by King County to control water levels in Horseshoe Lake, the Regional Stormwater Facility is not a levee or revetment that relies on structural stability for flood protection and, therefore, is not subject to special requirement #3.

2.2.4 Special Requirement #4: Source Controls

Special Requirement #4 does not apply, as the project is not classified as a commercial development in accordance with the *2021 King County Stormwater Pollution Prevention Manual.*

2.2.5 Special Requirement #5: Oil Control

Special Requirement #5 does not apply, as the Regional Stormwater Facility does not serve a “high-use” site, where a high-use site means an area within a commercial or industrial site with high traffic turnover, including an expected average daily traffic count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.

2.3 *DEPARTMENT OF ECOLOGY MINIMUM REQUIREMENTS*

This project will also satisfy the minimum requirements of the 2019 Department of Ecology Stormwater Management Manual for Western Washington (DOE Manual). A description of this project’s compliance with the 2019 DOE manual is given below:

2.3.1 MR 1: Preparation of Stormwater Site Plans

This report, along with the associated Project Plans, serve as the Stormwater Site Plan for the Project.

2.3.2 MR 2: Construction Stormwater Pollution Prevention Plan

See Section 8 of this report for information on Construction Pollution Prevention

2.3.3 MR 3: Source Control of Pollution

See Section 8 of this report for information on Source Control of Pollution.

2.3.4 MR 4: Preservation of Natural Drainage Systems and Outfalls

In the existing conditions stormwater either infiltrates within the project's tributary area or runs off into surrounding wetlands. In the developed condition, stormwater from developed areas will be collected by conveyance systems and either discharged to wetlands or groundwater to maintain critical areas or conveyed to the Regional Stormwater Facility and infiltrated. Per the requirements set forth by the Ten Trails MPD DA in section 7.4, the predeveloped average annual runoff volumes to wetlands in Stormwater Management Zones 3A, 3B and 3D and groundwater recharge for Zone 3C will be approximately matched in the developed condition (See discussion in Section 4). All excess stormwater created by development that is not utilized in maintaining critical areas will be conveyed to the Regional Stormwater Facility. There are no proposed surface outlets from the facility.

2.3.5 MR 5: On-Site Stormwater Management

The Project is subject to On-Site Stormwater Management BMPs based on project thresholds (i.e., the project is new development and results in greater than 5,000 sf of new hard surfaces). All minimum requirements apply to new and replaced hard surfaces and converted vegetation areas. As such, the new and replaced hard surfaces and converted vegetation areas are required to use any Flow Control BMPs to achieve the LID Performance

Standard and must apply *BMP T5.13: Post-Construction Soil Quality and Depth* per Table I-3.1 in the 2019 DOE Manual.

The project proposes to use *BMP T7.10: Infiltration Basins* (i.e., an infiltration pond) to infiltrate 100% of stormwater runoff, up to and including the 100-year storm event, that is not being used for critical area recharge requirements. By infiltrating 100% of the excess stormwater and matching critical area recharge requirements the project is complying with the LID performance standards. For more information, see Section 4 of this report.

2.3.6 MR 6: Runoff Treatment

The project provides a stormwater runoff treatment and flow control treatment train, made up of a Presettling Basin (BMP T6.10), a Large Sand Filter Basin (BMP T8.11) and an Infiltration Basin (BMP T7.10). The treatment train provides basic treatment and phosphorus treatment for the project which goes above and beyond the required basic treatment level that is required. For more information, see Section 4 of this report.

2.3.7 MR 7: Flow Control

The project proposes to use *BMP T7.10: Infiltration Basins* (i.e., an infiltration pond) to infiltrate 100% of stormwater runoff, up to and including the 100-year storm event, that is not being used for critical area recharge requirements. By infiltrating 100% of the excess stormwater and matching critical area recharge requirements the project is complying with MR 7. For more information, see Section 4 of this report.

2.3.8 MR 8: Wetlands Protection

Per the projects critical areas report, the Regional Stormwater Facility is not situated within any wetland buffers or wetlands. A small area of wetland buffer disturbance is required to complete installation of the Horseshoe Lake Pump line, and this disturbance and required restoration is addressed in the project's critical areas report. The development of the future phases of the Ten Trails MPD and Ten Trail MPD expansion area is required to provide

wetland protection. These developments shall comply with the requirements set forth by the Ten Trails MPD DA in section 7.4, maintaining the average annual predeveloped runoff volumes to wetlands in Stormwater Management Zones 3A, 3B and 3D and groundwater recharge for Zone 3C. See section 4.2.5 of this report for more information.

2.3.9 MR 9: Operation and Maintenance

See Section 10 of this report for Operation and Maintenance information.

3 OFFSITE ANALYSIS

3.1 RESOURCE REVIEW

Available existing resources were researched for the site and relevant information has been summarized below.

3.1.1 FEMA Maps

The project site is not within a floodplain as shown on the attached Firmette Panel 1295G.

3.1.2 Soil Survey

Several soil studies have been conducted by Associated Earth Sciences (AESI), Golder Associates and WSP USA Inc. (WSP, formerly known as Golder) These soil studies describe the soil conditions for the developed basins on the Ten Trails and Reserve at woodlands site, and the soil conditions specific to the Regional Stormwater Facility project area. These reports are referenced throughout this report and include the following:

Geotechnical Exploration and Recommendations: Reserve at Woodlands Regional Stormwater Control Facility - Black Diamond Washington, by Associated Earth Sciences Inc., dated November 14, 2024

Geologic Hazards Critical Areas Report – Reserve at Woodlands, by Golder Associates dated January 15, 2020.

Environmental Impact Statement Technical Report on Geology, Soils, and Ground Water for The Villages dated September 26, 2008, prepared by Associated Earth Sciences, Inc.

3.1.3 Sensitive Areas

The Regional Stormwater Facility location has been identified on copies of the following King County Hazard Maps:

Coal Mine: Site not mapped as lying within a hazard area.

Erosion: Site not mapped as lying within a hazard area.

Flooding: Site not mapped as lying within a hazard area.

Liquefaction: Site not mapped as lying within a hazard area.

Seismic: Site not mapped as lying within a hazard area.

Landslide: Site not mapped as lying within a hazard area.

Critical Aquifer Recharge: Site not mapped as lying within a hazard area.

Steep Slope: Site not mapped as lying within a hazard area.

Refer to the *Regional Stormwater Facility Sensitive Area Map exhibit from King County iMap, attached to this section, for mapping of off-site sensitive areas.*

3.1.4 King County Drainage Complaints

The King County iMap was used to look up drainage complaints from the TDA onsite discharge points to ¼-mile downstream. No drainage complaints were found within a quarter mile downstream of the Regional Stormwater Facility. Drainage complaints as recorded by iMap are displayed on the *Regional Stormwater Facility Sensitive Area Map exhibit attached.*

3.2 *EXISTING CONDITIONS*

The Regional Stormwater Facility project site is currently an undeveloped parcel that is forested except for gravel maintenance access roads and a temporary infiltration facility used as the Horseshoe Lake infiltration facility for King County. Several test pits, geotechnical borings and monitoring wells have been installed in recent years.

The site has relatively flat slopes (0 - 5% slopes) over the proposed footprint of the Regional Stormwater Facility with existing grades sloping to the south. There is a hill with moderate slopes located to the west of the facility. Site soils are outwash over the footprint of the Regional Stormwater Facility with till soils underlaying the slopes to the west and southeast of the Facility site.

This current Horseshoe Lake infiltration facility receives the pumped flows from Horseshoe Lake via a 12” HDPE pipe that discharges into a gabion lined energy dissipater at the facilities north end. This existing infiltration facility will be removed to construct the Regional Stormwater Facility, and its function will be replaced by the proposed facility.

See the *Upstream Basin Exhibit* located at the end of this section which presents the site’s existing conditions for reference.

3.3 UPSTREAM BASIN

In the existing condition, the Regional Stormwater Facility has an upstream tributary basin of 67.0 acres. The existing land use is almost entirely outwash forest with the exception of limited dirt and gravel access roads and the interim Horseshoe Lake infiltration facility. In the developed condition, a portion of this basin will be developed into residential uses at the Reserve at Woodlands and Ten Trails MPD and will continue to be tributary to the Facility via piped flows from these developments. A portion of this upstream basin will remain undeveloped and a minimal amount of surface flows into the facility are expected from this area due to the underlying outwash soils. These areas were accounted for in the sizing and modeling of the Facility. Refer to the Upstream Basin Exhibit, attached to this section.

3.4 DOWNSTREAM DRAINAGE ROUTE

The Regional Stormwater Facility lies within a shallow valley that slopes to the south. The first quarter mile downstream of the facility contains no signs of streams or other surface water courses leaving the footprint of the Regional Stormwater Facility. Slopes are relatively flat (less than 5%) and towards the southwest. A defined and steeply incised stream channel begins approximately 0.4 miles downstream of the Regional Stormwater Facility. This channel is listed as an unnamed tributary to Crisp Creek on King County iMap, which shows the stream channel flowing an additional 0.4 miles at which point it flows under 218th Avenue SE via culvert. From 218th Ave SE, this water course flows east, joining with Crisp Creek before flowing into the Green River.

Although overflows from the pond are not anticipated (see overflow modeling discussion in Section 4.4), downstream flow paths were evaluated. The initial quarter mile downstream flow from the Facility will be over existing grades and outwash soils with slopes ranging from 0 to 5% which will be left in an undeveloped state after Facility construction. The subsequent downstream flow paths are through stream courses cataloged by King County,

eventually joining the Green River. This overland downstream flow path is shown on the attached Downstream and Downstream Overview Exhibit.

3.5 *Provisional Overflow Pipe Design*

A provisional design for a piped overflow route has been included in the plan set for the Stormwater Facility. This pipe is not proposed to be constructed and has been shown on the associated plan set to comply with the Woodlands Development Agreement which requests that a design for an overflow pipe be submitted. Although analysis of a surface overflow route is not required because the Facility can reliably contain all tributary stormwater volumes per Section 5.2.1 of the KCSWDM, this pipe design may be utilized as a contingency if infiltration testing or other factors change the results of the analysis presented in Section 4.4.4. The provisional overflow pipe conveys water from the facility to the west approximately along a corridor that would coincide with the "Woodlands Sections" of the King County Green to Cedar Rivers Regional Trail connection to 218th Avenue SE. The pipe would outfall stormwater which would flow in the existing roadside ditch system located on the east shoulder of 218th Ave SE. The stormwater will then be conveyed via an existing roadside ditch which runs along the east side of 218th Ave SE, to a localized depression on the east side of the road. From this depression, an existing culvert would convey flows to the west side of the road. The stormwater would then flow overland to a defined channel/stream tributary to Crisp Creek, which eventually flows to the Green River. The downstream flow path for the provisional overflow pipe is shown on the attached Downstream and Downstream Overview Exhibit.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base Map information shown on the FIRM was derived from multiple sources. Base map files were provided in digital format by King County GIS, WA DNR, WSDOT, and Pierce County GIS. This information was compiled at scales of 1:12,000 to 24,000 during the time period of 1994-2012.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

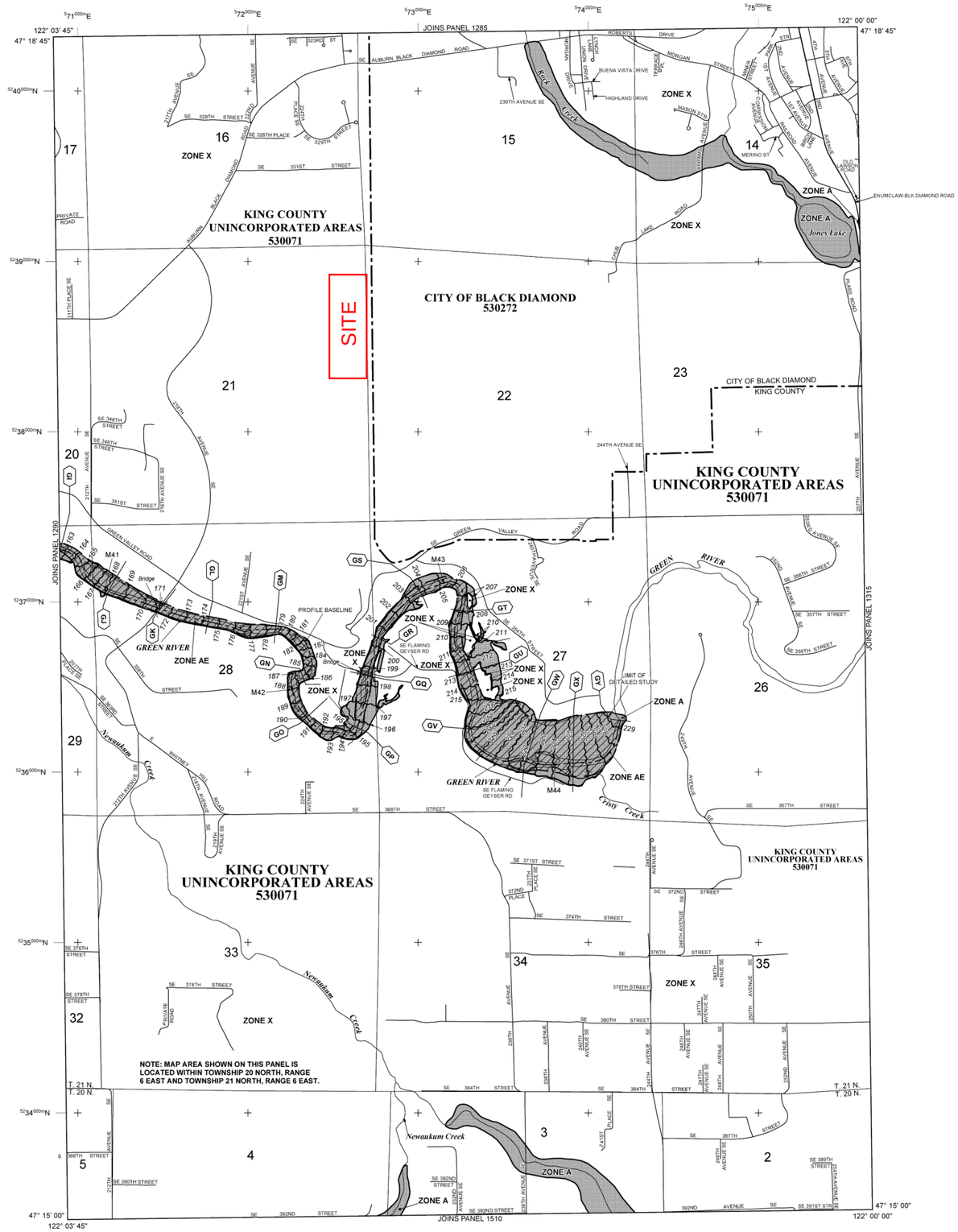
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- (A) — (A) Cross section line
- (23) — (23) Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4989000m N — 1000-meter Universal Transverse Mercator grid values, zone 10
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 29, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 1995
August 19, 2020 - to change Base Flood Elevations, to update corporate limits, to add roads and road names, to update the effects of wave action, to change Special Flood Hazard Areas, to change zone designations and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1295G

FIRM

FLOOD INSURANCE RATE MAP

KING COUNTY, WASHINGTON AND INCORPORATED AREAS

PANEL 1295 OF 1725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

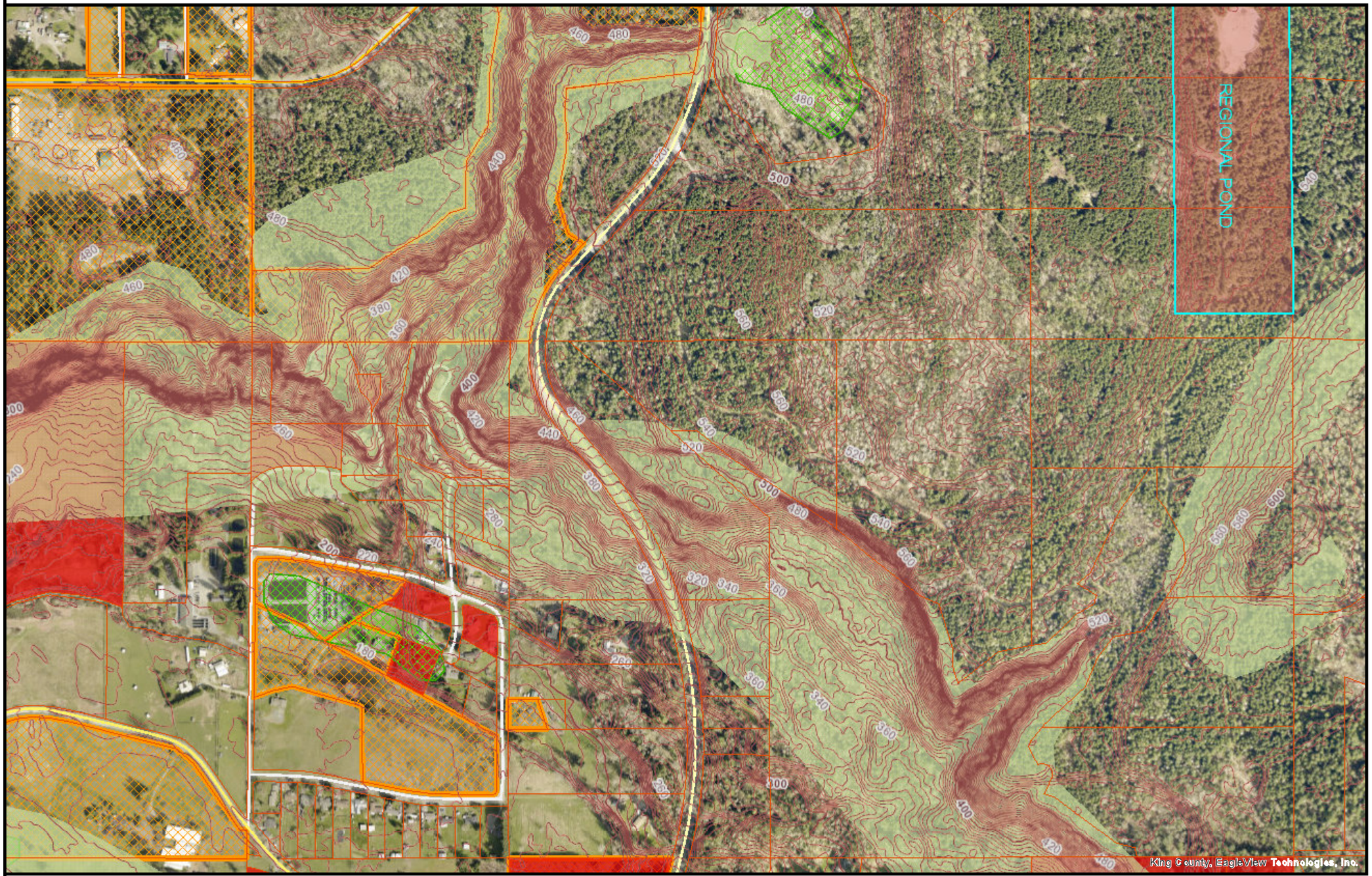
COMMUNITY	NUMBER	PANEL	SUFFIX
BLACK DIAMOND, CITY OF	530272	1295	G
KING COUNTY	530071	1295	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53033C1295G
MAP REVISED
AUGUST 19, 2020

Federal Emergency Management Agency

Regional Pond Downstream Sensitive Areas



Legend

- Parcels
- index contours - 100 foot
- contours - 5 foot (below 1000 feet) and 10 foot
- Erosion hazard (1990 SAO)
- Wetland (1990 SAO)
- Sensitive area notice on title

Arterial streets

- arterial street, principal
- arterial street, collector
- arterial street, minor

Local streets and roads

- local street
- local access road, alley, or other
- Drainage complaints

Date: 6/10/2022

Notes:

N

King County

REGIONAL POND DOWNSTREAM OVERVIEW

blue text/leader

FLOWS CONTAINED IN ROADSIDE DITCH UNTIL PASSING THROUGH A CULVERT TO FLOW TO A STREAM TRIBUTARY TO CRISP CREEK

OVERFLOW PIPE

STORMWATER REGIONAL MANAGEMENT FACILITY

KETA CREEK HATCHERY

OVERLAND FLOW PATH

UNNAMED STREAM, TRIBUTARY TO CRISP CREEK

Black Diamond Open Space

FLOWS IN DEFINED CHANNEL TRIBUTARY TO CRISP CREEK

CRISP CREEK, TRIBUTARY TO GREEN RIVER

Date: 8/24/2022

Notes:

N

King County

4 FLOW CONTROL AND WATER QUALITY DESIGN

4.1 PERFORMANCE STANDARDS

As mentioned in *Section 2 – Conditions and Requirements Summary*, the project is required to comply with Core Requirements #1-9 and applicable Special Requirements of the *King County, Washington, Surface Water Design Manual* dated July 23, 2021 (2021 KCSWDM). Per the 2021 KCSWDM the following Flow Control and Water Quality treatment standards are required for the Regional Stormwater Facility.

- Flow Control: All flows tributary to the Regional Stormwater Facility will be infiltrated on site, thus satisfying the flow control requirement.

- Basic Water Quality: The removal of 80% total suspended solids is required.

- Enhanced Basic Water Quality treatment: Although not a requirement, the Regional Stormwater Facility is electing to provide enhanced basic water quality treatment via a large sand filter.

- Facility sizing and modeling has been conducted using the Western Washington Hydrologic Model 2012 (WWHM), an approved hydrologic model.

The Regional Stormwater Facility as designed with a treatment train comprised of a pre-settling cell, a large sand filter, and an infiltration pond meets the performance standards in the following manner:

- Pre-settling is a requirement for any infiltration facility (i.e., a sand filter) that is not preceded by a water quality facility from the Basic WQ menu. The first cell of the Regional Stormwater Facility has been designed as a pre-settling cell per Section 6.5.1 of the 2021 KCSWDM and is sized with a treatment volume equal to 0.25 times the basic water quality treatment volume calculated by WWHM (an approved continuous runoff model).

- The second cell of the Regional Stormwater Facility will provide Enhanced Basic Water Quality treatment by removing 80% total suspended solids, greater than 30% of dissolved copper, greater than 60% of dissolved zinc, and 50% removal of total phosphorus for a typical rainfall year. The facility will filter 95% of the runoff volume through a Large Sand Filter, thereby satisfying both the Basic and Enhanced Basic Water Quality requirements. The bottom of the sand filter will not incorporate an underdrain as the underlying soils have a long-term design infiltration rate higher than the sand filter media.

- The third cell of the Regional Stormwater Facility is an infiltration pond that will infiltrate any remaining stormwater that bypasses the Large Sand Filter, thereby infiltrating 100% of flows tributary to the Facility. Infiltration is a low impact development (LID) technique, so the Regional Stormwater Facility meets the requirements of the Low Impact Development Performance Standard. Additional low impact development techniques are proposed for other individual development project and have been included in the assumptions of the tributary basin to the Regional Stormwater Facility.

- The fourth cell of the Regional Stormwater Facility will provide full infiltration of pumped flows from Horseshoe Lake to satisfy Section 6.5.2 of the Reserve at Woodlands Development Agreement. Per Section 6.5.2.3 of this agreement, the "*Facility shall be designed to accommodate a maximum volume of water from Horseshoe Lake that is equivalent to a flow of 6 cubic feet per second over a period of two weeks assuming wet season ground water conditions*". Because the Regional Stormwater Facility is not required to provide water quality treatment for pumped flows from Horseshoe Lake, the Horseshoe Lake flows are directed to this fourth cell. The Reserve at Woodlands Development Agreement requires that water quality treatment, if necessary for pumped Horseshoe Lake flows, will be provided by King County separately: Per Section 6.5.2.3 of this agreement "*The County Acknowledges that the Infiltration Facility* [Regional Stormwater Facility] *is not designed to provide water quality treatment for stormwater conveyed to it from Horseshoe Lake. The*

County covenants that any water pumped from Horseshoe Lake to the Infiltration Facility meets any requirements for direct discharge to an infiltration facility as set forth in the stormwater regulations (King County Code Title 9) and surface water design manual."

4.2 DEVELOPED CONDITIONS

This project proposes to construct all four cells of the Regional Stormwater Facility, a portion of the conveyance piping into the Facility and an access/maintenance road that runs along the south and east perimeter of the Facility. Portions of this maintenance road will also serve as the King County Regional Trail bench described in Section 7 of The Reserve at Woodlands Development Agreement. This project also proposes to bury portions of an existing 12" HDPE pipe that currently serves the pumping of Horseshoe Lake.

4.2.1 Tributary Basin

The tributary basin to the Stormwater Facility will include future phases of the Ten Trails MPD, a Ten Trail MPD expansion area, a portion of the Reserve at Woodlands and the access roads and areas immediately adjacent to the Regional Stormwater Facility. The Regional Stormwater Facility was designed with a total tributary basin area of 345.67 acres. The tributary basin accounts for the stormwater management zone requirements from section 7.4 of the Ten Tails MPD Development Agreement which are described in Section 4.3.2 below. The developed tributary basin is shown on the *Tributary Area Exhibit* and enumerated in the *Tributary Area Table* attached to the end of this section.

4.2.2 Stormwater Management Zones

The Ten Trails Villages FEIS dated December 2009, as well as The Ten Trails Villages MPD Permit Approval set forth in Black Diamond Ordinance No. 10-946 and The Villages MPD DA, dated December 12, 2011, contain stormwater management requirements for the Ten Trails MPD. The Ten Trails MPD is split into five Stormwater Management Zones (some of which have been further divided into sub-basins. These Stormwater Management Zones are described in *The Villages MPD Development Agreement* dated December 12, 2011, from pages 59 to 71 including Figure 7.4 entitled "Conceptual Stormwater Plan" showing the Stormwater Management Zones for the Ten Trails MPD. A copy of this figure is attached at the end of this section. The Regional Stormwater Facility serves development areas that lie

within Stormwater Management Zone 3. Please refer to Section 7.4.4 of the DA for additional discussion of the Stormwater Management Zones.

The Ten Trails MPD's Stormwater Management Zone 3 is divided into four subzones. Zone 3A is all the area surrounding Black Diamond Lake, Zone 3C is along the southwest border of the MPD and is underlain with shallow outwash soils (Qvr), Zones 3B and 3D make up the remainder of Stormwater Management Zone 3 with till soils and wetlands throughout the zone. The Ten Trails MPD DA defines stormwater requirements for each subzone as summarized below.

- **Zone 3A Requirements:** Only stormwater runoff from rooftops shall be used for recharge to Black Diamond Lake. Clean stormwater runoff from rooftops or backyards may be used for wetland recharge. Stormwater runoff from pollution generating surfaces shall be conveyed to the Regional Stormwater Facility. Once Black Diamond Lake recharge and wetland recharge requirements have been met, excess stormwater runoff shall be conveyed to the Regional Stormwater Facility.

- **Zone 3B Requirements:** Stormwater runoff from rooftops and backyards shall be used for wetland recharge. All excess runoff and stormwater runoff from pollution generating surfaces shall be conveyed to the Regional Stormwater Facility.

- **Zone 3C Requirements:** Stormwater runoff from rooftops and pervious areas shall be infiltrated to the shallow aquifer (Qvr) until the predeveloped average annual volume is met. Stormwater runoff from pollution generating surfaces shall be treated for basic water quality and infiltrated until the predeveloped average annual volume is met. All excess stormwater not needed for aquifer recharge shall be conveyed to the Regional Stormwater Facility.

- **Zone 3D Requirements:** If Black Diamond Lake requires more recharge volume than the developed Zone 3A can provide, stormwater runoff from rooftops shall be used for recharge to Black Diamond Lake to provide the remainder of the required volume. Stormwater runoff from rooftops and backyards shall be used for wetland

recharge. All excess runoff and stormwater runoff from pollution generating surfaces shall be conveyed to the Regional Stormwater Facility.

The construction of the Facility and its use as the treatment and discharge point for the excess stormwater volumes in each stormwater management zone will satisfy the stormwater management requirements of the Ten Trails DA. The relative volumes required for the Black Diamond Lake, groundwater recharge and wetland recharge requirements of the Ten Trails DA have been estimated and accounted for in the sizing of this Regional Stormwater Facility. Each phase of Ten Trails will demonstrate full compliance with the Development Agreement stormwater management requirements in forthcoming storm drainage reports associated with each specific phase of development.

4.2.3 Soil Classification

The tributary basin is underlain by a mix of Lodgement till and Recessional outwash soils based on the geotechnical findings provided in Figure 9 of the *Environmental Impact Statement Technical Report on Geology, Soils, and Ground Water for The Villages* dated September 26, 2008 (2008 AESI Report), prepared by Associated Earth Sciences, Inc. In general, Stormwater Management Zones 3A, 3B and 3D are underlain by till soils and Zone 3C by outwash soils. Figure 9 is attached at the end of this section for reference. The portion of basin contained in the Reserve at Woodlands was modeled as till, while the Facility's footprint was modeled as outwash.

4.2.4 Anticipated Land Uses

The land use assumptions for the tributary basin are based on a combination of preliminary plans and the MPD Site Plan from Exhibit U, revised November, 2018 of the DA. Exhibit U shows development parcels and associated land uses. These designations were used to create assumptions of the impervious coverage of each proposed parcel. **Table 1** below shows the assumptions based on each land use:

Table 1: Impervious Cover Assumptions for Land Uses

Land Use	Assumed Impervious Percentage
Low Density Residential (LDR)	70%
Medium Density Residential (MDR)	70%
High Density Residential (HDR)	80%
Commercial	90%
Park	30%
Roads / Right-of-Way	80%
Alleys	100%
Schools	80%
Mixed Use	90%
Forest	0%
Open Space Tract	30%

When the above assumptions are considered, the modeled area of the pond is as shown in **Table 2** below.

Table 2: Summary of Developed Areas Tributary to the Regional Stormwater Facility

Type of Tributary Area	Area
Impervious:	185.83
Till Grass:	52.84
Outwash Grass:	66.76
Till Forest:	15.09
Wetland:	25.15
Total Area to Facility	345.67

An expanded Tributary Area Table showing each parcel of development tributary to the Regional Stormwater Facility, as well as a Tributary Basin Exhibit which shows the modeled land use and impervious coverage assumptions is attached to the end of this section.

4.2.5 Wetland Hydrology and Shallow Aquifer & Wetland Recharge

Developed areas required to either discharge to Ten Trails buffers, infiltrate on the Ten Trails site or are otherwise required to not discharge to the Regional Stormwater Facility in order to satisfy Stormwater Management Zone requirements have been estimated and have been excluded from the tributary basin. The size of these non-tributary areas have been preliminarily estimated using the water balance methodology described in the 2008 AESI Report, included in Appendix D of the FEIS.

For the purposes of wetland and shallow aquifer hydrology calculations, average annual rainfall along with runoff, evapotranspiration and recharge volumes from various land coverage types specific to Ten Trails were taken from several tables presented in the FEIS. Wetland and groundwater recharge calculations seek to match the annual average runoff volume for areas tributary to wetlands and the shallow aquifer between the existing forested condition and the developed condition. The average annual volume to the wetlands is assumed to consist of runoff from the existing till forest area to be developed. Recharge from the till forest areas is assumed to reach the lower aquifer and not the wetlands and was therefore not included in the wetland recharge calculation. The average annual recharge for groundwater is assumed to consist of infiltration from the existing outwash forest area to be developed. Using the values from the AESI report, the volume of runoff that the forested areas would produce was calculated for the area to be developed.

It was found that an equivalent of 35 acres of impervious surface is required to satisfy wetland recharge to the multiple wetlands within the Regional Stormwater Facility tributary basin, while 64.2 acres of impervious surface is required to satisfy the recharge to the shallow groundwater aquifer. In total, 99.2 acres of impervious areas have been excluded from the Regional Stormwater Facility tributary basin.

4.2.6 Facility Overview

When fully developed, the Facility will have the following Dimensions:

Cell 1: Presettling Cell	
Top Elevation	535.5
DWS Elevation	534.5
Top of Sediment Storage	528.5
Bottom Elevation	527.5
Storage Depth (ft)	6
Water Quality Volume Required (cf)	317,313
Water Quality Volume Provided (cf)	349,727

Cell 2: Sand Filter	
Top Elevation	534.5
DWS Elevation	533.5
Top of Sand Elevation	527.5
Storage Depth (ft)	6
Bottom Area Required (sf)	90,300
Bottom Area Provided (sf)	94,903

Cell 3: Infiltration Cell	
Top Elevation	533.5
DWS Elevation	532.5
Bottom Elevation	525
Storage Depth (ft)	7.5
Bottom Area Required (sf)	210,103
Bottom Area Provided (sf)	220,736

Cell 4: Horseshoe Lake Infiltration Cell	
Top Elevation	546.5
DWS Elevation	545.5
Bottom Elevation	539.5
Storage Depth (ft)	6
Bottom Area Required (sf)	25,440
Bottom Area Provided (sf)	29,185

4.3 WATER QUALITY FACILITY ANALYSIS

The Enhanced Basic Water Quality treatment will be provided by a large sand filter preceded by a pre-settling cell designed per the 2021 KCSWDM. The following assumptions were used in sizing the large sand filter and pre-settling cell.

- The design infiltration rate of the sand filter media is 1 inch per hour, as required per the 2021 KCSWDM.
- The depth of filter sand layer is 1.5 feet.
- The depth of storage over the filter sand is 6.0 feet.
- Pre-settling cell treatment volume equal to 0.25 times the basic water quality treatment volume.
- The depth of the pre-settling cell is 6.0 feet.
- The length-to-width ratio of the pre-settling cell is at least 2:1.
- A Minimum of one foot of sediment storage is provided in the pre-settling cell.
- The sand filter has been sized to infiltrate a minimum of 95% of average annual tributary volumes.

4.3.1 Pre-settling Cell

The proposed pre-settling cell is required to have a dead storage volume of 0.25 times the basic water quality treatment volume associated with the large sand filter. The treatment volume was found to be 7.28 acre-feet per the WWHM output (attached at the end of this section). This equates to a required dead storage volume of 317,313 cubic feet. A safety factor of 10.2% (not a code requirement) has been added to the required volume for

constructability tolerance. This results in a proposed pre-settling vault with a dead storage volume of 349,727 cubic feet.

Pre-Settling Cell Dead Storage Volume

Required Volume	= 317,313 cf
Proposed Volume	= 349,727 cf
Factor of Safety	= 10.2%

The design of the proposed pre-settling cell results in a bottom surface area of 47,968 square feet. The design water surface elevation at the top of the dead storage is set at 534.50. The elevation at the bottom of the cell, below the dead storage and one foot of sediment storage, is 527.50. The side slopes of the pre-settling cell will be 3:1. The bottom and side slopes, up to one foot above the design water surface, will be lined with a minimum of 18 inches of compacted low permeability soils and a 40 mil LLDPE pond liner to prevent stormwater from infiltrating into the ground. A 15-foot-wide access road with a maximum slope of 12% will be installed in the pre-settling cell providing access to the bottom of the facility to aid in maintenance.

4.3.2 Large Sand Filter

To provide Enhanced Basic Water Quality treatment a large sand filter is proposed and sized to infiltrate 95% of the total volume of runoff passing through the facility. Analysis shows that the sand filter is required to have a surface area of 90,300 square feet. The design of the proposed sand filter results in a proposed surface area of 94,903 square feet. The design water surface elevation at the top of the live storage is set at 533.50. The bottom of the live storage and top of the sand bed elevation is at 527.50. The bottom of the sand filter will be covered in a filtration sand media per the gradation given in Table 6.5.2.AB, and has been modeled with an design infiltration rate of 1 inch per hour. The side slopes within the sand filter will be 3:1 and vertical for the sand bed. The side slopes of the sand filter will be lined with a minimum of 18 inches of compacted low permeability soils compliant with the treatment liner specifications in KCSWDM Section 6.2.4.2 to prevent unfiltered stormwater from bypassing the filtration of the sand bed. The sand filter bottom will be unlined and an

underdrain, drain rock and textile layer will not be utilized. Flows treated through the sand filter will be infiltrated directly to the underlying soils which have an infiltration rate higher than the treatment sand layer.

A 15-foot-wide access ramp with a maximum slope of 12% will be installed in the sand filter providing access to the bottom of the facility to aid in maintenance.

WWHM was used to model the large sand filter based on the anticipated land uses from **Table 2** (Section 3.4.5). The WWHM documentation associated with the large sand filter is attached at the end of this section.

Large Sand Filter Surface Areas

Required Bottom Area = 90,300 sf
Proposed Bottom Area = 94,903 sf

4.4 INFILTRATION FACILITY ANALYSIS

The requirements of the Ten Trails DA and the LID and Level 2 Flow Control requirements will be addressed by full infiltration of stormwater runoff by an infiltration pond. A design infiltration rate of 5.1 inches per hour was used for Facility modeling. This rate was determined by AESI and is presented in their *Geotechnical Exploration and Recommendations* report.

4.4.1 Infiltration Cell

The infiltration cell was sized using WWHM in accordance with the 2021 KCSWDM. The anticipated land uses for the tributary area in **Table 2** and the design infiltration rate of 5.09 inches per hour was input into the model. The analysis shows that 100% of the runoff volume from the tributary basin infiltrates up to and including the 100-year storm event. The WWHM documentation associated with the infiltration pond is attached at the end of this section.

The infiltration cell will have a bottom area of 220,736 square feet at elevation 525 and a water storage depth of 7.5 feet with a storage volume of 1,860,782 cubic feet. The side slopes within the infiltration cell will be 3:1. A 15-foot-wide access ramp with a maximum slope of 12% will be installed in the infiltration cell to provide access to the bottom of the cell.

Infiltration Cell
Modeled Bottom Area = 210,103
Provided Bottom Area = 220,736
Required Live Storage Volume = 1,766,619 cu-ft
Provided Live Storage Volume = 1,860,782 cu-ft

4.4.2 Infiltration, Groundwater & Mounding Analysis

Associated Earth Sciences, Inc. (AESI) performed a mounding analysis to vet the performance of the proposed facility. Investigations and the results of their analysis are summarized in their *Geotechnical Exploration and Recommendations* report. AESI described

the groundwater condition at the facility as: "*The mounding analysis results presented here are based on a 20-foot vertical separation between the bottom of the infiltration facility (525 feet) and seasonal high groundwater (505 feet). The results of the MODRET simulations indicate that the modeled infiltration facility will have the capacity to infiltrate the stormwater runoff routed to the facility during the design storm time series hydrographs provided by DEA, without reaching the DHWE.*"

Full detail of this analysis are presented in the above-mentioned geotechnical report.

4.4.3 Dam Safety Analysis

This facility does not utilize any berms and detains all volumes below existing grade. Because this facility does not detain more than 10 acre-feet above existing grade, it is exempt from Ecology review.

4.4.4 Facility Overflow Analysis

The proposed facility will create a closed depression that will not utilize any above grade berms to contain stormwater. The facility design provides 3.5' of freeboard from the design water surface of the infiltration cell to the top elevation at the natural grade along the south edge of the presettling cell. This freeboard, which extends over the infiltration cell, sand filter and wet pond, provides a freeboard storage volume of over 30 acre feet. The large amount of freeboard gives the facility the ability to contain all tributary stormwater with no overflow, even in cases of extreme weather and at infiltration rates much lower than the design infiltration rate.

Section 5.2.1 of the KCSWDM provides criteria and guidance for review staff to waive the requirement for an infiltration facility to identify and analyze a 100-year overflow pathway. These criteria includes the following three requirements:

1. An additional correction factor of 0.5 is used in calculating the design infiltration rate
2. The facility is sized to fully infiltrate the 100-year runoff event.
3. The facility is not bermed on any side.

These criteria were analyzed using WWHM and it was found that the facility can infiltrate all tributary flows using half of the design infiltration rate by utilizing the additional freeboard above the design water surface. Because of the ability to reliably contain and infiltrate all flows, identifying and analyzing an overflow path is not necessary and an overflow spillway out of the facility is not needed. WWHM modeling results demonstrating full infiltration at one half the design infiltration rate is attached to this section.

4.4.5 Horseshoe Lake Infiltration Cell

The Regional Stormwater Facility includes a fourth cell which will serve Horseshoe Lake in times of emergency, and which provides the capacity to infiltrate water pumped from the lake at a rate of up to 6.0 cubic feet per second as mandated by the Reserve at Woodlands Development Agreement.

The Horseshoe Lake infiltration cell was sized using WWHM in accordance with the 2021 KCSWDM. An infiltration rate of 5.1 inches per hour, as recommended by AESI in their Geotechnical *Exploration and Recommendations* report and the max pumping rate of 6.0 cubic feet per second were used to size the cell. The analysis shows that 100% of the pumped flow infiltrates. The WWHM documentation associated with the Horseshoe Lake infiltration cell is attached at the end of this section.

The Horseshoe Lake infiltration cell; will have a bottom area of 29,219 square feet at elevation 539.5 and a water storage depth of 6 feet with a storage volume of 228,270 cubic feet. The side slopes within the Horseshoe Lake infiltration cell will be 3:1. A 15-foot-wide access ramp with a maximum slope of 12% will be installed in the infiltration cell to provide access to the bottom of the cell.

Horseshoe Lake Infiltration Cell Live Storage Volumes:
Required Bottom Area = 25,440 sq. ft
Provided Bottom Area = 29,185 sq. ft
Required Live Storage Volume = 192,239 cu-ft
Provided Live Storage Volume = 228,270 cu-ft

The Horseshoe Lake infiltration cell may be over excavated below elevation 539.5 depending on soils encountered in the field and the results of infiltration testing and monitoring. Any over excavation below elevation 539.5 will ultimately be backfilled with infiltrative fill. The over excavation is intended to reduce groundwater mounding by allowing infiltrated water to reach the deep outwash deposits that would otherwise be slowed by intervening till/silt layers.

4.5 *Facility Phasing*

The Facility is proposed to be constructed in Phases which correspond to the development of the tributary basin and the needs of Horseshoe Lake. The phasing of the facility will allow monitoring and operating data to be gathered that can be used to demonstrate the effectiveness of the facility.

In the initial phase (Phase 1) the Pre-settling cell, the sand filter cell, and the Horseshoe Lake Infiltration cell are proposed to be constructed in full along with the maintenance access road and conveyance piping. In addition, during Phase 1, a portion of the infiltration cell will be excavated to the design bottom elevation so as to provide infiltration capacity for only the tributary development planned to drain to Phase 1. In later phases, the remainder of the infiltration cell will be excavated to the design water surface elevation of 532.50. This phased approach limits the infiltration capacity of the Facility until subsequent phases are approved.

In total, three phases of Facility construction are proposed. These phases are shown on the attached *Ten Trails Regional Stormwater Facility Phasing Exhibit.*

TRIBUTARY AREA TABLE

Stormwater Management Zones	Total Area (SF)	Total Area (AC)	Lot Area (SF)	Lot Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Open Space (SF)	Open Space (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	ROW Area (SF)	ROW Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Alley Area (SF)	Alley Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Trib. Undeveloped (SF)	Trib. Undeveloped (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)
Palmer Property/Offsite																											
Palmer Property	6,112,182	140.32	2,790,826	64.07	70%	44.85	19.22	271,316	6.23	30%	1.87	4.36	1,093,410	25.10	80%	20.08	5.02	210,700	4.84	100%	4.84	0.00	1,745,930	40.08	0%	0.00	40.08
Outwash	3,543,450	81.35	1,471,449	33.78	70%	23.65	10.13	200,446	4.60	30%	1.38	3.22	599,196	13.76	80%	11.00	2.75	176,644	4.06	100%	4.06	0.00	1,095,715	25.15	0%	0.00	25.15
Till	2,573,779	59.09	1,319,368	30.29	70%	21.20	9.09	70,670	1.62	30%	0.49	1.14	494,170	11.34	80%	9.08	2.27	32,461	0.75	100%	0.75	0.00	657,109	15.09	0%	0.00	15.09
V Parcels																											
Zone 3A	4,056,635	93.13	2,286,315	52.49	70%	36.74	15.75	229,321	5.26	30%	1.58	3.69	1,393,799	32.00	80%	25.60	6.40	147,200	3.38	100%	3.38	0.00	0	0.00	0%	0.00	0.00
Outwash	2,061,645	47.33	1,106,919	25.41	70%	17.79	7.62	158,989	3.65	30%	1.09	2.55	693,890	15.93	80%	12.74	3.19	101,847	2.34	100%	2.34	0.00	0	0.00	0%	0.00	0.00
Till	1,994,976	45.80	1,179,396	27.08	70%	18.95	8.12	70,332	1.61	30%	0.48	1.13	699,895	16.07	80%	12.85	3.21	45,353	1.04	100%	1.04	0.00	0	0.00	0%	0.00	0.00
Zone 3A - School	2,824,646	64.84	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,824,646	64.84	80%	51.88	12.97	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	718,559	16.50	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	718,559	16.50	80%	13.20	3.30	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	2,106,086	48.35	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,106,086	48.35	80%	38.68	9.67	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Offsite School Area	1,053,935	24.20	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	0	0.00	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	1,053,935	24.20	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Zone 3A Total	7,935,215	182.17	2,286,315	52.5	70%	36.74	15.75	229,321	5.26	30%	1.58	3.69	5,272,379.9	96.84	80%	96.83	24.21	147,200	3.38	100%	3.38	0.00	0	0.00	0%	0.00	0.00
Zone 3B Total	2,096,710	48.13	1,498,684	34.41	70%	24.08	10.32	63,684	1.46	30%	0.44	1.02	486,260	11.16	80%	8.93	2.23	48,082	1.10	100%	1.10	0.00	0	0.00	0%	0.00	0.00
Outwash	1,149,482	26.39	806,294	18.51	70%	12.96	5.55	48,105	1.10	30%	0.33	0.77	247,778	5.69	80%	4.55	1.14	47,304	1.09	100%	1.09	0.00	0	0.00	0%	0.00	0.00
Till	947,228	21.75	692,390	15.90	70%	11.13	4.77	15,491	0.36	30%	0.11	0.25	238,482	5.47	80%	4.38	1.09	865	0.02	100%	0.02	0.00	0	0.00	0%	0.00	0.00
Zone 3C Total	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00	0	0.00	0%	0.00	0.00
Outwash	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00	0	0.00	0%	0.00	0.00
Till	0	0.00	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Zone 3D	996,116	22.87	571,498	13.12	70%	9.18	3.94	163,121	3.74	30%	1.12	2.62	224,791	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Outwash	11,012	0.25	0	0.0	70%	0.00	0.00	11,012	0.25	30%	0.08	0.18		0.00	80%	0.00	0.00		0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	985,104	22.61	571,498	13.1	70%	9.18	3.94	152,108	3.49	30%	1.05	2.44	224,791.2	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Zone 3D Total	996,116	22.87	571,498	13.1	70%	9.18	3.94	163,121	3.74	30%	1.12	2.62	224,791	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Total Palmer	6,112,182	140.32	2,790,826	64.07	70%	44.85	19.22	271,316	6.23	30%	1.87	4.36	1,093,410	25.10	80%	20.08	5.02	210,700	4.84	100%	4.84	0.00	1,745,930	40.08	0%	0.00	40.08
Total V Parcels	14,699,771	337.46	6,578,197	151.01	70%	105.71	45.30	913,966	20.98	30%	6.29	14.69	6,787,543	131.63	80%	124.66	31.16	420,064	9.64	100%	9.64	0.00	0	0.00	0%	0.00	0.00
Total	20,811,953	477.78	9,369,023	215.08	70%	150.56	64.52	1,185,282	27.21	30%	8.16	19.05	7,880,953	156.73	80%	144.74	36.18	630,765	14.48	100%	14.48	0.00	1,745,930	40.08	0%	0.00	40.08

Stormwater Management Zones	Total Impervious	Impervious outwash	Impervious Till	Total Pervious	Pervious outwash	Pervious Till
Palmer Property / Offiste	71.63	40.09	31.55	68.68	41.26	27.42
Zone 3A	138.53	47.16	91.37	43.64	16.66	26.98
Zone 3B	34.56	18.92	15.63	13.58	7.46	6.11
Zone 3C	57.94	57.94	0.00	26.35	26.35	0.00
Zone 3D	15.28	0.08	15.20	7.59	0.18	7.41
	Percentage	51.6%	48.4%			

Basin 4				
	Precipitation (FT)	Evapo-transpiration (ACFT/AC)	Recharge (ACFT/AC)	Runoff (ACFT/AC)
Outwash Forest	4.51	1.59	2.91	0.00
Till Forest	4.51	1.94	1.39	1.17
Outwash Grass	4.51	1.53	2.92	0.07
Till Grass	4.51	1.53	1.39	1.59
Impervious	4.51	0.68	0.00	3.82

Stormwater Management Zones	Total Area (ft)	Total Area (ac)	Outwash Forest (ac)	Till Forest (ac)	Recharge (ac/ft)	Runoff (ac/ft)	Required Impervious for Water Balance (ac)
Palmer Property / Offsite	6,112,182	140.32	81.35	58.97	-	68.99	18.06
Zone 3A	7,935,215	182.17	63.82	118.34	-	138.46	36.25
Zone 3B	2,096,710	48.13	26.39	21.75	-	25.44	6.66
Zone 3C	3,671,729	84.29	84.29	0.00	245.29	-	64.21
Zone 3D	996,116	22.87	0.25	22.61	-	26.46	6.93
Total Palmer	6,112,182	140.32	81.35	58.97	0.00	68.99	18.06
Total V Parcels	14,699,771	337.46	174.76	162.70	245.29	190.36	114.04
Total	20,811,953	477.78	256.10	221.67	245.29	259.36	132.11

	Initial Area	Impervious	Pervious outwash	Pervious Till	Water Balance Area	Total Area
Areas to Pond with Palmer	477.78	317.94	91.91	67.92	132.11	345.67
Areas to Pond No Palmer	337.46	246.30	50.65	40.50	114.04	223.42
Palmer / Offsite Only	140.32	71.63	41.26	27.42	18.06	122.25

	WWHM Pre Developed		WWHM Developed				
	Outwash Forest	Till Forest	Outwash Forest	Till Forest	Outwash Pervious	Till Pervious	Impervious
Palmer / Offsite Only	70.88	51.38	25.15	15.09	16.11	12.34	53.57
Phase 3 & V Parcels	115.70	107.72	-	-	50.65	40.50	132.26
Total	186.57	159.10	25.15	15.09	66.76	52.84	185.83

HORSESHOE LAKE INFILTRATION CELL

FUTURE TEN TRAILS MPD EXPANSION PHASE B

MPD EXPANSION 2

MPD EXPANSION 3

MPD EXPANSION 4

MPD EXPANSION 5

V-31 (PLAT 2-F)

FUTURE TEN TRAILS MPD EXPANSION PHASE A

V-52

V53-V56

V59

V61

V57

V58

V-34

V-35

V-36

V-37

V-38

V-39

V-40

V-41

V-42

V-43

V-44

V- 45 to 51

RESERVE AREA TO STORMWATER MANAGEMENT FACILITY

KING COUNTY

CITY OF BLACK DIAMOND

SCALE

600 0 300 600 1200

(FEET)

1 INCH = 600 FT.

N

LOT AREA

ROW AREA

ALLEY AREA

TRAIL AREA

OPEN SPACE AREA

FORESTED AREA

SCHOOL SITES AREA

REGIONAL STORMWATER FACILITY TRIBUTARY BASIN BOUNDARY

TEN TRAILS MPD BOUNDARY

THE DEVELOPMENT AREAS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE.

OAKPOINTE COMMUNITIES

DAVID EVANS AND ASSOCIATES INC.

20300 Woodinville Snohomish Rd NE
Woodinville Washington 98072
Phone: 425.415.2000

REGIONAL STORMWATER FACILITY

TRIBUTARY BASIN EXHIBIT

KING COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

DATE: ----

REVIEWED BY: ----

EXHIBIT DATED 9/18/24

CHECKED BY: ----
DESIGNED BY: ----
DRAWN BY: ----

FIRST SUBMITTAL DATE: --/--/--

PROJECT NO.
OAKPCBDP6001

SHEET NO.

1 OF 1

Plot Date: 9/19/2024 4:15 PM
Save Date: 9/18/2024 2:24 PM
By: Taylor Wilmsen
By: Tsw
File:P:\O\OAKPCBDP6001\0400\CAD\EC\EXHIBIT\SF\Final\Ten_Trails\Phase 3\Reserve Pond_TIR\FINAL\4-1 Tributary Area Exhibit.dwg

TRIBUTARY AREA TABLE

Stormwater Management Zones	Total Area (SF)	Total Area (AC)	Lot Area (SF)	Lot Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Open Space (SF)	Open Space (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	ROW Area (SF)	ROW Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Alley Area (SF)	Alley Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Trib. Undeveloped (SF)	Trib. Undeveloped (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)
Palmer Property/Offsite																											
Palmer Property	6,112,182	140.32	2,790,826	64.07	70%	44.85	19.22	271,316	6.23	30%	1.87	4.36	1,093,410	25.10	80%	20.08	5.02	210,700	4.84	100%	4.84	0.00	1,745,930	40.08	0%	0.00	40.08
Outwash	3,543,450	81.35	1,471,449	33.78	70%	23.65	10.13	200,446	4.60	30%	1.38	3.22	599,196	13.76	80%	11.00	2.75	176,644	4.06	100%	4.06	0.00	1,095,715	25.15	0%	0.00	25.15
Till	2,573,779	59.09	1,319,368	30.29	70%	21.20	9.09	70,670	1.62	30%	0.49	1.14	494,170	11.34	80%	9.08	2.27	32,461	0.75	100%	0.75	0.00	657,109	15.09	0%	0.00	15.09
V Parcels																											
Zone 3A	4,056,635	93.13	2,286,315	52.49	70%	36.74	15.75	229,321	5.26	30%	1.58	3.69	1,393,799	32.00	80%	25.60	6.40	147,200	3.38	100%	3.38	0.00	0	0.00	0%	0.00	0.00
Outwash	2,061,645	47.33	1,106,919	25.41	70%	17.79	7.62	158,989	3.65	30%	1.09	2.55	693,890	15.93	80%	12.74	3.19	101,847	2.34	100%	2.34	0.00	0	0.00	0%	0.00	0.00
Till	1,994,976	45.80	1,179,396	27.08	70%	18.95	8.12	70,332	1.61	30%	0.48	1.13	699,895	16.07	80%	12.85	3.21	45,353	1.04	100%	1.04	0.00	0	0.00	0%	0.00	0.00
Zone 3A - School	2,824,646	64.84	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,824,646	64.84	80%	51.88	12.97	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	718,559	16.50	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	718,559	16.50	80%	13.20	3.30	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	2,106,086	48.35	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,106,086	48.35	80%	38.68	9.67	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Offsite School Area	1,053,935	24.20	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	0	0.00	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	1,053,935	24.20	0	0.0	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Zone 3A Total	7,935,215	182.17	2,286,315	52.5	70%	36.74	15.75	229,321	5.26	30%	1.58	3.69	5,272,379.9	96.84	80%	96.83	24.21	147,200	3.38	100%	3.38	0.00	0	0.00	0%	0.00	0.00
Zone 3B Total	2,096,710	48.13	1,498,684	34.41	70%	24.08	10.32	63,684	1.46	30%	0.44	1.02	486,260	11.16	80%	8.93	2.23	48,082	1.10	100%	1.10	0.00	0	0.00	0%	0.00	0.00
Outwash	1,149,482	26.39	806,294	18.51	70%	12.96	5.55	48,105	1.10	30%	0.33	0.77	247,778	5.69	80%	4.55	1.14	47,304	1.09	100%	1.09	0.00	0	0.00	0%	0.00	0.00
Till	947,228	21.75	692,390	15.90	70%	11.13	4.77	15,491	0.36	30%	0.11	0.25	238,482	5.47	80%	4.38	1.09	865	0.02	100%	0.02	0.00	0	0.00	0%	0.00	0.00
Zone 3C Total	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00	0	0.00	0%	0.00	0.00
Outwash	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00	0	0.00	0%	0.00	0.00
Till	0	0.00	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Zone 3D	996,116	22.87	571,498	13.12	70%	9.18	3.94	163,121	3.74	30%	1.12	2.62	224,791	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Outwash	11,012	0.25	0	0.0	70%	0.00	0.00	11,012	0.25	30%	0.08	0.18		0.00	80%	0.00	0.00		0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	985,104	22.61	571,498	13.1	70%	9.18	3.94	152,108	3.49	30%	1.05	2.44	224,791.2	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Zone 3D Total	996,116	22.87	571,498	13.1	70%	9.18	3.94	163,121	3.74	30%	1.12	2.62	224,791	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Total Palmer	6,112,182	140.32	2,790,826	64.07	70%	44.85	19.22	271,316	6.23	30%	1.87	4.36	1,093,410	25.10	80%	20.08	5.02	210,700	4.84	100%	4.84	0.00	1,745,930	40.08	0%	0.00	40.08
Total V Parcels	14,699,771	337.46	6,578,197	151.01	70%	105.71	45.30	913,966	20.98	30%	6.29	14.69	6,787,543	131.63	80%	124.66	31.16	420,064	9.64	100%	9.64	0.00	0	0.00	0%	0.00	0.00
Total	20,811,953	477.78	9,369,023	215.08	70%	150.56	64.52	1,185,282	27.21	30%	8.16	19.05	7,880,953	156.73	80%	144.74	36.18	630,765	14.48	100%	14.48	0.00	1,745,930	40.08	0%	0.00	40.08

Stormwater Management Zones	Total Impervious	Impervious outwash	Impervious Till	Total Pervious	Pervious outwash	Pervious Till
Palmer Property / Offiste	71.63	40.09	31.55	68.68	41.26	27.42
Zone 3A	138.53	47.16	91.37	43.64	16.66	26.98
Zone 3B	34.56	18.92	15.63	13.58	7.46	6.11
Zone 3C	57.94	57.94	0.00	26.35	26.35	0.00
Zone 3D	15.28	0.08	15.20	7.59	0.18	7.41
	Percentage	51.6%	48.4%			

Basin 4				
	Precipitation (FT)	Evapo-transpiration (ACFT/AC)	Recharge (ACFT/AC)	Runoff (ACFT/AC)
Outwash Forest	4.51	1.59	2.91	0.00
Till Forest	4.51	1.94	1.39	1.17
Outwash Grass	4.51	1.53	2.92	0.07
Till Grass	4.51	1.53	1.39	1.59
Impervious	4.51	0.68	0.00	3.82

Stormwater Management Zones	Total Area (ft)	Total Area (ac)	Outwash Forest (ac)	Till Forest (ac)	Recharge (ac/ft)	Runoff (ac/ft)	Required Impervious for Water Balance (ac)
Palmer Property / Offsite	6,112,182	140.32	81.35	58.97	-	68.99	18.06
Zone 3A	7,935,215	182.17	63.82	118.34	-	138.46	36.25
Zone 3B	2,096,710	48.13	26.39	21.75	-	25.44	6.66
Zone 3C	3,671,729	84.29	84.29	0.00	245.29	-	64.21
Zone 3D	996,116	22.87	0.25	22.61	-	26.46	6.93
Total Palmer	6,112,182	140.32	81.35	58.97	0.00	68.99	18.06
Total V Parcels	14,699,771	337.46	174.76	162.70	245.29	190.36	114.04
Total	20,811,953	477.78	256.10	221.67	245.29	259.36	132.11

	Initial Area	Impervious	Pervious outwash	Pervious Till	Water Balance Area	Total Area
Areas to Pond with Palmer	477.78	317.94	91.91	67.92	132.11	345.67
Areas to Pond No Palmer	337.46	246.30	50.65	40.50	114.04	223.42
Palmer / Offsite Only	140.32	71.63	41.26	27.42	18.06	122.25

	WWHM Pre Developed		WWHM Developed				
	Outwash Forest	Till Forest	Outwash Forest	Till Forest	Outwash Pervious	Till Pervious	Impervious
Palmer / Offsite Only	70.88	51.38	25.15	15.09	16.11	12.34	53.57
Phase 3 & V Parcels	115.70	107.72	-	-	50.65	40.50	132.26
Total	186.57	159.10	25.15	15.09	66.76	52.84	185.83

HORSESHOE LAKE INFILTRATION CELL

FUTURE TEN TRAILS MPD EXPANSION PHASE B

MPD EXPANSION 2

MPD EXPANSION 3

MPD EXPANSION 4

MPD EXPANSION 5

V-31 (PLAT 2-F)

FUTURE TEN TRAILS MPD EXPANSION PHASE A

V-52

V53-V56

V59

V61

V57

V58

V-34

V-35

V-36

V-37

V-38

V-39

V-40

V-41

V-42

V-43

V-44

V- 45 to 51

RESERVE AREA TO STORMWATER MANAGEMENT FACILITY

KING COUNTY

CITY OF BLACK DIAMOND

SCALE

600 0 300 600 1200

(FEET)

1 INCH = 600 FT.

N

LOT AREA

ROW AREA

ALLEY AREA

TRAIL AREA

OPEN SPACE AREA

FORESTED AREA

SCHOOL SITES AREA

REGIONAL STORMWATER FACILITY TRIBUTARY BASIN BOUNDARY

TEN TRAILS MPD BOUNDARY

THE DEVELOPMENT AREAS SHOWN ARE CONCEPTUAL AND SUBJECT TO CHANGE.

OAKPOINTE COMMUNITIES

DAVID EVANS AND ASSOCIATES INC.

20300 Woodinville Snohomish Rd NE
Woodinville Washington 98072
Phone: 425.415.2000

REGIONAL STORMWATER FACILITY

TRIBUTARY BASIN EXHIBIT

KING COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

DATE: ----

REVIEWED BY: ----

EXHIBIT DATED 9/18/24

CHECKED BY: ----
DESIGNED BY: ----
DRAWN BY: ----

FIRST SUBMITTAL DATE: --/--/--

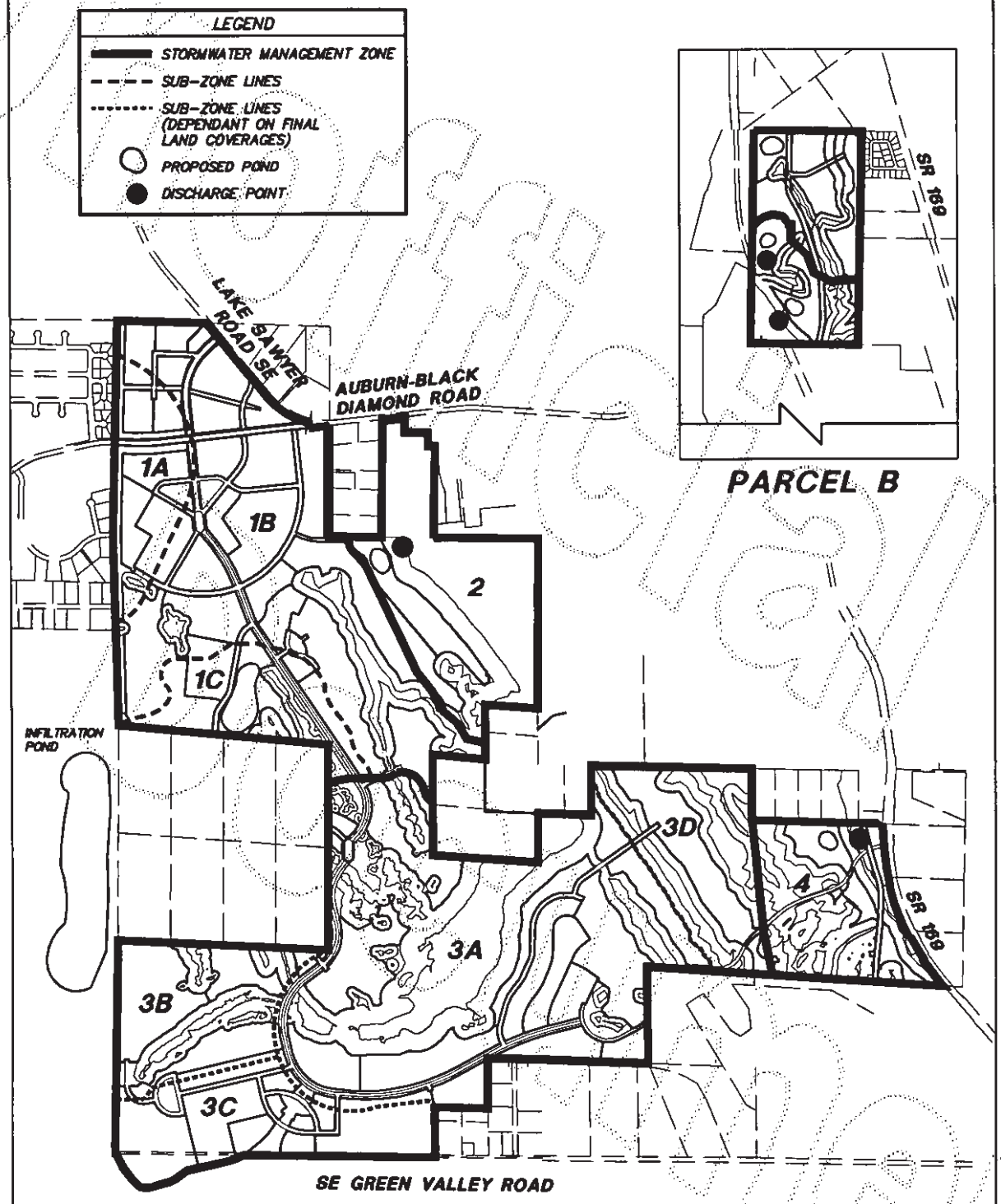
PROJECT NO.
OAKPCBDP6001

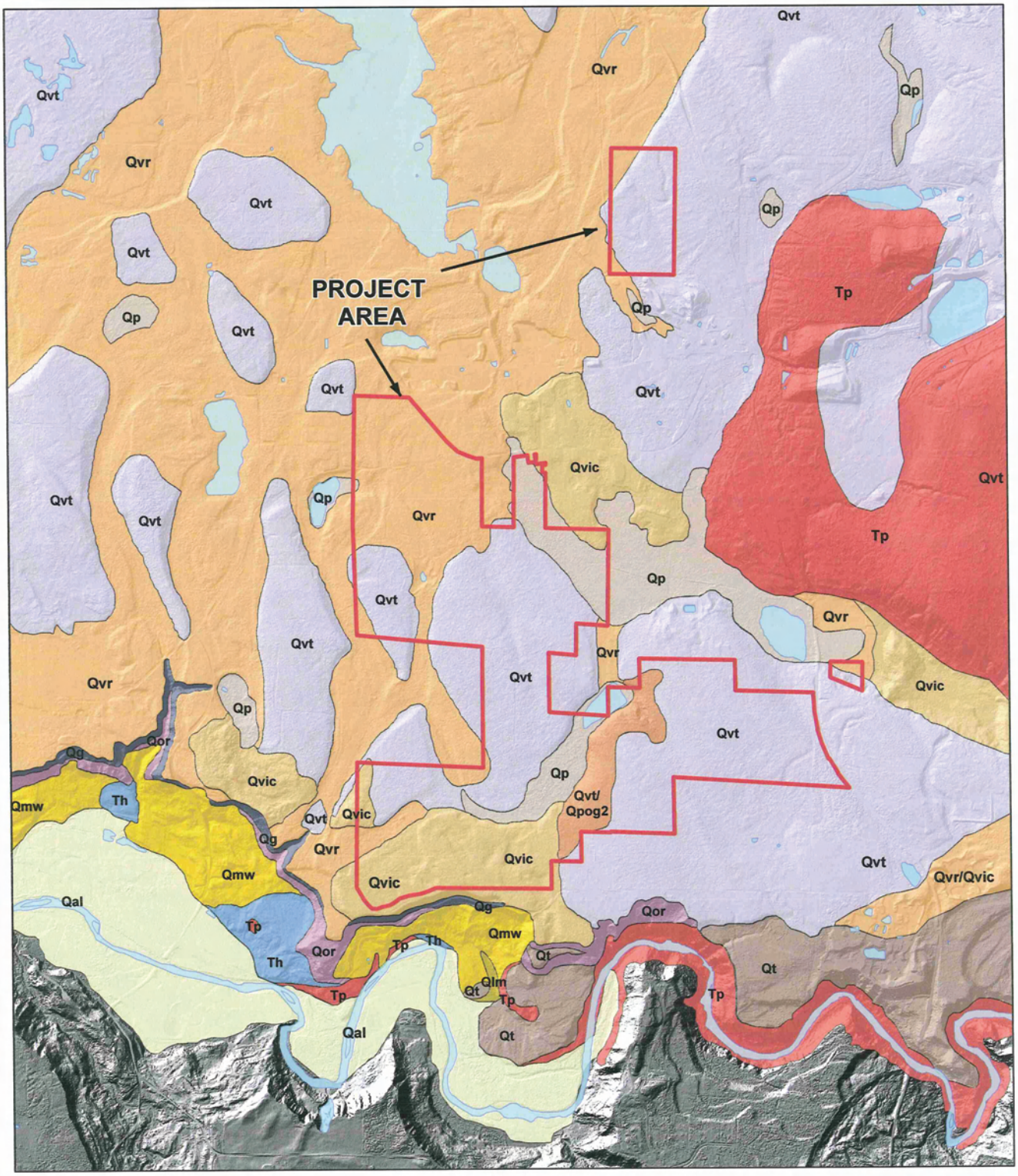
SHEET NO.

1 OF 1

Plot Date: 9/19/2024 4:15 PM
Save Date: 9/18/2024 2:24 PM
By: Taylor Wilmsen
By: Tsw
File:P:\O\OAKPCBDP6001\0400\CAD\EC\EXHIBIT\SF\Final\Ten_Trails\Phase 3\Reserve Pond_TIR\FINAL\4-1 Tributary Area Exhibit.dwg

FIGURE 7.4:
CONCEPTUAL STORMWATER PLAN





Legend

RECENT/HOLOCENE

- Qal — River alluvium
- Qp — Peat/organic deposits
- Qmw — Mass wasting
- Qlm — Lacustrine deposits
- Qt — Terrace alluvium

VASHON DRIFT

- Qvr — Recessional outwash
- Qvic — Ice Contact
- Qvt — Lodgement till
- Qg — Undifferentiated till and outwash

PRE-OLYMPIA GLACIAL DEPOSITS

- Qvt/Qpog2 — Coarse-grained
- Qor — Orting Drift

TERTIARY

- Th — Hammer Bluff Formation
- Tp — Puget Group

N

0 1,000 2,000 Feet

Reference: Geology modified by AESI from Mullineaux, D.R., *Geologic Map of the Black Diamond Quadrangle*, GQ-407, USGS, 1965
Roads, waterbodies, parcel outlines - King County GIS Center, acquired 2-08; Contours and shaded relief generated from 1 meter DEM; King County GIS Center, acquired 2-08;

N:\060601KGA_Villages\Figures_11_17\Draft_Geology.mxd

Associated Earth Sciences, Inc.

GEOLOGY MAP
THE VILLAGES
BLACK DIAMOND, WASHINGTON

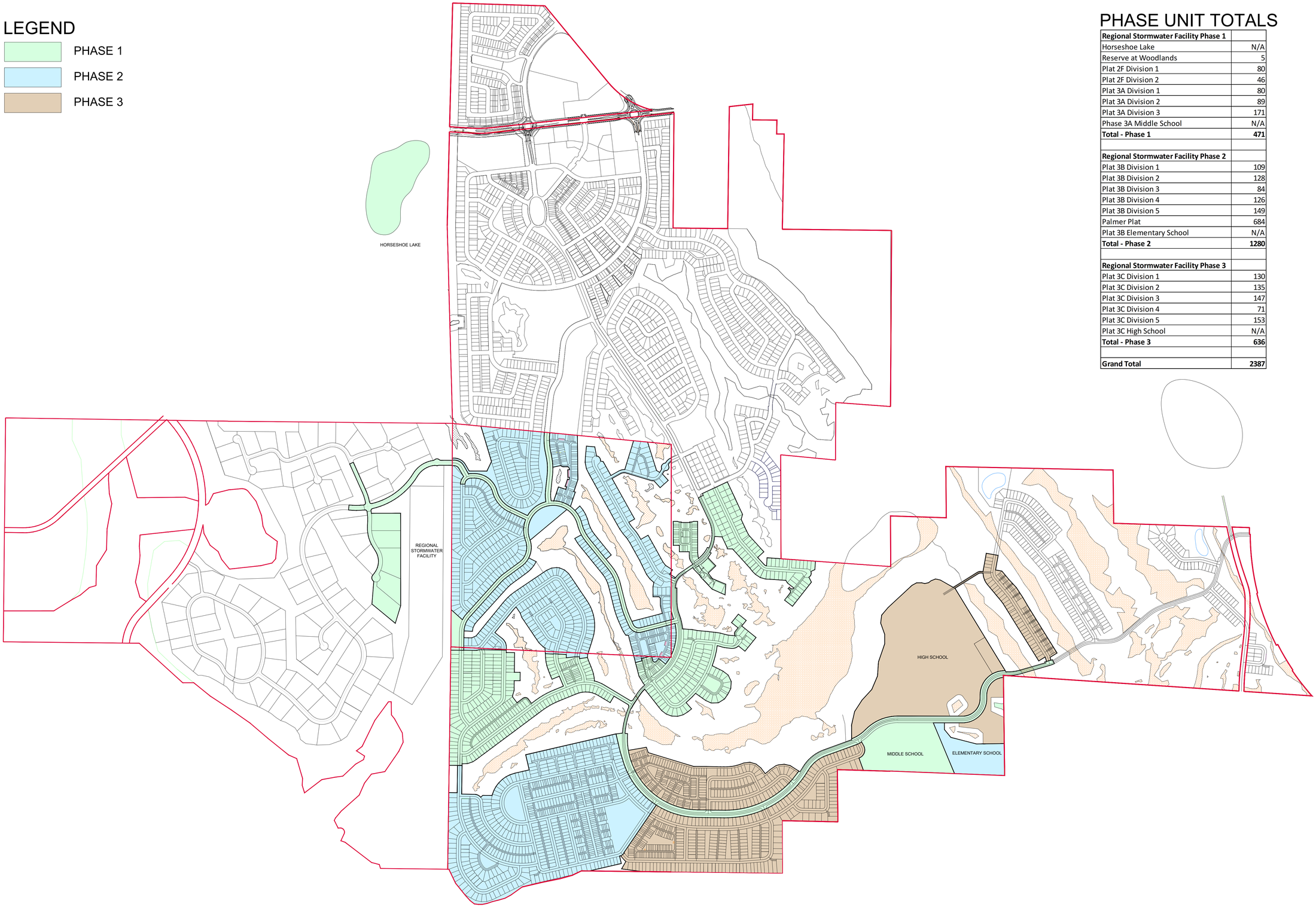
FIGURE 9
DATE 9/08
PROJ. NO. KG060601A

LEGEND

- PHASE 1
- PHASE 2
- PHASE 3

PHASE UNIT TOTALS

Regional Stormwater Facility Phase 1	
Horseshoe Lake	N/A
Reserve at Woodlands	5
Plat 2F Division 1	80
Plat 2F Division 2	46
Plat 3A Division 1	80
Plat 3A Division 2	89
Plat 3A Division 3	171
Phase 3A Middle School	N/A
Total - Phase 1	**471**
Regional Stormwater Facility Phase 2	
Plat 3B Division 1	109
Plat 3B Division 2	128
Plat 3B Division 3	84
Plat 3B Division 4	126
Plat 3B Division 5	149
Palmer Plat	684
Plat 3B Elementary School	N/A
Total - Phase 2	**1280**
Regional Stormwater Facility Phase 3	
Plat 3C Division 1	130
Plat 3C Division 2	135
Plat 3C Division 3	147
Plat 3C Division 4	71
Plat 3C Division 5	153
Plat 3C High School	N/A
Total - Phase 3	**636**
Grand Total	**2387**



TEN TRAILS REGIONAL STORMWATER FACILITY PHASING EXHIBIT

OAKPOINTE

N

0 125 250 500

SCALE: 1" = 500'

AUGUST 30, 2022

WWHM2012
PROJECT REPORT

Project Name: Phase 3 RIP HSL 5.09 in-hr
Site Name: Phase 3 Pond
Site Address: Ten Trails
City : Black Diamond
Report Date: 9/16/2022
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.17
Version Date: 2018/10/10
Version : 4.2.16

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Ten Trails Phase 3
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	115.7
C, Forest, Flat	107.72
Pervious Total	223.42

Impervious Land Use	acre
Impervious Total	0
Basin Total	223.42

Element Flows To:

Surface	Interflow	Groundwater

Name : Palmer 157 & Offsite Area
Bypass: No

GroundWater: No

Pervious Land Use	acre

A B, Forest, Flat	70.88
C, Forest, Flat	51.38
Pervious Total	122.26

Impervious Land Use	acre
Impervious Total	0
Basin Total	122.26

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Ten Trails Phase 3
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	50.65
C, Lawn, Flat	40.51
Pervious Total	91.16

Impervious Land Use	acre
ROADS FLAT	132.26
Impervious Total	132.26
Basin Total	223.42

Element Flows To:

Surface	Interflow	Groundwater
Presettling Pond	Presettling Pond	

Name : Palmer 157 & Offsite Area
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Mod	25.15
A B, Lawn, Flat	16.11

C, Forest, Mod	**15.09**
C, Lawn, Flat	**12.34**
Pervious Total	**68.69**

Impervious Land Use	**acre**
ROADS FLAT	**53.57**
Impervious Total	**53.57**
Basin Total	**122.26**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Presettling Pond	Presettling Pond	

Name : Presettling Pond
Bottom Length: 345.00 ft.
Bottom Width: 145.50 ft.
Depth: 7 ft.
Volume at riser head: 8.2959 acre-feet.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 180 in.

Element Flows To:

Outlet 1	**Outlet 2**
Large Sand Filter	

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.152	0.000	0.000	0.000
0.0778	1.157	0.089	0.000	0.000
0.1556	1.162	0.180	0.000	0.000
0.2333	1.168	0.270	0.000	0.000
0.3111	1.173	0.361	0.000	0.000
0.3889	1.178	0.453	0.000	0.000
0.4667	1.184	0.545	0.000	0.000
0.5444	1.189	0.637	0.000	0.000
0.6222	1.194	0.730	0.000	0.000
0.7000	1.200	0.823	0.000	0.000
0.7778	1.205	0.916	0.000	0.000
0.8556	1.210	1.010	0.000	0.000
0.9333	1.216	1.105	0.000	0.000
1.0111	1.221	1.200	0.000	0.000

1.0889	1.226	1.295	0.000	0.000
1.1667	1.232	1.390	0.000	0.000
1.2444	1.237	1.486	0.000	0.000
1.3222	1.243	1.583	0.000	0.000
1.4000	1.248	1.680	0.000	0.000
1.4778	1.254	1.777	0.000	0.000
1.5556	1.259	1.875	0.000	0.000
1.6333	1.264	1.973	0.000	0.000
1.7111	1.270	2.072	0.000	0.000
1.7889	1.275	2.171	0.000	0.000
1.8667	1.281	2.270	0.000	0.000
1.9444	1.286	2.370	0.000	0.000
2.0222	1.292	2.470	0.000	0.000
2.1000	1.297	2.571	0.000	0.000
2.1778	1.303	2.672	0.000	0.000
2.2556	1.309	2.774	0.000	0.000
2.3333	1.314	2.876	0.000	0.000
2.4111	1.320	2.978	0.000	0.000
2.4889	1.325	3.081	0.000	0.000
2.5667	1.331	3.185	0.000	0.000
2.6444	1.336	3.288	0.000	0.000
2.7222	1.342	3.392	0.000	0.000
2.8000	1.348	3.497	0.000	0.000
2.8778	1.353	3.602	0.000	0.000
2.9556	1.359	3.708	0.000	0.000
3.0333	1.364	3.814	0.000	0.000
3.1111	1.370	3.920	0.000	0.000
3.1889	1.376	4.027	0.000	0.000
3.2667	1.381	4.134	0.000	0.000
3.3444	1.387	4.242	0.000	0.000
3.4222	1.393	4.350	0.000	0.000
3.5000	1.399	4.458	0.000	0.000
3.5778	1.404	4.568	0.000	0.000
3.6556	1.410	4.677	0.000	0.000
3.7333	1.416	4.787	0.000	0.000
3.8111	1.421	4.897	0.000	0.000
3.8889	1.427	5.008	0.000	0.000
3.9667	1.433	5.119	0.000	0.000
4.0444	1.439	5.231	0.000	0.000
4.1222	1.444	5.343	0.000	0.000
4.2000	1.450	5.456	0.000	0.000
4.2778	1.456	5.569	0.000	0.000
4.3556	1.462	5.682	0.000	0.000
4.4333	1.468	5.796	0.000	0.000
4.5111	1.474	5.911	0.000	0.000
4.5889	1.479	6.026	0.000	0.000
4.6667	1.485	6.141	0.000	0.000
4.7444	1.491	6.257	0.000	0.000
4.8222	1.497	6.373	0.000	0.000
4.9000	1.503	6.490	0.000	0.000
4.9778	1.509	6.607	0.000	0.000
5.0556	1.515	6.724	0.000	0.000
5.1333	1.521	6.843	0.000	0.000
5.2111	1.526	6.961	0.000	0.000
5.2889	1.532	7.080	0.000	0.000
5.3667	1.538	7.199	0.000	0.000
5.4444	1.544	7.319	0.000	0.000

5.5222	1.550	7.440	0.000	0.000
5.6000	1.556	7.561	0.000	0.000
5.6778	1.562	7.682	0.000	0.000
5.7556	1.568	7.804	0.000	0.000
5.8333	1.574	7.926	0.000	0.000
5.9111	1.580	8.049	0.000	0.000
5.9889	1.586	8.172	0.000	0.000
6.0667	1.592	8.295	2.741	0.000
6.1444	1.598	8.420	8.741	0.000
6.2222	1.604	8.544	16.67	0.000
6.3000	1.610	8.669	26.15	0.000
6.3778	1.616	8.795	36.94	0.000
6.4556	1.623	8.921	48.91	0.000
6.5333	1.629	9.047	61.95	0.000
6.6111	1.635	9.174	75.97	0.000
6.6889	1.641	9.302	90.90	0.000
6.7667	1.647	9.429	106.7	0.000
6.8444	1.653	9.558	123.3	0.000
6.9222	1.659	9.687	140.6	0.000
7.0000	1.665	9.816	158.8	0.000
7.0778	1.672	9.946	177.6	0.000

Name : Large Sand Filter
Bottom Length: 300.00 ft.
Bottom Width: 301.00 ft.
Depth: 7 ft.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Filtration On
Hydraulic conductivity: 1
Depth of filter medium: 1.5
Total Volume Infiltrated (ac-ft.): 40071.392
Total Volume Through Riser (ac-ft.): 2094.152
Total Volume Through Facility (ac-ft.): 42165.544
Percent Infiltrated: 95.03
Total Precip Applied to Facility: 469.161
Total Evap From Facility: 81.673
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 180 in.

Element Flows To:
Outlet 1 **Outlet 2**
Regional Infiltration

Sand Filter Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	2.073	0.000	0.000	0.000
0.0778	2.079	0.161	0.000	2.198
0.1556	2.085	0.323	0.000	2.307
0.2333	2.092	0.486	0.000	2.415

0.3111	2.098	0.648	0.000	2.523
0.3889	2.105	0.812	0.000	2.632
0.4667	2.111	0.976	0.000	2.740
0.5444	2.118	1.140	0.000	2.849
0.6222	2.124	1.306	0.000	2.957
0.7000	2.131	1.471	0.000	3.065
0.7778	2.137	1.637	0.000	3.174
0.8556	2.144	1.804	0.000	3.282
0.9333	2.151	1.971	0.000	3.390
1.0111	2.157	2.138	0.000	3.499
1.0889	2.164	2.306	0.000	3.607
1.1667	2.170	2.475	0.000	3.716
1.2444	2.177	2.644	0.000	3.824
1.3222	2.183	2.814	0.000	3.932
1.4000	2.190	2.984	0.000	4.041
1.4778	2.197	3.154	0.000	4.149
1.5556	2.203	3.325	0.000	4.258
1.6333	2.210	3.497	0.000	4.366
1.7111	2.217	3.669	0.000	4.474
1.7889	2.223	3.842	0.000	4.583
1.8667	2.230	4.015	0.000	4.691
1.9444	2.237	4.189	0.000	4.799
2.0222	2.243	4.363	0.000	4.908
2.1000	2.250	4.538	0.000	5.016
2.1778	2.257	4.713	0.000	5.125
2.2556	2.263	4.889	0.000	5.233
2.3333	2.270	5.065	0.000	5.341
2.4111	2.277	5.242	0.000	5.450
2.4889	2.284	5.420	0.000	5.558
2.5667	2.290	5.598	0.000	5.667
2.6444	2.297	5.776	0.000	5.775
2.7222	2.304	5.955	0.000	5.883
2.8000	2.311	6.135	0.000	5.992
2.8778	2.318	6.315	0.000	6.100
2.9556	2.324	6.495	0.000	6.208
3.0333	2.331	6.676	0.000	6.317
3.1111	2.338	6.858	0.000	6.425
3.1889	2.345	7.040	0.000	6.534
3.2667	2.352	7.223	0.000	6.642
3.3444	2.359	7.406	0.000	6.750
3.4222	2.366	7.590	0.000	6.859
3.5000	2.372	7.774	0.000	6.967
3.5778	2.379	7.959	0.000	7.076
3.6556	2.386	8.144	0.000	7.184
3.7333	2.393	8.330	0.000	7.292
3.8111	2.400	8.516	0.000	7.401
3.8889	2.407	8.703	0.000	7.509
3.9667	2.414	8.891	0.000	7.617
4.0444	2.421	9.079	0.000	7.726
4.1222	2.428	9.268	0.000	7.834
4.2000	2.435	9.457	0.000	7.943
4.2778	2.442	9.646	0.000	8.051
4.3556	2.449	9.837	0.000	8.159
4.4333	2.456	10.02	0.000	8.268
4.5111	2.463	10.21	0.000	8.376
4.5889	2.470	10.41	0.000	8.485
4.6667	2.477	10.60	0.000	8.593

4.7444	2.484	10.79	0.000	8.701
4.8222	2.491	10.99	0.000	8.810
4.9000	2.498	11.18	0.000	8.918
4.9778	2.505	11.37	0.000	9.026
5.0556	2.512	11.57	0.000	9.135
5.1333	2.519	11.76	0.000	9.243
5.2111	2.526	11.96	0.000	9.352
5.2889	2.533	12.16	0.000	9.460
5.3667	2.541	12.36	0.000	9.568
5.4444	2.548	12.55	0.000	9.677
5.5222	2.555	12.75	0.000	9.785
5.6000	2.562	12.95	0.000	9.894
5.6778	2.569	13.15	0.000	10.00
5.7556	2.576	13.35	0.000	10.11
5.8333	2.584	13.55	0.000	10.21
5.9111	2.591	13.75	0.000	10.32
5.9889	2.598	13.95	0.000	10.43
6.0667	2.605	14.16	2.741	10.54
6.1444	2.612	14.36	8.741	10.65
6.2222	2.620	14.56	16.67	10.76
6.3000	2.627	14.77	26.15	10.86
6.3778	2.634	14.97	36.94	10.97
6.4556	2.641	15.18	48.91	11.08
6.5333	2.649	15.38	61.95	11.19
6.6111	2.656	15.59	75.97	11.30
6.6889	2.663	15.80	90.90	11.41
6.7667	2.671	16.00	106.7	11.52
6.8444	2.678	16.21	123.3	11.62
6.9222	2.685	16.42	140.6	11.73
7.0000	2.693	16.63	158.8	11.84
7.0778	2.700	16.84	177.6	11.95

Name : Regional Infiltration Pond
Bottom Length: 289.00 ft.
Bottom Width: 728.00 ft.
Depth: 8.5 ft.
Volume at riser head: 40.6101 acre-feet.
Infiltration On
Infiltration rate: 5.09
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 2165.925
Total Volume Through Riser (ac-ft.): 0.00
Total Volume Through Facility (ac-ft.): 2165.93
Percent Infiltrated: 100
Total Precip Applied to Facility: 73.277
Total Evap From Facility: 0.903
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 7.5 ft.
Riser Diameter: 48 in.

Element Flows To:

Outlet 1 **Outlet 2**

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	4.829	0.000	0.000	0.000
0.0944	4.843	0.456	0.000	24.85
0.1889	4.856	0.914	0.000	24.92
0.2833	4.869	1.374	0.000	24.99
0.3778	4.883	1.834	0.000	25.06
0.4722	4.896	2.296	0.000	25.13
0.5667	4.909	2.759	0.000	25.19
0.6611	4.922	3.223	0.000	25.26
0.7556	4.936	3.689	0.000	25.33
0.8500	4.949	4.156	0.000	25.40
0.9444	4.963	4.624	0.000	25.47
1.0389	4.976	5.093	0.000	25.54
1.1333	4.989	5.564	0.000	25.61
1.2278	5.003	6.036	0.000	25.67
1.3222	5.016	6.509	0.000	25.74
1.4167	5.030	6.983	0.000	25.81
1.5111	5.043	7.459	0.000	25.88
1.6056	5.057	7.936	0.000	25.95
1.7000	5.070	8.414	0.000	26.02
1.7944	5.084	8.894	0.000	26.09
1.8889	5.097	9.375	0.000	26.16
1.9833	5.111	9.857	0.000	26.23
2.0778	5.124	10.34	0.000	26.30
2.1722	5.138	10.82	0.000	26.37
2.2667	5.151	11.31	0.000	26.44
2.3611	5.165	11.79	0.000	26.51
2.4556	5.178	12.28	0.000	26.58
2.5500	5.192	12.77	0.000	26.65
2.6444	5.206	13.26	0.000	26.72
2.7389	5.219	13.76	0.000	26.79
2.8333	5.233	14.25	0.000	26.86
2.9278	5.247	14.74	0.000	26.93
3.0222	5.260	15.24	0.000	27.00
3.1167	5.274	15.74	0.000	27.07
3.2111	5.288	16.24	0.000	27.14
3.3056	5.302	16.74	0.000	27.21
3.4000	5.315	17.24	0.000	27.28
3.4944	5.329	17.74	0.000	27.35
3.5889	5.343	18.24	0.000	27.42
3.6833	5.357	18.75	0.000	27.49
3.7778	5.370	19.26	0.000	27.56
3.8722	5.384	19.76	0.000	27.63
3.9667	5.398	20.27	0.000	27.70
4.0611	5.412	20.78	0.000	27.77
4.1556	5.426	21.30	0.000	27.85
4.2500	5.440	21.81	0.000	27.92
4.3444	5.454	22.32	0.000	27.99
4.4389	5.468	22.84	0.000	28.06
4.5333	5.482	23.36	0.000	28.13

4.6278	5.495	23.87	0.000	28.20
4.7222	5.509	24.39	0.000	28.27
4.8167	5.523	24.92	0.000	28.35
4.9111	5.537	25.44	0.000	28.42
5.0056	5.551	25.96	0.000	28.49
5.1000	5.565	26.49	0.000	28.56
5.1944	5.579	27.01	0.000	28.63
5.2889	5.593	27.54	0.000	28.71
5.3833	5.608	28.07	0.000	28.78
5.4778	5.622	28.60	0.000	28.85
5.5722	5.636	29.13	0.000	28.92
5.6667	5.650	29.66	0.000	29.00
5.7611	5.664	30.20	0.000	29.07
5.8556	5.678	30.73	0.000	29.14
5.9500	5.692	31.27	0.000	29.21
6.0444	5.706	31.81	0.000	29.29
6.1389	5.721	32.35	0.000	29.36
6.2333	5.735	32.89	0.000	29.43
6.3278	5.749	33.43	0.000	29.50
6.4222	5.763	33.98	0.000	29.58
6.5167	5.777	34.52	0.000	29.65
6.6111	5.792	35.07	0.000	29.72
6.7056	5.806	35.62	0.000	29.80
6.8000	5.820	36.16	0.000	29.87
6.8944	5.835	36.71	0.000	29.94
6.9889	5.849	37.27	0.000	30.02
7.0833	5.863	37.82	0.000	30.09
7.1778	5.878	38.37	0.000	30.16
7.2722	5.892	38.93	0.000	30.24
7.3667	5.906	39.49	0.000	30.31
7.4611	5.921	40.05	0.000	30.39
7.5556	5.935	40.61	0.555	30.46
7.6500	5.949	41.17	2.464	30.53
7.7444	5.964	41.73	5.119	30.61
7.8389	5.978	42.29	8.340	30.68
7.9333	5.993	42.86	12.01	30.76
8.0278	6.007	43.43	16.06	30.83
8.1222	6.022	43.99	20.39	30.90
8.2167	6.036	44.56	24.93	30.98
8.3111	6.051	45.13	29.59	31.05
8.4056	6.065	45.71	34.30	31.13
8.5000	6.080	46.28	38.96	31.20
8.5944	6.094	46.85	43.49	31.28

Name : Horseshoe Lake Pond
Bottom Length: 159.00 ft.
Bottom Width: 160.00 ft.
Depth: 7 ft.
Volume at riser head: 4.4132 acre-feet.
Infiltration On
Infiltration rate: 6.8
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 0
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 0

Percent Infiltrated: 0
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.

Element Flows To:
Outlet 1 **Outlet 2**

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.584	0.000	0.000	0.000
0.0778	0.587	0.045	0.000	4.027
0.1556	0.590	0.091	0.000	4.051
0.2333	0.594	0.137	0.000	4.075
0.3111	0.597	0.183	0.000	4.098
0.3889	0.601	0.230	0.000	4.122
0.4667	0.604	0.277	0.000	4.146
0.5444	0.608	0.324	0.000	4.170
0.6222	0.611	0.372	0.000	4.194
0.7000	0.615	0.419	0.000	4.218
0.7778	0.618	0.467	0.000	4.242
0.8556	0.622	0.515	0.000	4.266
0.9333	0.625	0.564	0.000	4.290
1.0111	0.629	0.613	0.000	4.314
1.0889	0.632	0.662	0.000	4.339
1.1667	0.636	0.711	0.000	4.363
1.2444	0.640	0.761	0.000	4.388
1.3222	0.643	0.811	0.000	4.412
1.4000	0.647	0.861	0.000	4.437
1.4778	0.650	0.911	0.000	4.462
1.5556	0.654	0.962	0.000	4.486
1.6333	0.658	1.013	0.000	4.511
1.7111	0.661	1.065	0.000	4.536
1.7889	0.665	1.116	0.000	4.561
1.8667	0.668	1.168	0.000	4.586
1.9444	0.672	1.220	0.000	4.611
2.0222	0.676	1.273	0.000	4.636
2.1000	0.679	1.325	0.000	4.662
2.1778	0.683	1.378	0.000	4.687
2.2556	0.687	1.432	0.000	4.712
2.3333	0.691	1.485	0.000	4.738
2.4111	0.694	1.539	0.000	4.763
2.4889	0.698	1.593	0.000	4.789
2.5667	0.702	1.648	0.000	4.815
2.6444	0.706	1.703	0.000	4.840
2.7222	0.709	1.758	0.000	4.866
2.8000	0.713	1.813	0.000	4.892

2.8778	0.717	1.869	0.000	4.918
2.9556	0.721	1.925	0.000	4.944
3.0333	0.724	1.981	0.000	4.970
3.1111	0.728	2.037	0.000	4.996
3.1889	0.732	2.094	0.000	5.022
3.2667	0.736	2.151	0.000	5.049
3.3444	0.740	2.209	0.000	5.075
3.4222	0.744	2.267	0.000	5.101
3.5000	0.747	2.325	0.000	5.128
3.5778	0.751	2.383	0.000	5.154
3.6556	0.755	2.442	0.000	5.181
3.7333	0.759	2.500	0.000	5.208
3.8111	0.763	2.560	0.000	5.235
3.8889	0.767	2.619	0.000	5.261
3.9667	0.771	2.679	0.000	5.288
4.0444	0.775	2.739	0.000	5.315
4.1222	0.779	2.800	0.000	5.342
4.2000	0.783	2.860	0.000	5.369
4.2778	0.787	2.921	0.000	5.396
4.3556	0.791	2.983	0.000	5.424
4.4333	0.795	3.045	0.000	5.451
4.5111	0.799	3.107	0.000	5.478
4.5889	0.803	3.169	0.000	5.506
4.6667	0.807	3.231	0.000	5.533
4.7444	0.811	3.294	0.000	5.561
4.8222	0.815	3.358	0.000	5.589
4.9000	0.819	3.421	0.000	5.616
4.9778	0.823	3.485	0.000	5.644
5.0556	0.827	3.549	0.000	5.672
5.1333	0.831	3.614	0.000	5.700
5.2111	0.835	3.679	0.000	5.728
5.2889	0.839	3.744	0.000	5.756
5.3667	0.843	3.809	0.000	5.784
5.4444	0.847	3.875	0.000	5.812
5.5222	0.851	3.941	0.000	5.841
5.6000	0.856	4.007	0.000	5.869
5.6778	0.860	4.074	0.000	5.897
5.7556	0.864	4.141	0.000	5.926
5.8333	0.868	4.209	0.000	5.954
5.9111	0.872	4.276	0.000	5.983
5.9889	0.876	4.344	0.000	6.012
6.0667	0.881	4.413	0.273	6.040
6.1444	0.885	4.481	0.869	6.069
6.2222	0.889	4.550	1.636	6.098
6.3000	0.893	4.620	2.501	6.127
6.3778	0.897	4.689	3.386	6.156
6.4556	0.902	4.759	4.216	6.185
6.5333	0.906	4.830	4.924	6.214
6.6111	0.910	4.900	5.468	6.243
6.6889	0.914	4.971	5.848	6.273
6.7667	0.919	5.043	6.205	6.302
6.8444	0.923	5.114	6.512	6.332
6.9222	0.927	5.186	6.805	6.361
7.0000	0.932	5.259	7.086	6.391
7.0778	0.936	5.331	7.357	6.420

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:345.68
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:159.85
Total Impervious Area:185.83

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.246726
5 year	2.067032
10 year	2.646264
25 year	3.400248
50 year	3.970698
100 year	4.544495

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	85.154795
5 year	112.361185
10 year	131.874468
25 year	158.298283
50 year	179.306495
100 year	201.483097

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	1.339	122.874
1950	3.120	113.111
1951	2.853	77.382
1952	0.917	59.624
1953	0.753	58.577
1954	1.047	68.299
1955	1.728	82.399
1956	1.498	79.443
1957	1.289	90.831
1958	1.271	64.160
1959	1.033	61.353
1960	2.024	70.197
1961	1.029	79.148
1962	0.671	61.648
1963	0.971	81.854
1964	1.040	71.205
1965	0.903	95.802

1966	0.829	63.523
1967	1.740	116.891
1968	1.055	106.955
1969	1.090	82.994
1970	0.951	74.277
1971	0.933	88.698
1972	2.321	116.952
1973	0.963	52.260
1974	1.026	78.814
1975	1.636	91.408
1976	1.037	64.928
1977	0.191	62.673
1978	0.929	88.732
1979	0.547	104.543
1980	1.520	128.601
1981	0.820	88.453
1982	1.907	134.971
1983	1.314	95.558
1984	0.872	65.148
1985	0.484	88.898
1986	2.202	74.963
1987	2.020	108.662
1988	0.798	69.409
1989	0.478	84.701
1990	3.102	188.050
1991	2.766	134.984
1992	0.947	60.016
1993	1.025	54.886
1994	0.335	60.791
1995	1.369	71.885
1996	2.779	101.895
1997	2.527	87.845
1998	0.631	75.910
1999	1.626	183.112
2000	1.016	85.706
2001	0.225	79.882
2002	1.275	115.175
2003	0.991	89.857
2004	2.492	174.806
2005	1.309	74.027
2006	1.579	67.036
2007	6.376	180.176
2008	3.496	139.087
2009	1.874	113.159

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	6.3760	188.0500
2	3.4956	183.1120
3	3.1204	180.1760
4	3.1021	174.8060
5	2.8529	139.0870
6	2.7785	134.9840
7	2.7660	134.9710
8	2.5271	128.6010

9	2.4921	122.8740
10	2.3213	116.9520
11	2.2018	116.8910
12	2.0242	115.1750
13	2.0199	113.1590
14	1.9065	113.1110
15	1.8742	108.6620
16	1.7400	106.9550
17	1.7280	104.5430
18	1.6360	101.8950
19	1.6263	95.8017
20	1.5786	95.5579
21	1.5196	91.4078
22	1.4980	90.8305
23	1.3694	89.8569
24	1.3389	88.8984
25	1.3137	88.7319
26	1.3086	88.6977
27	1.2886	88.4534
28	1.2753	87.8449
29	1.2705	85.7062
30	1.0902	84.7009
31	1.0547	82.9935
32	1.0466	82.3989
33	1.0402	81.8536
34	1.0365	79.8823
35	1.0328	79.4433
36	1.0295	79.1482
37	1.0263	78.8137
38	1.0250	77.3816
39	1.0164	75.9098
40	0.9908	74.9630
41	0.9713	74.2769
42	0.9628	74.0274
43	0.9513	71.8853
44	0.9468	71.2051
45	0.9330	70.1965
46	0.9294	69.4090
47	0.9173	68.2988
48	0.9031	67.0358
49	0.8719	65.1480
50	0.8286	64.9279
51	0.8204	64.1601
52	0.7977	63.5231
53	0.7527	62.6728
54	0.6707	61.6480
55	0.6309	61.3532
56	0.5465	60.7907
57	0.4844	60.0156
58	0.4780	59.6244
59	0.3354	58.5770
60	0.2246	54.8864
61	0.1912	52.2597

Stream Protection Duration
POC #1

The Facility FAILED

Facility FAILED duration standard for 1+ flows.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.6234	19335	374946	1939	Fail
0.6572	17032	365321	2144	Fail
0.6910	15381	356765	2319	Fail
0.7248	13868	348424	2512	Fail
0.7586	12403	340724	2747	Fail
0.7924	11088	333238	3005	Fail
0.8262	10076	326393	3239	Fail
0.8600	9167	319763	3488	Fail
0.8939	8312	313560	3772	Fail
0.9277	7529	307785	4087	Fail
0.9615	6849	302224	4412	Fail
0.9953	6256	296877	4745	Fail
1.0291	5713	291743	5106	Fail
1.0629	5240	287252	5481	Fail
1.0967	4877	282546	5793	Fail
1.1305	4472	278054	6217	Fail
1.1643	4141	273777	6611	Fail
1.1982	3816	269713	7067	Fail
1.2320	3484	266077	7637	Fail
1.2658	3213	262227	8161	Fail
1.2996	2973	258591	8697	Fail
1.3334	2731	254954	9335	Fail
1.3672	2515	251746	10009	Fail
1.4010	2331	248324	10653	Fail
1.4348	2169	245330	11310	Fail
1.4686	2024	242121	11962	Fail
1.5025	1860	239127	12856	Fail
1.5363	1752	236132	13477	Fail
1.5701	1628	233352	14333	Fail
1.6039	1456	230785	15850	Fail
1.6377	1320	228005	17273	Fail
1.6715	1232	225438	18298	Fail
1.7053	1156	222871	19279	Fail
1.7391	1084	220305	20323	Fail
1.7730	1036	217952	21037	Fail
1.8068	980	215599	21999	Fail
1.8406	916	213246	23280	Fail
1.8744	880	210979	23974	Fail
1.9082	800	208669	26083	Fail
1.9420	740	206487	27903	Fail
1.9758	684	204477	29894	Fail
2.0096	636	202359	31817	Fail
2.0434	588	200263	34058	Fail
2.0773	532	198231	37261	Fail
2.1111	492	196328	39904	Fail
2.1449	444	194488	43803	Fail
2.1787	412	192456	46712	Fail
2.2125	368	190553	51780	Fail
2.2463	348	188671	54215	Fail
2.2801	320	186895	58404	Fail
2.3139	276	185184	67095	Fail
2.3477	244	183323	75132	Fail

2.3816	212	181591	85656	Fail
2.4154	196	179666	91666	Fail
2.4492	176	177869	101061	Fail
2.4830	160	176073	110045	Fail
2.5168	140	174276	124482	Fail
2.5506	128	172522	134782	Fail
2.5844	124	170768	137716	Fail
2.6182	120	168993	140827	Fail
2.6521	112	167346	149416	Fail
2.6859	100	165827	165827	Fail
2.7197	92	164373	178666	Fail
2.7535	76	162961	214422	Fail
2.7873	60	161592	269320	Fail
2.8211	52	160266	308203	Fail
2.8549	44	159026	361422	Fail
2.8887	36	157828	438411	Fail
2.9225	36	156630	435083	Fail
2.9564	32	155454	485793	Fail
2.9902	28	154384	551371	Fail
3.0240	28	153400	547857	Fail
3.0578	20	152331	761655	Fail
3.0916	20	151326	756630	Fail
3.1254	12	150385	1253208	Fail
3.1592	8	149444	1868050	Fail
3.1930	8	148438	1855475	Fail
3.2268	8	147476	1843450	Fail
3.2607	8	146577	1832212	Fail
3.2945	8	145636	1820450	Fail
3.3283	8	144759	1809487	Fail
3.3621	8	143861	1798262	Fail
3.3959	8	142984	1787300	Fail
3.4297	8	142064	1775800	Fail
3.4635	8	141145	1764312	Fail
3.4973	4	140311	3507775	Fail
3.5311	4	139455	3486375	Fail
3.5650	4	138642	3466050	Fail
3.5988	4	137808	3445200	Fail
3.6326	4	136995	3424875	Fail
3.6664	4	136204	3405100	Fail
3.7002	4	135348	3383700	Fail
3.7340	4	134536	3363400	Fail
3.7678	4	133744	3343600	Fail
3.8016	4	132953	3323825	Fail
3.8355	4	132183	3304575	Fail
3.8693	4	131413	3285325	Fail
3.9031	4	130686	3267150	Fail
3.9369	4	129958	3248950	Fail
3.9707	4	129231	3230775	Fail

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

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 29.138 **acre-feet**
On-line facility target flow: 34.744 **cfs.**
Adjusted for 15 min: 34.744 **cfs.**
Off-line facility target flow: 19.566 **cfs.**
Adjusted for 15 min: 19.566 **cfs.**

LID Report

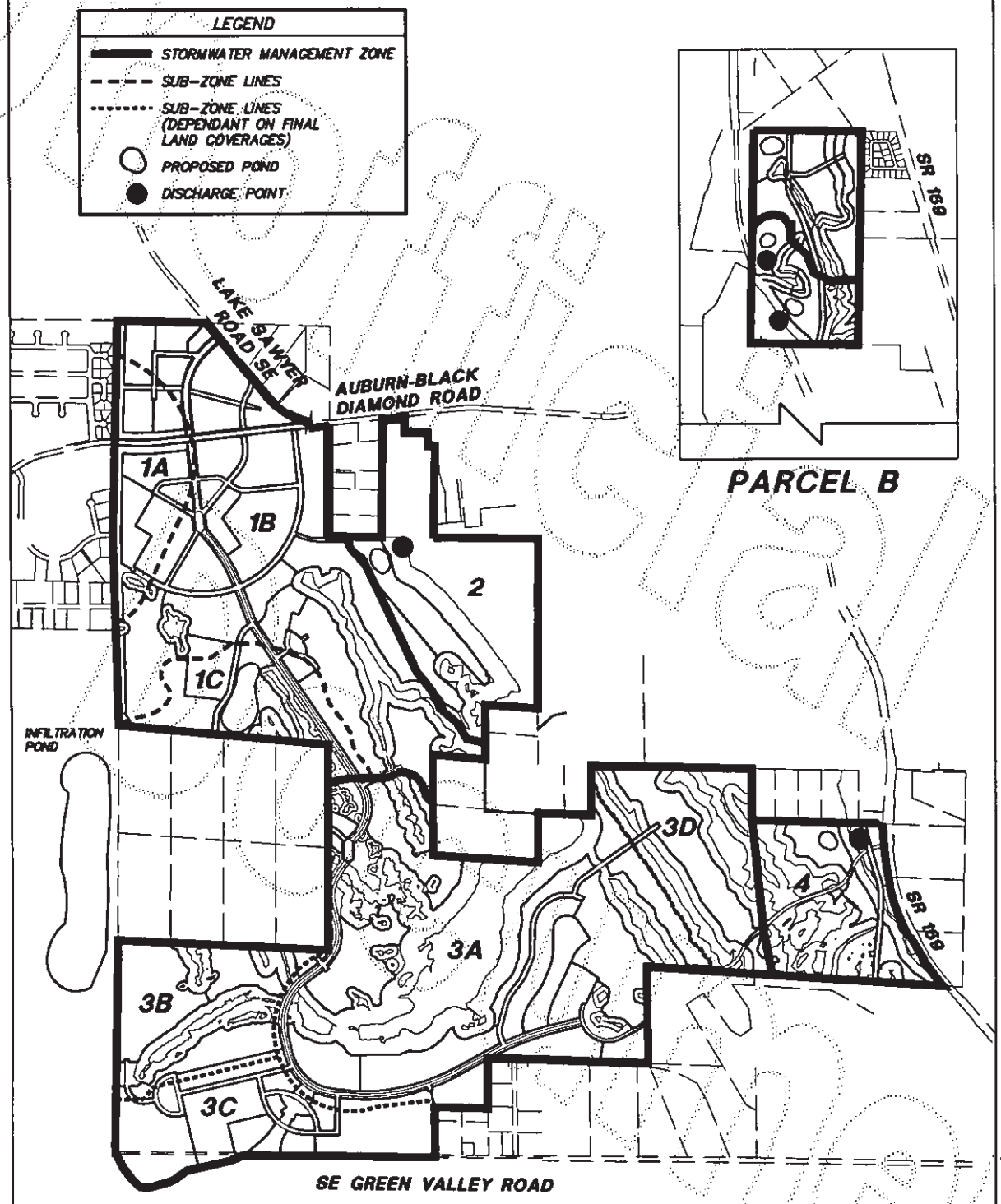
LID Technique	Used for Water Quality Treatment?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Comment Percent Water Quality Treated
Presettling Pond POC	N	38014.34			N	0.00	
Total Volume Infiltrated		38014.34	0.00	0.00		0.00	
0.00	0%	No Treat. Credit					

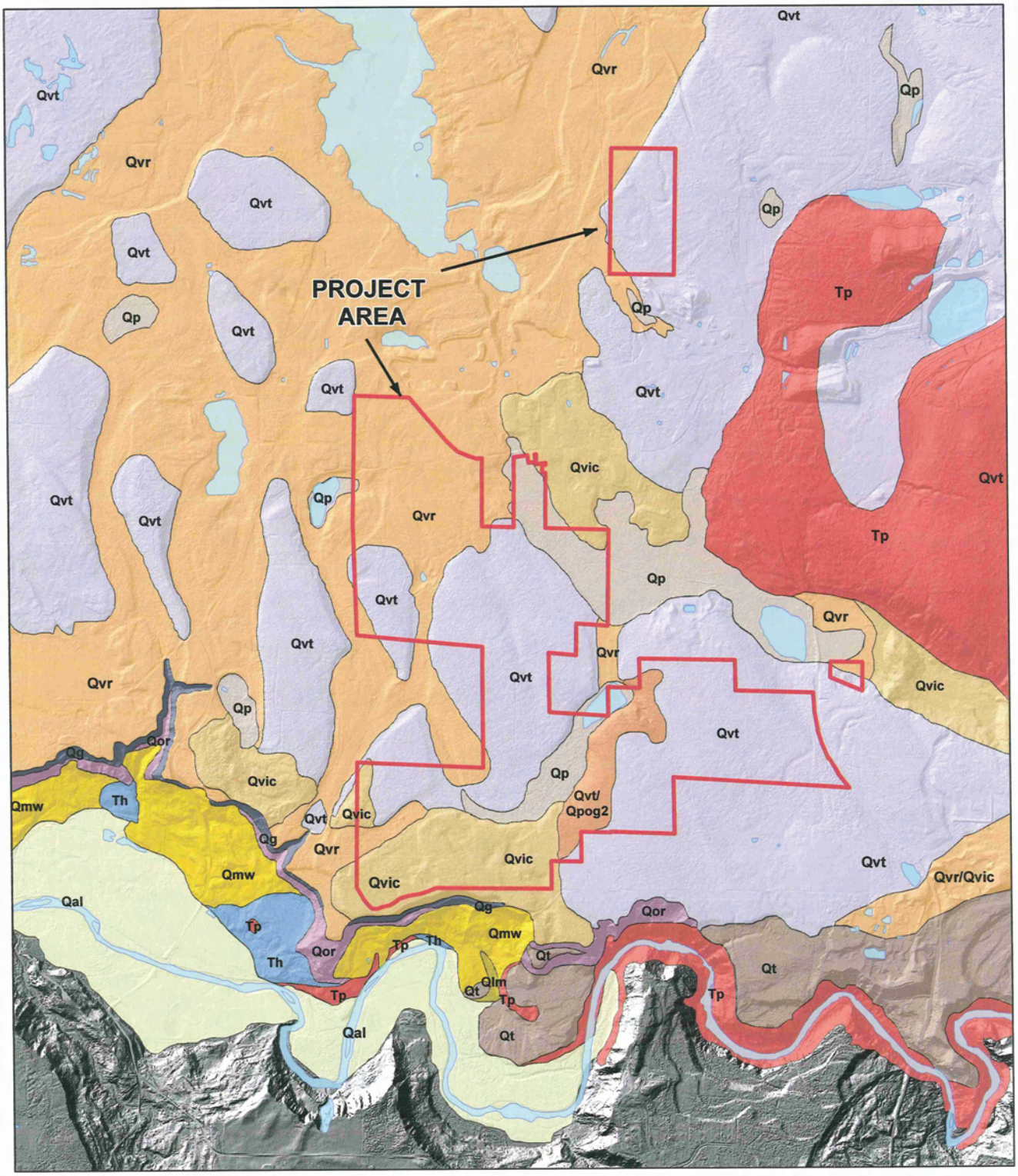
Compliance with LID Standard 8
Duration Analysis Result = Failed

Perlnd and Implnd Changes

No changes have been made.

FIGURE 7.4:
CONCEPTUAL STORMWATER PLAN





Legend

RECENT/HOLOCENE

- Qal — River alluvium
- Qp — Peat/organic deposits
- Qmw — Mass wasting
- Qlm — Lacustrine deposits
- Qt — Terrace alluvium

VASHON DRIFT

- Qvr — Recessional outwash
- Qvic — Ice Contact
- Qvt — Lodgement till
- Qg — Undifferentiated till and outwash

PRE-OLYMPIA GLACIAL DEPOSITS

- Qvt/Qpog2 — Coarse-grained
- Qor — Orting Drift

TERTIARY

- Th — Hammer Bluff Formation
- Tp — Puget Group

N

0 1,000 2,000 Feet

Reference: Geology modified by AESI from Mullineaux, D.R., *Geologic Map of the Black Diamond Quadrangle*, GQ-407, USGS, 1965
Roads, waterbodies, parcel outlines - King County GIS Center, acquired 2-08; Contours and shaded relief generated from 1 meter DEM; King County GIS Center, acquired 2-08;

N:\060601KGA_Villages\Figures_11_17\Draft_Geology.mxd

Associated Earth Sciences, Inc.

GEOLOGY MAP
THE VILLAGES
BLACK DIAMOND, WASHINGTON

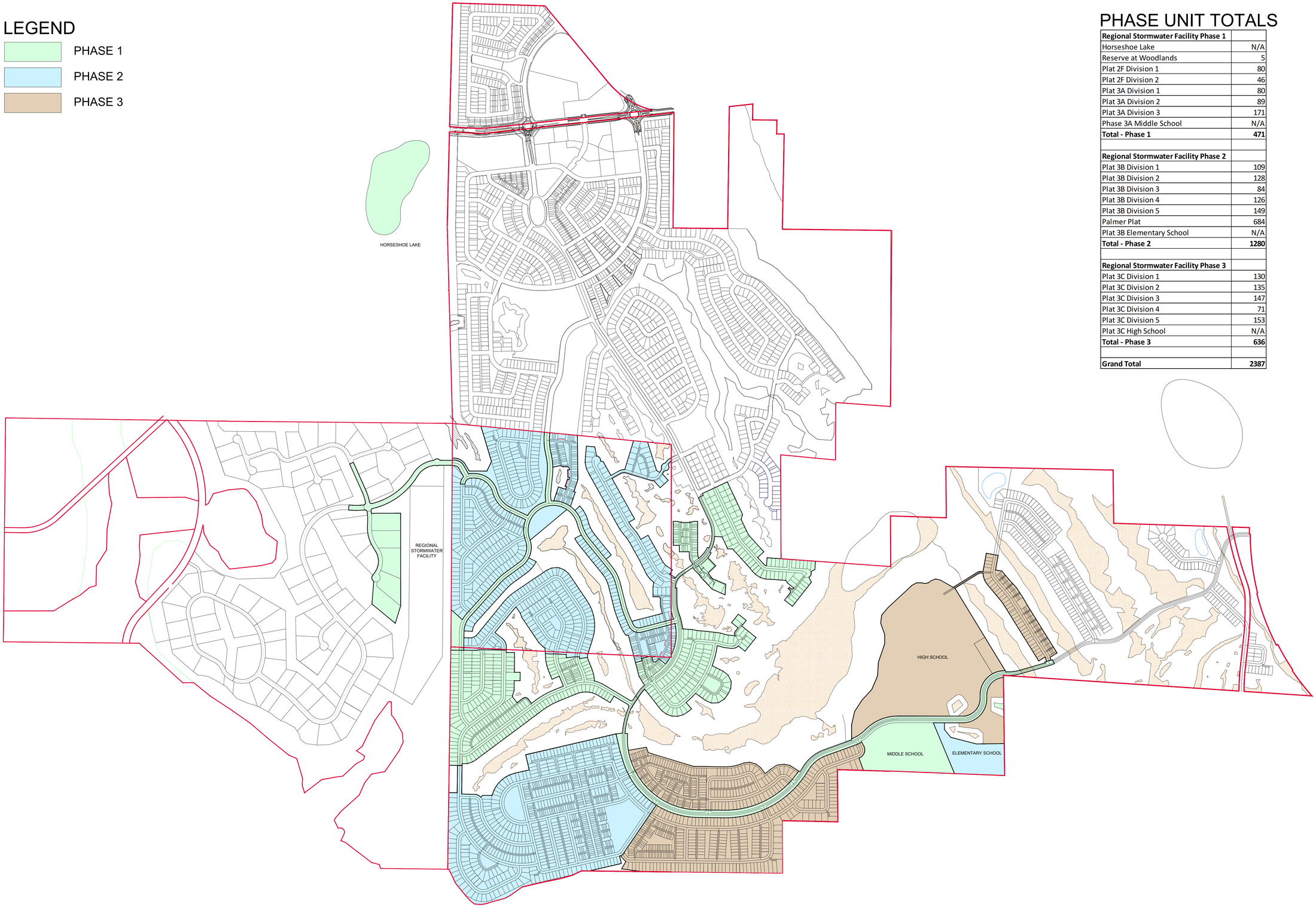
FIGURE 9
DATE 9/08
PROJ. NO. KG060601A

LEGEND

- PHASE 1
- PHASE 2
- PHASE 3

PHASE UNIT TOTALS

Regional Stormwater Facility Phase 1	
Horseshoe Lake	N/A
Reserve at Woodlands	5
Plat 2F Division 1	80
Plat 2F Division 2	46
Plat 3A Division 1	80
Plat 3A Division 2	89
Plat 3A Division 3	171
Phase 3A Middle School	N/A
Total - Phase 1	**471**
Regional Stormwater Facility Phase 2	
Plat 3B Division 1	109
Plat 3B Division 2	128
Plat 3B Division 3	84
Plat 3B Division 4	126
Plat 3B Division 5	149
Palmer Plat	684
Plat 3B Elementary School	N/A
Total - Phase 2	**1280**
Regional Stormwater Facility Phase 3	
Plat 3C Division 1	130
Plat 3C Division 2	135
Plat 3C Division 3	147
Plat 3C Division 4	71
Plat 3C Division 5	153
Plat 3C High School	N/A
Total - Phase 3	**636**
Grand Total	**2387**



TEN TRAILS REGIONAL STORMWATER FACILITY PHASING EXHIBIT

OAKPOINTE

N

0 125 250 500

SCALE: 1" = 500'

AUGUST 30, 2022

5 CONVEYANCE SYSTEM ANALYSIS & DESIGN

Several stormwater conveyance systems will be constructed with the Regional Stormwater Facility. Those systems are divided into two categories: the three inlet pipes that convey runoff from the development areas into the Regional Stormwater Facility, and the pipes and weir vaults that provided outfalls and conveyance between elements of the facility.

5.1 CONVEYANCE DESIGN FLOWS

Per Sections 1.2.4.3 and 3.2.2 of the 2021 KCSWDM, WWHM is an acceptable continuous model for analyzing and determining design flow rates and was used to calculate all conveyance flows. The conveyance systems for this project have been designed to safely convey the modeled 100-year flow from the areas tributary to each system.

To calculate the conveyance flow for each of the tributary basins, the land use assumptions for the Regional Stormwater Facility tributary basin (See Section 4.3.5) were input into WWHM for each system. WWHM outputs for each of the conveyance system basins along with the Conveyance Basin Exhibit showing the basin delineations are attached at the end of this section.

5.2 INLET CONVEYANCE PIPES

There are three main conveyance pipes that outfall into the pre-settling cell. Each of these conveyance lines will be designed for this project and will be used for future developments within the Ten Trails MPD. The three systems can be referred to as the Miner's Ridge System, Phase 3 North System, and the Phase 3 South System. Refer to the Conveyance Basin Exhibit for more information.

The Miner's Ridge System drains portions the MPD Expansion Area (an area that is anticipated to be incorporated into the Ten Trails MPD) and Ten Trails Phase 2 Plat F. The Phase 3 North System drains portions of the northern portion of the proposed Ten Trails

Phase 3 development. The Phase 3 South System drains portions of the southern portion of the proposed Ten Trails Phase 3 development, and the Phase 3 School sites.

The backwater analysis computer program StormCAD, was used to verify the hydraulic performance of the proposed conveyance systems. The proposed pipe layouts were analyzed to verify that the portions of these conveyance pipes constructed under this project will have sufficient capacity to serve the anticipated future development.

To analyze the proposed systems, the developed peak flows for each tributary basin were calculated using the 15-min time step series in WWHM. The peak flows are distributed in StormCAD to each of the systems elements proportionally, according to each element's tributary area. Refer to the *Conveyance Basins Exhibit, Conveyance Tributary Area Flows* spreadsheet, and the StormCAD Conveyance Calculation output spreadsheets at the end of this section. For the conveyance systems upstream of the pre-settling cell, the tailwater elevation was assumed to be at the design 100-year water surface elevation of 534.5.

StormCAD results demonstrate that the hydraulic grade line for the 100-year peak storm event is below each rim elevation for every catch basin and conveyance element. Output tables from StormCAD showing the available freeboard at each structure, during the 100-year event, are attached at the end of this section.

5.3 INTERNAL FACILITY CONVEYANCE SIZING

The following conveyance systems are interior to the Facility footprint and transfer water between the pre-settling, sandfilter and infiltration cells. These conveyance structures were sized to convey the 100-year peak flow for the entire basin without affecting upstream conveyance systems.

The WWHM modeling results for the flow rates from the Presettling Cell to the Sand Filter Cell are presented in the Tables below:

Table 5.1: Flow Rates from Presettling Cell into Sand Filter

Flows from Presettling Cell into Sand Filter	
Return Period	Flow(cfs)
2 year	85.2
5 year	112.4
10 year	131.9
25 year	158.3
50 year	179.3
100 year	201.5

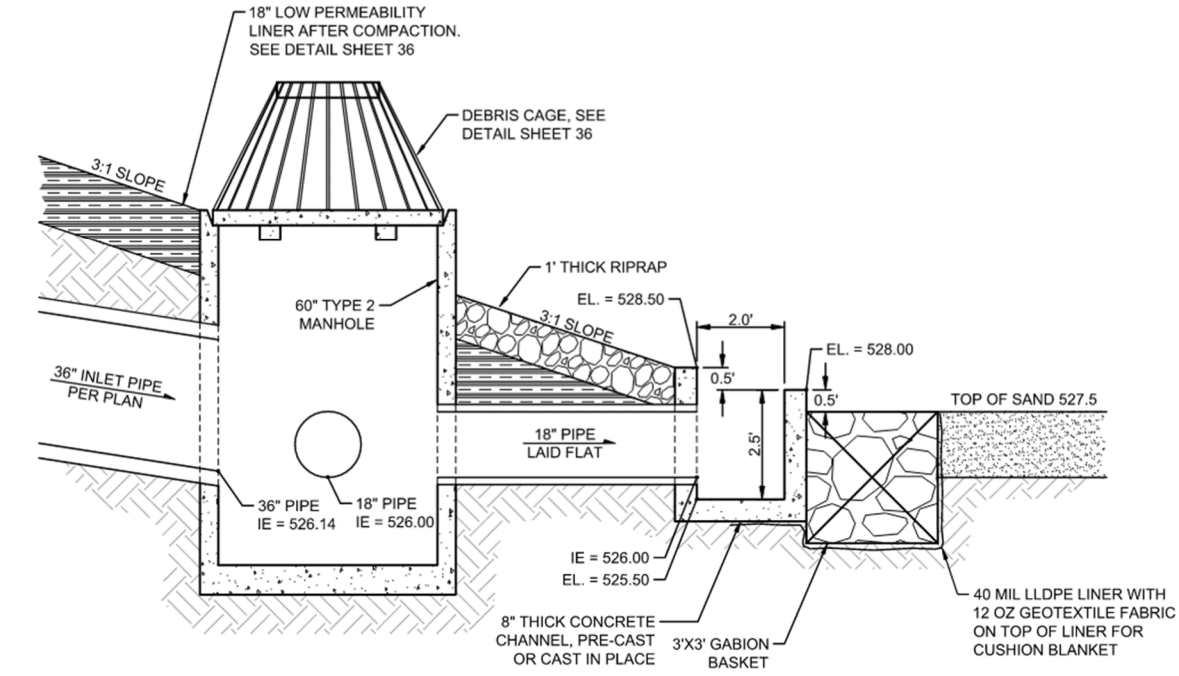
Table 5.2: Flow Rates from Sand Filter into Infiltration Cell

Flows from Sand Filter to Infiltration	
Return Period	Flow(cfs)
2 year	39.6
5 year	70.2
10 year	93.5
25 year	125.8
50 year	151.5
100 year	178.5

5.3.1 Sand Filter Level Spreader

Flow will leave the pre-settling cell and enter the large sand filter through three 36-inch pipes located at the west end of the pre-settling cell. These pipes will have a reverse slope, with an inlet invert elevation of 528.5 (top of sediment storage elevation) and an outlet invert elevation of 529.04. The outlet pipes will connect to three concrete vaults (one pipe connecting to each vault) located within the berm between the pre-settling cell and the large sand filter. The vaults will contain an 18-foot-long weir with a top elevation of 534.5. The weirs set the design water surface elevation of the pre-settling cell. Stormwater that overflows the weirs will exit each vault via a 36-inch pipe that connects to a 48-inch Type II catch basin (one catch basin per each vault outlet). Flows will connect laterally via 18” pipes between these three catch basins and four additional catch basins located on the south end of the berm. These seven catch basins will distribute flow to the concrete level spreader at seven different locations. The level spreader is located 6” above the bottom of the large sand filter and runs the entire width of the filter. Flows from the level spreader fall onto a

row of gabion baskets located below the low edge of the level spreader for additional energy dissipation. As the water in the sand filter rises to the level of the catch basins, flows will bubble up out of the seven catch basins into the sand filter. This system is depicted in the figure, below.



SAND FILTER LEVEL SPREADER DETAIL
NOT TO SCALE

To analyze the conveyance pipe on the sand filter side of the berm, it was assumed that the sand filter is filled to an elevation of 533.5 when the 100-year peak flow is entering the pond. The 533.5 elevation was used as the tailwater at the catch basin beehive outlet. Any of the three pipes can be chosen to be analyzed as they are identical. StormCAD was used to calculate the required headwater on the 36-inch pipe at the vault. A third of the total basin conveyance flow of 116.16 cfs was applied to this pipe. A head water elevation of 540.15 was found to be required to pass the conveyance flow through this pipe. The headwater elevation is below the weir elevation and will therefore not affect the upstream conveyance systems.

Next, the flow capacity of the three weirs was calculated using the Francis weir equation for suppressed weirs, subject to the condition that *H/P* ≤ 0.33 and *H/B* ≤ 0.33. Using a third of the total conveyance flow:

$$Q = \frac{2}{3} b c_1 \sqrt{2gH}^{3/2}$$

$$Q = 3.33\, BH^{3/2}$$

Where: Q = Flow Rate over weir (cfs) = 40.69 cfs

B = Length of weir (ft) = 18 ft per weir

P = Height of weir (ft) = 4 ft

H = Depth of flow over weir (ft) = 0.78 ft

Solving for the depth of flow over the weir results in a depth of 0.78 feet needed to pass the conveyance flow.

The required depth of the weir sets the tailwater condition for the reversed sloped 36-inch pipe on the pre-settling cell side of the berm at an elevation of 535.28. This pipe was analyzed in StormCAD and was found to require a head water of 535.56. This elevation is below the elevation of the berm of 536 and therefore provides enough capacity to pass the conveyance flow without affecting any upstream conveyance systems. The StormCAD output for the pre-settling and sand filter berm conveyance system is attached to the end of this section.

Table 5.3: Weir Design Summary Tables

Pre-settling Cell to Sand Filter Weir Table				
	Weir #1	Weir #2	Weir #3	Spillway
Weir Coefficient	0.612	0.612	0.612	0.6
Weir Length (ft)	18	18	18	100
Weir Elevation	534.5	534.5	534.5	535.3
Head of Water Over Weir (ft)	1	1	1	0.2
Flow at M.W.S.E 335.5 (cfs)	59.0	59.0	59.0	29.2

Sand Filter to Infiltration Cell Weir Table				
	Weir #1	Weir #2	Weir #3	Spillway
Weir Coefficient	0.612	0.612	0.612	0.6
Weir Length (ft)	18	18	18	100
Weir Elevation	533.5	533.5	533.5	534.4
Head of Water Over Weir (ft)	1	1	1	0.1
Flow at M.W.S.E 334.5 (cfs)	59.0	59.0	59.0	10.2

Maximum Water Surface Elevation (MWSE) is set at top of berm

Weir #1 Elevation is set at the design water surface (DWS) elevation, which is 1 foot below the top of berm

5.3.2 Sand Filter Spillway

An overflow spillway will be provided between the pre-settling cell and sand filter. This spillway will convey flows above the capacity of the weir vault system and is anticipated only to be used during large inflow events when the stage of the sand filter is near the design water surface. The spillway will be constructed with an asphalt surface at the top, and a gabion lining on the sides for erosion protection.

The spillway must have a minimum length of 61 feet. The plans propose a spillway that is 100 feet long with an overflow elevation of 535.5. Analysis of the overflow spillway was done using the following broad-crested weir equation per Section 5.1.1.2 of the 2021

KCSWDM, assuming the discharge coefficient C = 0.6 and the angle of the side slopes are 3:1 (Tan θ = 3).

$$Q_{100} = 3.21\ (LH^{3/2} + 2.4H^{5/2})$$

Solving for the required width *L* gives:

$$L = \frac{Q_{100}}{3.21H^{3/2}} - 2.4H$$

Where: Q_{100} = Peak Flow for 100-year runoff event (cfs) = 40.69 cfs

L = length of weir (ft) = 61 ft

H = Depth of flow over weir (ft) = 1.0 ft

$Q_{100} = C(2g)^{1/2}\ [^{2}/_{3}\ LH^{3/2} + {}^{8}/_{15}\ (TAN\ \theta)\ H^{5/2}]$

Where

Q	=	Conveyance flow rate for the entire facility (115.36 cfs)
C	=	Discharge coefficient (0.60)
g	=	Gravity (32.2 ft/sec^2)
L	=	Length of Weir (100 ft)
H	=	Height of water over weir
TAN θ	=	Angle of side slopes (10:1 slopes are used)

The equation results in an overflow weir length of 61 feet. The 100-foot-long weir can convey the required flow with a head of 0.2', which is within the provided freeboard.

5.3.3 Sand Filter to Infiltration Cell Conveyance

Similar to the conveyance between the Pre-settling cell and the Sand Filter, flow will leave the Sand Filter and enter the Infiltration Cell through three 36-inch pipes located at the south end of the Sand Filter. These pipes will have a reverse slope, with an inlet invert elevation of 527.5 (top of sand layer) and an outlet invert elevation of 528.04. The outlet

pipes will connect to three concrete vaults (one pipe connecting to each vault) located within the berm between the Sand Filter and the Infiltration Cell. The vaults will contain an 18-foot-long weir with a top elevation of 533.5. The weirs set the design water surface elevation of the Sand Filter. Stormwater that overflows the weirs will exit each vault via a 36-inch pipe that connects to a 48-inch Type II catch basin (one catch basin per each vault outlet).

North Conveyance Basin

Stormwater Management Zones	Total Area (SF)	Total Area (AC)	Lot Area (SF)	Lot Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Open Space (SF)	Open Space (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	ROW Area (SF)	ROW Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Alley Area (SF)	Alley Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Trib. Undeveloped (SF)	Trib. Undeveloped (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)
Palmer Property/Offsite																											
Palmer Property	4,058,791	93.18	2,545,754	58.44	70%	40.91	17.53	226,053	5.19	30%	1.56	3.63	939,872	21.58	80%	17.26	4.32	129,784	2.98	100%	2.98	0.00	217,327	4.99	0%	0.00	4.99
Outwash	2,360,704	54.19	1,455,207	33.41	70%	23.38	10.02	160,910	3.69	30%	1.11	2.59	578,563	13.28	80%	10.63	2.66	97,274	2.23	100%	2.23	0.00	68,751	1.58	0%	0.00	1.58
Till	1,698,086	38.98	1,090,548	25.04	70%	17.52	7.51	65,144	1.50	30%	0.45	1.05	361,310	8.29	80%	6.64	1.66	32,510	0.75	100%	0.75	0.00	148,576	3.41	0%	0.00	3.41
Zone 3A Total	1,714,597	39.36	1,067,847	24.51	70%	17.16	7.35	55,731	1.28	30%	0.38	0.90	559,011	12.83	80%	10.27	2.57	32,007	0.73	100%	0.73	0.00	0	0.00	0%	0.00	0.00
Outwash	197,531	4.53	73,743	1.69	70%	1.19	0.51	1,412	0.03	30%	0.01	0.02	122,376	2.81	80%	2.25	0.56	0	0.00	100%	0.00	0.00					
Till	1,517,066	34.83	994,104	22.82	70%	15.98	6.85	54,319	1.25	30%	0.37	0.87	436,635	10.02	80%	8.02	2.00	32,007	0.73	100%	0.73	0.00					
Zone 3B Total	306,554	7.04	201,122	4.62	70%	3.23	1.39	4,887	0.11	30%	0.03	0.08	100,544	2.31	80%	1.85	0.46	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	0	0.00	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00					
Till	306,554	7.04	201,122	4.62	70%	3.23	1.39	4,887	0.11	30%	0.03	0.08	100,544	2.31	80%	1.85	0.46	0	0.00	100%	0.00	0.00					

Stormwater Management Zones	Total Impervious	Impervious outwash	Impervious Till	Total Pervious	Pervious outwash	Pervious Till
Palmer/Offsite	62.71	37.35	25.36	30.47	16.84	13.63
Zone 3A	28.55	3.44	25.10	10.82	1.09	9.72
Zone 3B	5.11	0.00	5.11	1.93	0.00	1.93
	Percentage	42.3%	57.7%			

Basin 4	Precipitation (FT)	Evapo-transpiration (ACFT/AC)	Recharge (ACFT/AC)	Runoff (ACFT/AC)
Outwash Forest	4.51	1.59	2.91	0.00
Till Forest	4.51	1.94	1.39	1.17
Outwash Grass	4.51	1.53	2.92	0.07
Till Grass	4.51	1.53	1.39	1.59
Impervious	4.51	0.68	0.00	3.82

Stormwater Management Zones	Total Area (ft)	Total Area (ac)	Outwash Forest (ac)	Till Forest (ac)	Recharge (ac/ft)	Runoff (ac/ft)	Required Impervious for Water Balance
Palmer	4,058,791	93.18	54.19	38.98	-	45.61	11.94
Zone 3A	1,714,597	39.36	4.53	34.83	-	40.75	10.67
Zone 3B	306,554	7.04	0.00	7.04	-	8.23	2.16
total	6,079,941	139.58	58.73	80.85	0.00	94.59	24.76

	Initial Area	Impervious	Pervious outwash	Pervious Till	Water Balance Area	Total Area
Areas to Pond	139.58	96.36	17.94	25.28	24.76	114.81

	WWHM Pre Developed		WWHM Developed				
	Outwash Forest	Till Forest	Outwash Forest	Till Forest	Outwash Pervious	Till Pervious	Impervious
total	48.31	66.50	-	-	17.94	25.28	71.60

WWHM Flow Rates	
2-Year	35.736329
5-Year	46.415332
10-Year	53.981654
25-Year	64.127698
50-Year	72.1247
100-Year	80.508763

Central Conveyance Basin

Stormwater Management	Total Area	Total Area	Lot Area (SF)	Lot Area (AC)	Percent	Impervious	Pervious	Open Space	Open Space	Percent	Impervious	Pervious	ROW Area	ROW	Percent	Impervious	Pervious	Alley	Alley	Percent	Impervious	Pervious	Trib.	Trib.	Percent	Impervious	Pervious
Palmer Property/Offsite			**Palmer Property**																								
Palmer Property	421,743	9.68	244,219	5.61	70%	3.92	1.68	45,014	1.03	30%	0.31	0.72	110,659	2.54	80%	2.03	0.51	0	0.00	100%	0.00	0.00	21,850	0.50	0%	0.00	0.50
Outwash	73,894	1.70	15,407	0.35	70%	0.25	0.11	39,488	0.91	30%	0.27	0.63	18,999	0.44	80%	0.35	0.09	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	347,849	7.99	228,812	5.25	70%	3.68	1.58	5,526	0.13	30%	0.04	0.09	91,660	2.10	80%	1.68	0.42	0	0.00	100%	0.00	0.00	21,850	0.50	0%	0.00	0.50
Zone 3B Total	544,334	12.50	403,885	9.27	70%	6.49	2.78	13,775	0.32	30%	0.09	0.22	126,674	2.91	80%	2.33	0.58	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Outwash	249,988	5.74	184,676	4.24	70%	2.97	1.27	5,170	0.12	30%	0.04	0.08	60,142	1.38	80%	1.10	0.28	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00
Till	294,346	6.76	219,210	5.03	70%	3.52	1.51	8,604	0.20	30%	0.06	0.14	66,532	1.53	80%	1.22	0.31	0	0.00	100%	0.00	0.00	0	0.00	0%	0.00	0.00

Stormwater Management Zones	Total Impervious	Impervious outwash	Impervious Till	Total Pervious	Pervious outwash	Pervious Till
Palmer/Offsite	6.27	0.87	5.40	3.42	0.83	2.59
Zone 3B	8.91	4.11	4.80	3.58	1.63	1.95
	Percentage	32.8%	67.2%			

Basin 4				
	Precipitation (FT)	**Evapo-transpiration (ACFT/AC)**	**Recharge (ACFT/AC)**	**Runoff (ACFT/AC)**
Outwash Forest	4.51	1.59	2.91	0.00
Till Forest	4.51	1.94	1.39	1.17
Outwash Grass	4.51	1.53	2.92	0.07
Till Grass	4.51	1.53	1.39	1.59
Impervious	4.51	0.68	0.00	3.82

Stormwater Management Zones	Total Area (ft)	Total Area (ac)	Outwash Forest (ac)	Till Forest (ac)	Recharge (ac/ft)	Runoff (ac/ft)	Required Impervious for Water Balance
Palmer	421,743	9.68	1.70	7.99	-	9.34	2.45
Zone 3B	544,334	12.50	5.74	6.76	-	7.91	2.07
total	966,077	22.18	7.44	14.74	0.00	17.25	4.52

	Initial Area	Impervious	Pervious outwash	Pervious Till	Water Balance Area	Total Area
Areas to Pond	22.18	15.18	2.46	4.54	4.52	17.66

	WWHM Pre Developed		WWHM Developed				
	Outwash Forest	**Till Forest**	**Outwash Forest**	**Till Forest**	**Outwash Pervious**	**Till Pervious**	**Impervious**
total	5.92	11.74	-	-	2.46	4.54	10.66

WWHM Flow Rates	
2-Year	5.403995
5-Year	7.047077
10-Year	8.214862
25-Year	9.784703
50-Year	11.024763
100-Year	12.327112

South Conveyance Basin

Stormwater Management Zones	Total Area (SF)	Total Area (AC)	Lot Area (SF)	Lot Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Open Space (SF)	Open Space (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	ROW Area (SF)	ROW Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Alley Area (SF)	Alley Area (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)	Trib. Undeveloped (SF)	Trib. Undeveloped (AC)	Percent Impervious	Impervious Area (AC)	Pervious Area (AC)
Zone 3A	2,341,110	53.74	1,218,488	27.97	70%	19.58	8.39	173,590	3.99	30%	1.20	2.79	833,839	19.14	80%	15.31	3.83	115,193	2.64	100%	2.64	0.00	0	0.00	0%	0.00	0.00
Outwash	1,862,716	42.76	1,033,182	23.72	70%	16.60	7.12	157,100	3.61	30%	1.08	2.52	570,587	13.10	80%	10.48	2.62	101,847	2.34	100%	2.34	0.00					
Till	478,380	10.98	185,292	4.25	70%	2.98	1.28	16,491	0.38	30%	0.11	0.26	263,252	6.04	80%	4.83	1.21	13,346	0.31	100%	0.31	0.00					
Zone 3A - School	2,824,646	64.84	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,824,646	64.84	80%	51.88	12.97	0	0.00	100%	0.00	0.00					
Outwash	718,559	16.50	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	718,559	16.50	80%	13.20	3.30	0	0.00	100%	0.00	0.00					
Till	2,106,086	48.35	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	2,106,086	48.35	80%	38.68	9.67	0	0.00	100%	0.00	0.00					
Offsite School Area	1,053,935	24.20	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00					
Till	1,053,935	24.20	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	1,053,935	24.20	80%	19.36	4.84	0	0.00	100%	0.00	0.00					
Zone 3A Total	6,219,690	142.78	1,218,488	28.0	70%	19.58	8.39	173,590	3.99	30%	1.20	2.79	4,712,419.8	83.99	80%	86.55	21.64	115,193	2.64	100%	2.64	0.00	0	0.00	0%	0.00	0.00
Zone 3B Total	1,203,672	27.63	858,896	19.72	70%	13.80	5.92	43,609	1.00	30%	0.30	0.70	259,006	5.95	80%	4.76	1.19	42,162	0.97	100%	0.97	0.00	0	0.00	0%	0.00	0.00
Outwash	847,601	19.46	586,840	13.47	70%	9.43	4.04	41,609	0.96	30%	0.29	0.67	177,855	4.08	80%	3.27	0.82	41,297	0.95	100%	0.95	0.00					
Till	356,069	8.17	272,053	6.25	70%	4.37	1.87	2,000	0.05	30%	0.01	0.03	81,151	1.86	80%	1.49	0.37	865	0.02	100%	0.02	0.00					
Zone 3C Total	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00	0	0.00	0%	0.00	0.00
Outwash	3,671,729	84.29	2,221,700	51.00	70%	35.70	15.30	457,841	10.51	30%	3.15	7.36	804,112	18.46	80%	14.77	3.69	188,076	4.32	100%	4.32	0.00					
Till	0	0.00	0	0.00	70%	0.00	0.00	0	0.00	30%	0.00	0.00	0	0.00	80%	0.00	0.00	0	0.00	100%	0.00	0.00					
Zone 3D Total	996,116	22.87	571,498	13.12	70%	9.18	3.94	163,121	3.74	30%	1.12	2.62	224,791	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00	0	0.00	0%	0.00	0.00
Outwash	11,012	0.25	0	0.0	70%	0.00	0.00	11,012	0.25	30%	0.08	0.18		0.00	80%	0.00	0.00		0.00	100%	0.00	0.00					
Till	985,104	22.61	571,498	13.1	70%	9.18	3.94	152,108	3.49	30%	1.05	2.44	224,791.2	5.16	80%	4.13	1.03	36,706	0.84	100%	0.84	0.00					

Stormwater Management Zones	Total Impervious	Impervious outwash	Impervious Till	Total Pervious	Pervious outwash	Pervious Till
Zone 3A	109.97	43.70	66.27	32.82	15.56	17.26
Zone 3B	19.83	13.93	5.90	7.81	5.53	2.28
Zone 3C	57.94	57.94	0.00	26.35	26.35	0.00
Zone 3D	15.28	0.08	15.20	7.59	0.18	7.41
Percentage		57.0%	43.0%			

Basin 4	Precipitation (FT)	Evapo-transpiration (ACFT/AC)	Recharge (ACFT/AC)	Runoff (ACFT/AC)
Outwash Forest	4.51	1.59	2.91	0.00
Till Forest	4.51	1.94	1.39	1.17
Outwash Grass	4.51	1.53	2.92	0.07
Till Grass	4.51	1.53	1.39	1.59
Impervious	4.51	0.68	0.00	3.82

Stormwater Management Zones	Total Area (ft)	Total Area (ac)	Outwash Forest (ac)	Till Forest (ac)	Recharge (ac/ft)	Runoff (ac/ft)	Required Impervious for Water Balance
Zone 3A	6,219,690	142.78	59.26	83.53	-	97.73	25.58
Zone 3B	1,203,672	27.63	19.46	8.17	-	9.56	2.50
Zone 3C	3,671,729	84.29	84.29	0.00	245.29	-	64.21
Zone 3D	996,116	22.87	0.25	22.61	-	26.46	6.93
Total V Parcels	12,091,208	277.58	163.26	114.32	245.29	133.75	99.22

	Initial Area	Impervious	Pervious outwash	Pervious Till	Water Balance Area	Total Area
Areas to Pond	277.58	203.01	47.61	26.95	99.22	178.35

	WWHM Pre Developed		WHM Developed				
	Outwash Forest	**Till Forest**	**Outwash Forest**	**Till Forest**	**Outwash Pervious**	**Till Pervious**	**Impervious**
Phase 3 & V Parcels	104.90	73.45	-	-	47.61	26.95	103.79

WWHM Flow Rates	
2-Year	**51.30**
5-Year	**66.74**
10-Year	**77.69**
25-Year	**92.39**
50-Year	**103.99**
100-Year	**116.16**

The Reserve at Woodlands - Regional Stormwater Facility
StormCAD Output for Catch Basins, Manholes and Outfalls
Date: 06/20/2024

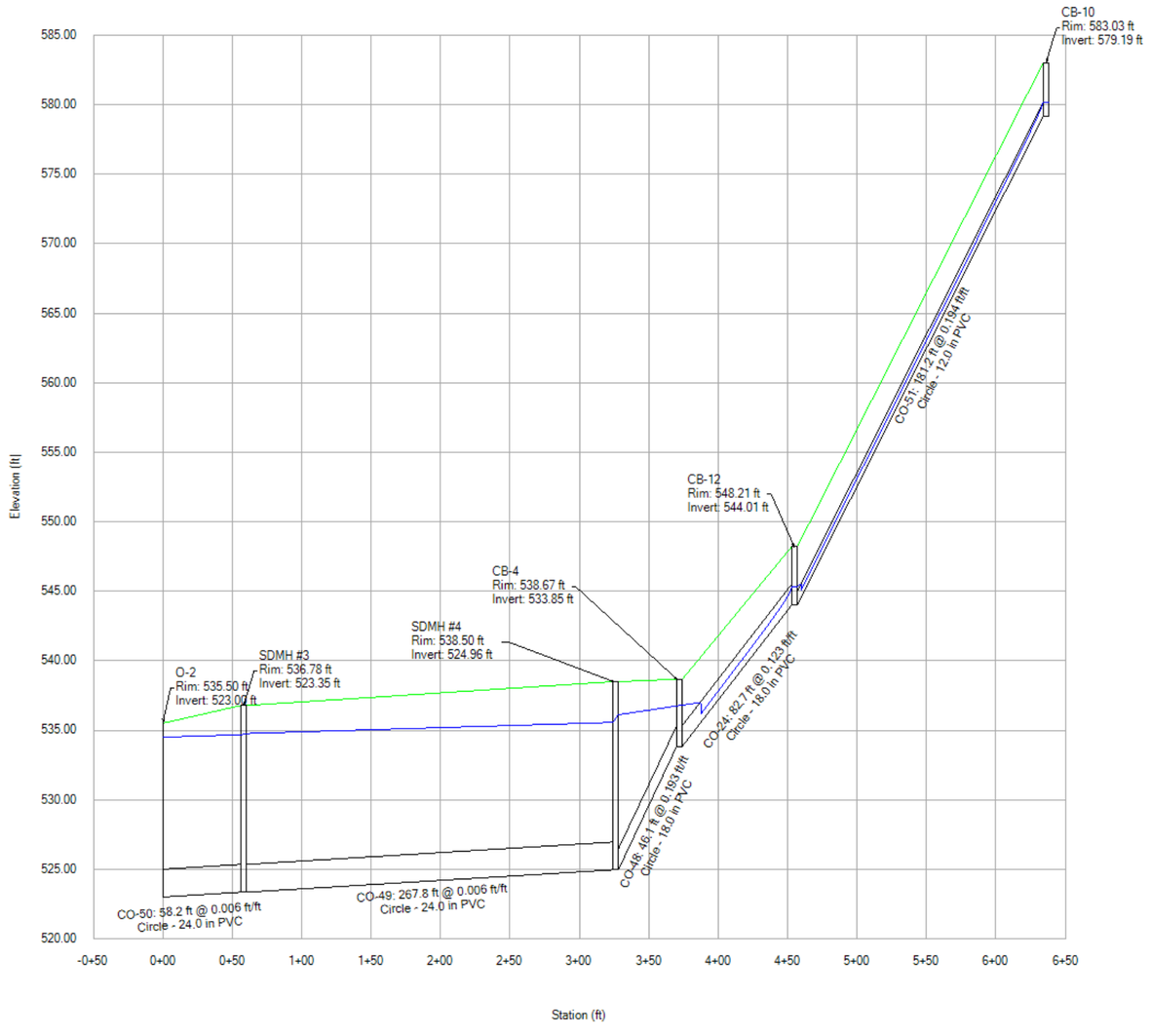
Label	Elevation (Rim) (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Available Freeboard (ft)	Is Ever Overflowing?	Headloss (ft)	Diameter (in)	Headloss Method	HEC-22 Benching Method
CB-1	561.72	0.00	110.36	552.20	555.41	555.37	6.31	FALSE	0.03	48.0	HEC-22 Energy	None
CB-3	569.58	0.00	5.80	563.58	564.54	564.53	5.04	FALSE	0.01	48.0	HEC-22 Energy	None
CB-4	538.67	0.00	12.33	533.85	536.81	536.75	1.86	FALSE	0.06	48.0	HEC-22 Energy	None
CB-6	572.94	0.00	5.80	567.94	568.88	568.87	4.06	FALSE	0.01	54.0	HEC-22 Energy	None
CB-10	583.03	0.00	9.25	579.19	580.18	580.18	2.85	FALSE	0.00	48.0	HEC-22 Energy	None
CB-11	550.97	0.00	3.08	545.97	546.72	546.72	4.25	FALSE	0.00	48.0	HEC-22 Energy	None
CB-12	548.21	0.00	12.33	544.01	545.35	545.34	2.86	FALSE	0.01	48.0	HEC-22 Energy	None
CB-13	536.87	0.00	69.64	525.48	535.11	535.04	1.76	FALSE	0.06	72.0	HEC-22 Energy	None
CB-14	538.61	0.00	69.64	525.82	535.33	535.26	3.28	FALSE	0.07	84.0	HEC-22 Energy	None
CB-15	537.16	5.04	61.50	526.83	535.55	535.52	1.61	FALSE	0.03	72.0	HEC-22 Energy	None
CB-16	536.88	3.72	8.14	529.45	535.73	535.67	1.15	FALSE	0.06	48.0	HEC-22 Energy	None
CB-19	562.35	0.00	100.68	552.07	556.01	556.01	6.34	FALSE	0.00	48.0	HEC-22 Energy	None
CB-29	574.24	0.00	2.90	568.85	569.58	569.58	4.66	FALSE	0.00	48.0	HEC-22 Energy	None
CB-30	573.69	0.00	2.90	568.38	569.11	569.11	4.58	FALSE	0.00	48.0	HEC-22 Energy	None
CB-31	562.52	0.00	9.68	552.53	555.41	555.41	7.11	FALSE	0.00	48.0	HEC-22 Energy	None
CB-33	542.29	0.00	54.77	535.16	539.29	539.29	3.00	FALSE	0.00	72.0	HEC-22 Energy	None
CB-34	541.47	0.00	54.77	534.14	537.92	537.91	3.55	FALSE	0.01	72.0	HEC-22 Energy	None
CB-35	541.17	0.00	54.77	533.56	537.76	537.75	3.41	FALSE	0.01	72.0	HEC-22 Energy	None
CB-36	540.05	0.00	54.77	532.65	537.49	537.48	2.56	FALSE	0.01	72.0	HEC-22 Energy	None
CB-37	539.89	1.69	56.46	532.23	537.36	537.35	2.53	FALSE	0.01	72.0	HEC-22 Energy	None
CB-38	538.90	0.00	56.46	531.54	537.14	537.11	1.76	FALSE	0.03	72.0	HEC-22 Energy	None
CB-39	539.31	0.00	56.46	531.16	537.00	536.97	2.31	FALSE	0.02	72.0	HEC-22 Energy	None
CB-40	539.61	0.00	56.46	530.79	536.86	536.83	2.75	FALSE	0.03	72.0	HEC-22 Energy	None
CB-41	538.40	0.00	56.46	529.59	536.46	536.44	1.94	FALSE	0.02	72.0	HEC-22 Energy	None
CB-42	539.02	0.00	56.46	528.97	536.25	536.23	2.77	FALSE	0.02	72.0	HEC-22 Energy	None
CB-43	538.16	0.00	56.46	527.83	535.87	535.86	2.29	FALSE	0.02	72.0	HEC-22 Energy	None
CB-44	540.89	4.42	4.42	537.20	538.01	538.01	2.88	FALSE	0.00	48.0	HEC-22 Energy	None
CB-45	540.28	0.00	4.42	536.25	537.06	537.06	3.22	FALSE	0.01	48.0	HEC-22 Energy	None
CB-46	539.83	0.00	4.42	535.50	536.54	536.53	3.29	FALSE	0.00	48.0	HEC-22 Energy	None
CB-47	538.24	0.00	4.42	533.20	536.18	536.18	2.06	FALSE	0.00	48.0	HEC-22 Energy	None
CB-48	536.82	0.00	4.42	530.90	535.77	535.76	1.05	FALSE	0.01	48.0	HEC-22 Energy	None
CB-49	539.18	0.00	0.00	533.81	536.18	536.18	3.00	FALSE	0.00	48.0	HEC-22 Energy	None
CB-50	538.50	0.00	0.70	533.50	535.42	535.42	3.08	FALSE	0.00	36.0	HEC-22 Energy	None
CB-52	551.86	0.00	1.29	546.86	547.34	547.34	4.52	FALSE	0.00	36.0	HEC-22 Energy	None
CB-53	559.25	0.00	0.15	555.25	555.41	555.41	3.84	FALSE	0.00	36.0	HEC-22 Energy	None
CB-54	545.50	0.00	1.13	541.50	541.95	541.95	3.55	FALSE	0.00	36.0	HEC-22 Energy	None

The Reserve at Woodlands - Regional Stormwater Facility
StormCAD Output for Catch Basins, Manholes and Outfalls
Date: 06/20/2024

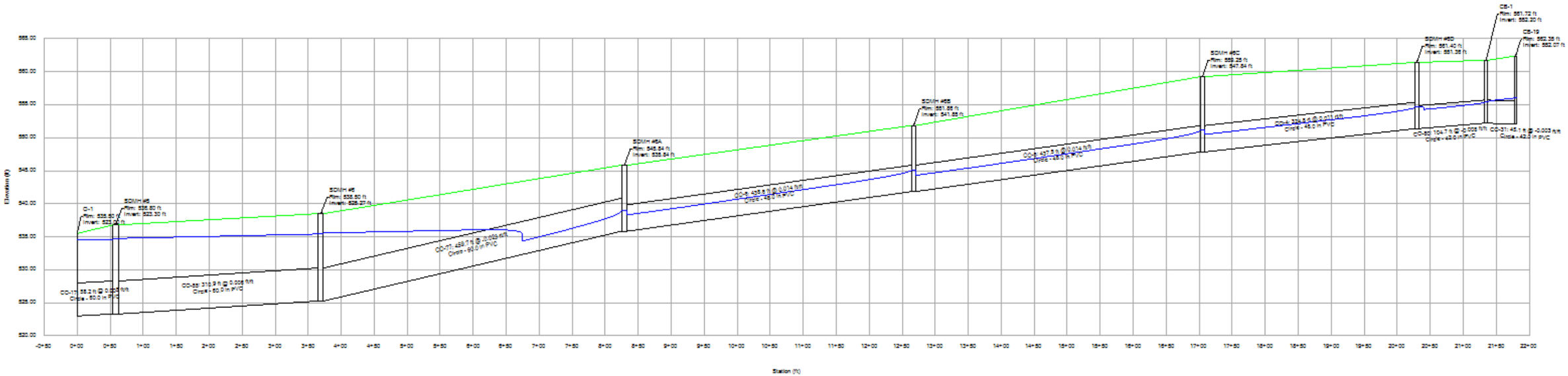
Label	Elevation (Rim) (ft)	Flow (Additional Subsurface) (cfs)	Flow (Total Out) (cfs)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Available Freeboard (ft)	Is Ever Overflowing?	Headloss (ft)	Diamerter (in)	Headloss Method	HEC-22 Benching Method
MH-14	536.68	0.00	69.64	525.24	534.93	534.87	1.75	FALSE	0.06	96.0	HEC-22 Energy	None
SDMH #1	536.78	0.00	69.64	523.35	534.64	534.54	2.14	FALSE	0.09	96.0	HEC-22 Energy	None
SDMH #2	536.10	0.00	69.64	524.27	534.76	534.74	1.34	FALSE	0.01	96.0	HEC-22 Energy	None
SDMH #3	536.78	0.00	12.33	523.35	534.77	534.67	2.01	FALSE	0.09	48.0	HEC-22 Energy	None
SDMH #4	538.50	0.00	12.33	524.96	536.12	535.56	2.38	FALSE	0.55	48.0	HEC-22 Energy	None
SDMH #5	536.80	0.00	119.43	523.30	534.76	534.62	2.04	FALSE	0.13	96.0	HEC-22 Energy	None
SDMH #6	538.50	0.00	119.43	525.27	535.41	535.41	3.09	FALSE	0.00	96.0	HEC-22 Energy	None
SDMH #6A	545.84	0.00	118.73	535.84	538.96	538.95	6.88	FALSE	0.01	96.0	HEC-22 Energy	None
SDMH #6B	551.86	0.00	117.60	541.85	545.13	545.12	6.73	FALSE	0.01	72.0	HEC-22 Energy	None
SDMH #6C	559.25	0.00	116.31	547.84	551.11	551.09	8.14	FALSE	0.01	72.0	HEC-22 Energy	None
SDMH #6D	561.40	0.00	116.16	551.36	554.65	554.61	6.75	FALSE	0.04	72.0	HEC-22 Energy	None

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Flow (Total Out) (cfs)
O-1	535.50	523.00	User Defined	534.5	119.43
O-3	535.50	523.00	User Defined	534.5	69.64
O-2	535.50	523.00	User Defined	534.5	12.33

Phase 3 North System
Inlet Conveyance Profile

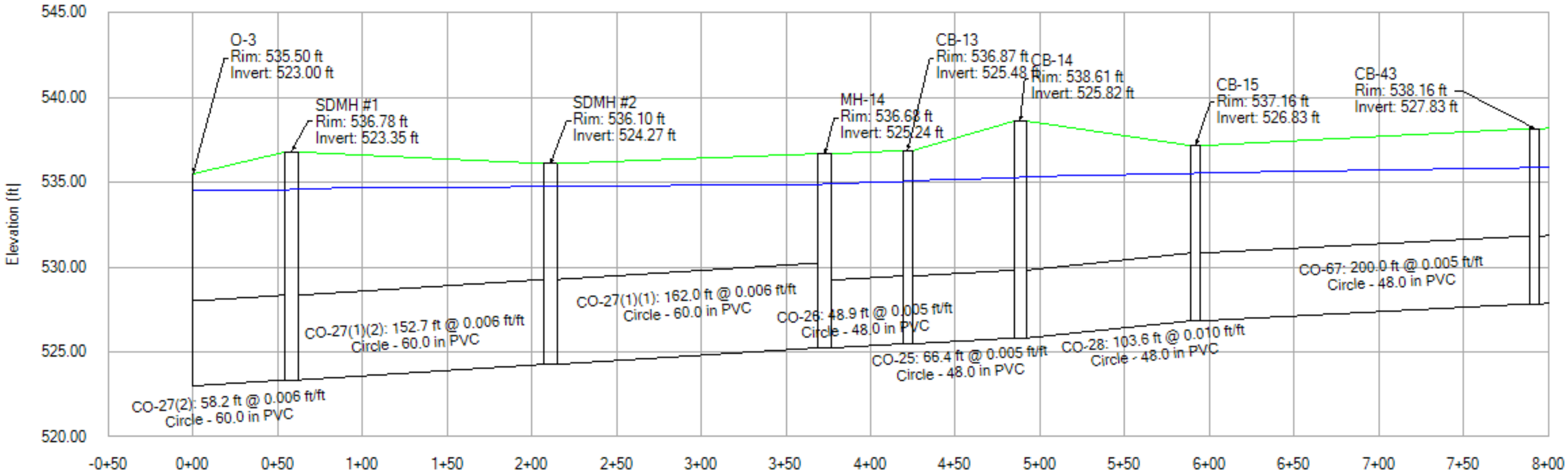


Phase 3 South System
Inlet Conveyance Profile



Station (ft)

Miner's Ridge System
Inlet Conveyance Profile



The Reserve at Woodlands Regional Stormwater Facility
DOE Water Quality Design - NRCS Curve Number Method
Date: 10/13/2022

Water Quality Design Storm

2-year, 24-hour Precipitation =	2.00	in.	(From Figure III-B.1 of the 2019 SWMMWW)
6-month Precipitation (**P**) =	1.44	in.	(Per Volume III Chapter 2.3, the 6-month precip. equals 72% of the 2 year precip.)

Post-Developed Runoff Curve Numbers (CN) (From Table III-2.5 of the 2019 SWMMWW)

CN for Impervious =	98	
CN for Till Grass =	86	Good Condition
CN for Outwash Grass =	68	Good Condition
CN for Till Forest =	70	Good Condition
CN for Outwash Forest =	30	Good Condition
CN for Wetland =	100	

(The soils are Alderwood and Everett per the Web Soil Survey. The Hydrologic Soil Group for Alderwood is Type C and Everett is Type A per Table III-2.4 of the 2019 SWMMWW)

Area's Maximum Potential Detention (S)

S = (1000/CN) - 10

S for Impervious =	0.20	0.2S for Impervious =	0.04
S for Till Grass =	1.63	0.2S for Till Grass =	0.33
S for Outwash Grass =	4.71	0.2S for Outwash Grass =	0.94
S for Till Forest =	4.29	0.2S for Till Forest =	0.86
S for Outwash Forest =	23.33	0.2S for Outwash Forest =	4.67
S for Wetland =	0.00	0.2S for Wetland =	0.00

Determinaning Runoff Depth (Q_d)

If $P \geq 0.2S$, then $Q_d = (P - 0.2S)^2 / (P + 0.8S)$

If $P < 0.2S$, then $Q_d = 0$

Q_d for Impervious =	1.22	inches	Q_d for Till Forest =	0.07	inches
Q_d for Till Grass =	0.45	inches	Q_d for Outwash Forest =	0.00	inches
Q_d for Outwash Grass =	0.05	inches	Q_d for Wetlands =	1.44	inches

Area of Land Cover

Area of Impervious =	185.8	acres	Area of Till Forest =	15.1	acres
Area of Till Grass =	52.8	acres	Area of Outwash Forest =	25.2	acres
Area of Outwash Grass =	66.8	acres	Area of Wetlands =	0.0	acres

Total Runoff Volume (V)

V = 3,630 (cu. ft./ac. in.) x Q_d (in) x Area (ac)

Volume for Impervious =	823,695	cu. ft	Volume for Till Forest =	3,822	cu. ft
Volume for Till Grass =	86,865	cu. ft	Vol. for Outwash Forest =	0	cu. ft
Volume for Outwash Grass =	11,586	cu. ft	Volume for Wetlands =	0	cu. ft

WQ Design Storm Volume =	922,146	cu. ft	(Per BMP T6.10 Presettling Basin of the 2019 SWMMWW, the treatment volume shall be at least 30% of the 6-month, 24-hour storm event)
Presettling Basin Design Volume =	276,644	cu. ft	
Proposed Presettling Basin Volume =	361,456	cu. ft	

6 SPECIAL REPORTS AND STUDIES

The following special reports and/or studies have been prepared for this project.

- *Geotechnical Exploration and Recommendations: Reserve at Woodlands Regional Stormwater Control Facility - Black Diamond Washington*, by Associated Earth Sciences Inc., dated November 14, 2024 (Not included with this report.)
- *Geologic Hazards Critical Areas Report – Reserve at Woodlands*, by Golder Associates dated January 15, 2020. (Not included with this report.)
- *Mine Hazard Study – Executive Summary for The Villages Project,* dated May 4, 2006, prepared by Golder Associates, Inc. (Not included with this report.)
- *The Villages Final Environmental Impact Statement,* dated December 2009 (Not included with this report.)
- *The Villages Master Planned Development* as adopted by Ordinance Number 10-946 (Not included with this report.)
- *The Villages MPD Development Agreement*, issued December 12, 2012 (Not included with this report.)
- *Environmental Impact Statement Technical Report on Geology, Soils, and Ground Water for The Villages*, dated September 26, 2008, prepared by Associated Earth Sciences, Inc. from Appendix D of the FEIS (Not included with this report.)

7 OTHER PERMITS

The following approvals/permits will likely be needed for the Phase 3 Regional Stormwater Facility project (this list may not include all necessary permits).

Permit	Agency
Grading Permit	King County
Flood Hazard Certificate	King County
NPDES Permit	DOE

8 CONSTRUCTION STORMWATER POLLUTION PREVENTION

A Construction Stormwater Pollution Prevention (CSWPP) plan will be prepared and submitted as a separate document at final engineering. Additionally, a Stormwater Pollution Prevention Plan (SWPPP) will be prepared as an element of the required NPDES Construction Discharge permit, administered through the Department of Ecology

8.1 CONSTRUCTION SOURCE CONTROL

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed in the SWPPP. A detailed list of personnel shall be submitted to King County prior to any construction activity on the site, including the TESC supervisor and personnel responsible for the proper refueling of construction equipment and any concrete washout facility.

9 BOND QUANTITIES, FACILITY SUMMARIES AND DECLARATION OF COVENANT

9.1 BOND QUANTITIES

King County Site Improvement and Critical Areas Mitigation Bond Quantity Worksheets will be attached at the end of this section when completed.

King County
Department of Permitting
Environmental Review
35030 SE Douglas Str, Suite 210
Snoqualmie, WA 98065-9266
206-296-6600 TTY Relay: 711

Critical Areas Mitigation
Bond Quantity Worksheet

C24 09/09/2015
ls-wks-sensareaBQ.xls
ls-wks-sensareaBQ.pdf

Project Name: **Date:** **Prepared by:**

Project Number: **Project Description:**

Location: **Applicant:** **Phone:**

PLANT MATERIALS (includes labor cost for plant installation)

Type	Unit Price	Unit	Quantity	Description	Cost
PLANTS: Potted, 4" diameter, medium	$5.00	Each			$ -
PLANTS: Container, 1 gallon, medium soil	$11.50	Each			$ -
PLANTS: Container, 2 gallon, medium soil	$20.00	Each			$ -
PLANTS: Container, 5 gallon, medium soil	$36.00	Each			$ -
PLANTS: Seeding, by hand	$0.50	SY			$ -
PLANTS: Slips (willow, red-osier)	$2.00	Each			$ -
PLANTS: Stakes (willow)	$2.00	Each			$ -
PLANTS: Stakes (willow)	$2.00	Each			$ -
PLANTS: Flats/plugs	$2.00	Each			$ -
				TOTAL	**$ -**

INSTALLATION COSTS (LABOR, EQUIPMENT, & OVERHEAD)

Type	Unit Price	Unit			Cost
Compost, vegetable, delivered and spread	$37.88	CY			$ -
Decompacting till/hardpan, medium, to 6" depth	$1.57	CY			$ -
Decompacting till/hardpan, medium, to 12" depth	$1.57	CY			$ -
Hydroseeding	$0.51	SY			$ -
Labor, general (landscaping other than plant installation)	$40.00	HR			$ -
Labor, general (construction)	$40.00	HR			$ -
Labor: Consultant, supervising	$55.00	HR			$ -
Labor: Consultant, on-site re-design	$95.00	HR			$ -
Rental of decompacting machinery & operator	$70.00	HR			$ -
Sand, coarse builder's, delivered and spread	$42.00	CY			$ -
Staking material (set per tree)	$7.00	Each			$ -
Surveying, line & grade	$250.00	HR			$ -
Surveying, topographical	$250.00	HR			$ -
Watering, 1" of water, 50' soaker hose	$3.62	MSF			$ -
Irrigation - temporary	$3,000.00	Acre			$ -
Irrigation - buried	$4,500.00	Acre			$ -
Tilling topsoil, disk harrow, 20hp tractor, 4"-6" deep	$1.02	SY			$ -
				TOTAL	**$ -**

HABITAT STRUCTURES*

ITEMS	Unit Cost	Unit			Cost
Fascines (willow)	$ 2.00	Each			$ -
Logs, (cedar), w/ root wads, 16"-24" diam., 30' long	$1,000.00	Each			$ -
Logs (cedar) w/o root wads, 16"-24" diam., 30'	$400.00	Each			$ -
Logs, w/o root wads, 16"-24" diam., 30' long	$245.00	Each			$ -
Logs w/ root wads, 16"-24" diam., 30' long	$460.00	Each			$ -
Rocks, one-man	$60.00	Each			$ -
Rocks, two-man	$120.00	Each			$ -
Root wads	$163.00	Each			$ -
Spawning gravel, type A	$22.00	CY			$ -
Weir - log	$1,500.00	Each			$ -
Weir - adjustable	$2,000.00	Each			$ -
Woody debris, large	$163.00	Each			$ -
Snags - anchored	$400.00	Each			$ -
Snags - on site	$50.00	Each			$ -
Snags - imported	$800.00	Each			$ -
* All costs include delivery and installation				*TOTAL*	**$ -**

EROSION CONTROL

ITEMS	Unit Cost	Unit			Cost
Backfill and Compaction-embankment	$ 4.89	CY			$ -
Crushed surfacing, 1 1/4" minus	$30.00	CY			$ -
Ditching	$7.03	CY			$ -
Excavation, bulk	$4.00	CY			$ -
Fence, silt	$1.60	LF			$ -
Jute Mesh	$1.26	SY			$ -
Mulch, by hand, straw, 2" deep	$1.27	SY			$ -
Mulch, by hand, wood chips, 2" deep	$3.25	SY			$ -
Mulch, by machine, straw, 1" deep	$0.32	SY			$ -
Piping, temporary, CPP, 6"	$9.30	LF			$ -
Piping, temporary, CPP, 8"	$14.00	LF			$ -
Piping, temporary, CPP, 12"	$18.00	LF			$ -
Plastic covering, 6mm thick, sandbagged	$2.00	SY			$ -
Rip Rap, machine placed, slopes	$33.98	CY			$ -
Rock Constr. Entrance 100'x15'x1'	$3,000.00	Each			$ -
Rock Constr. Entrance 50'x15'x1'	$1,500.00	Each			$ -
Sediment pond riser assembly	$1,695.11	Each			$ -
Sediment trap, 5' high berm	$15.57	LF			$ -
Sediment trap, 5' high berm w/spillway incl. riprap	$59.60	LF			$ -
Sodding, 1" deep, level ground	$5.24	SY			$ -
Sodding, 1" deep, sloped ground	$6.48	SY			$ -
Straw bales, place and remove	$600.00	TON			$ -
Hauling and disposal	$20.00	CY			$ -
Topsoil, delivered and spread	$35.73	CY			$ -
				TOTAL	**$ -**

GENERAL ITEMS

ITEMS	Unit Cost	Unit			Cost
Fencing, chain link, 6' high	$18.89	LF			$ -
Fencing, chain link, corner posts	$111.17	Each			$ -
Fencing, chain link, gate	$277.63	Each			$ -
Fencing, split rail, 3' high (2-rail)	$10.54	LF			$ -
Fencing, temporary (NGPE)	$1.20	LF			$ -
Signs, sensitive area boundary (inc. backing, post, install)	$28.50	Each			$ -
				TOTAL	**$ -**

OTHER

				(Construction Cost Subtotal)	**$ -**
ITEMS	Percentage of Construction Cost	Unit			Cost
Mobilization	10%	1			$ -
Contingency	30%	1			$ -
				TOTAL	**$ -**

MAINTENANCE AND MONITORING

NOTE: Projects with multiple permit requirements may be required to have longer monitoring and maintenance terms. This will be evaluated on a case-by-case basis for development applications. Monitoring and maintance ranges may be assessed anywhere from 5 to 10 years.

Maintenance, annual (by owner or consultant)					
Less than 1,000 sq.ft. and buffer mitigation only	$ 1.08	SF		(3 X SF total for 3 annual events; Includes monitoring)	$ -
Less than 1,000 sq.ft. with wetland or aquatic area mitigation	$ 1.35	SF		(3 X SF total for 3 annual events; Includes monitoring)	$ -
Larger than 1,000 sq. ft. but less than 5,000 sq.ft. of buffer mitigation	$ 180.00	EACH		(4hr @$45/hr)	$ -
Larger than 1,000 sq. ft. but less than 5,000 sq.ft. of wetland or aquatic area mitigation	$ 270.00	EACH		(6hr @$45/hr)	$ -
Larger than 5,000 sq.ft. but < 1 acre -buffer mitigation only	$ 360.00	EACH		(8 hrs @ 45/hr)	$ -
Larger than 5,000 sq.ft. but < 1 acre with wetland or aquatic area mitigation	$ 450.00	EACH		(10 hrs @ $45/hr)	$ -
Larger than 1 acre but < 5 acres - buffer and / or wetland or aquatic area mitigation	$ 1,600.00	DAY		(WEC crew)	$ -
Larger than 5 acres - buffer and / or wetland or aquatic area mitigation	$ 2,000.00	DAY		(1.25 X WEC crew)	$ -
Monitoring, annual (by owner or consultant)					
Larger than 1,000 sq.ft. but less than 5,000 wetland or buffer mitigation	$ 720.00	EACH		(8 hrs @ 90/hr)	$ -
Larger than 5,000 sq.ft. but < 1 acre with wetland or aquatic area impacts	$ 900.00	EACH		(10 hrs @ $90/hr)	$ -
Larger than 1 acre but < 5 acres - buffer and / or wetland or aquatic area impacts	$ 1,440.00	DAY		(16 hrs @ $90/hr)	$ -
Larger than5 acres - buffer and / or wetland or aquatic area impacts	$ 2,160.00	DAY		(24 hrs @ $90/hr)	$ -
				TOTAL	**$ -**

Total	**$0.00**

10 OPERATIONS AND MAINTENANCE

All storm drainage facilities serving the project site are to be maintained per the three-part maintenance agreement between the Project developer, King County and City of Black Diamond. These facilities include storm conveyance (pipes, catch basins, etc.), flow control (infiltration pond), and water quality (pre-settling cell, large sand filter, etc.) and should be maintained per the King County Manual's recommendations for these facilities which are attached to this section.

NO. 2 – INFILTRATION FACILITIES

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Infiltration Pond, Top or Side Slopes of Dam, Berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of dams, berms or slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat to dam, berm, or embankment integrity or not interfering with access or maintenance, they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Storage Area	Sediment accumulation	If two inches or more sediment is present or a percolation test indicates facility is working at or less than 90% of design.	Facility infiltrates as designed.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
Infiltration Tank Structure	Plugged air vent	Any blockage of the vent.	Tank or vault freely vents.
	Tank bent out of shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape.	Tank repaired or replaced to design.
	Gaps between sections, damaged joints or cracks or tears in wall	A gap wider than ½-inch at the joint of any tank sections or any evidence of soil particles entering the tank at a joint or through a wall.	No water or soil entering tank through joints or walls.
Infiltration Vault Structure	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch, any evidence of soil entering the structure through cracks or qualified inspection personnel determines that the vault is not structurally sound.	Vault is sealed and structurally sound.

NO. 2 – INFILTRATION FACILITIES

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Inlet/Outlet Pipes	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Access Manhole	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open manhole requires immediate maintenance.**	Manhole access covered.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Ladder rungs unsafe	Missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Large access doors/plate	Damaged or difficult to open	Large access doors or plates cannot be opened/removed using normal equipment.	Replace or repair access door so it can opened as designed.
	Gaps, doesn't cover completely	Large access doors not flat and/or access opening not completely covered.	Doors close flat; covers access opening completely.
	Lifting Rings missing, rusted	Lifting rings not capable of lifting weight of door or plate.	Lifting rings sufficient to lift or remove door or plate.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Filter Bags	Plugged	Filter bag more than $^1/_2$ full.	Replace filter bag or redesign system.
Infiltration Pond, Tank, Vault, Trench, or Small Basin Pre-settling Ponds and Vaults	Sediment accumulation	6" or more of sediment has accumulated.	Pre-settling occurs as designed
Infiltration Pond, Rock Filter	Plugged	High water level on upstream side of filter remains for extended period of time or little or no water flows through filter during heavy rain storms.	Rock filter replaced evaluate need for filter and remove if not necessary.
Infiltration Pond Emergency Overflow Spillway	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Spillway restored to design standards.
	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the structure opening or is blocking capacity of the structure by more than 10%.	No Trash or debris blocking or potentially blocking entrance to structure.
		Trash or debris in the structure that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the structure.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Sediment	Sediment exceeds 60% of the depth from the bottom of the structure to the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section or is within 6 inches of the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section.	Sump of structure contains no sediment.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering structure through cracks, or maintenance person judges that structure is unsound.	Structure is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering structure through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Structure has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Ladder rungs missing or unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
FROP-T Section	Damage	T section is not securely attached to structure wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	T section 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 or show signs of deteriorated grout.	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 missing.	Replace cleanout gate.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
		Cleanout gate is not watertight.	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.
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.
	Deformed or damaged lip	Lip of overflow pipe is bent or deformed.	Overflow pipe does not allow overflow at an elevation lower than design
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Metal Grates (If Applicable)	Unsafe grate opening	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.	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.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		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 catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ 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.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	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.	Grate free of trash and debris.
	Damaged or missing	Grate missing or broken member(s) of the grate. **Any open structure requires urgent maintenance**.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

NO. 7 – DEBRIS BARRIERS (E.G., TRASH RACKS)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed.
Site	Trash and debris	Trash or debris plugging more than 20% of the area of the barrier.	Barrier clear to receive capacity flow.
	Sediment accumulation	Sediment accumulation of greater than 20% of the area of the barrier	Barrier clear to receive capacity flow.
Structure	Cracked broken or loose	Structure which bars attached to is damaged - pipe is loose or cracked or concrete structure is cracked, broken of loose.	Structure barrier attached to is sound.
Bars	Bar spacing	Bar spacing exceeds 6 inches.	Bars have at most 6 inches spacing.
	Damaged or missing bars	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than ¾ inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.

NO. 8 – ENERGY DISSIPATERS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed.
Site	Trash and debris	Trash and/or debris accumulation.	Dissipater clear of trash and/or debris.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Rock Pad	Missing or moved Rock	Only one layer of rock exists above native soil in area five square feet or larger or any exposure of native soil.	Rock pad prevents erosion.
Dispersion Trench	Pipe plugged with sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench).	Water discharges from feature by sheet flow.
	Perforations plugged.	Over 1/4 of perforations in pipe are plugged with debris or sediment.	Perforations freely discharge flow.
	Water flows out top of “distributor” catch basin.	Water flows out of distributor catch basin during any storm less than the design storm.	No flow discharges from distributor catch basin.
	Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Gabions	Damaged mesh	Mesh of gabion broken, twisted or deformed so structure is weakened or rock may fall out.	Mesh is intact, no rock missing.
	Corrosion	Gabion mesh shows corrosion through more than ¼ of its gage.	All gabion mesh capable of containing rock and retaining designed form.
	Collapsed or deformed baskets	Gabion basket shape deformed due to any cause.	All gabion baskets intact, structure stands as designed.
	Missing rock	Any rock missing that could cause gabion to loose structural integrity.	No rock missing.
Manhole/Chamber	Worn or damaged post, baffles or side of chamber	Structure dissipating flow deteriorates to ½ or original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure is in no danger of failing.
	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch or any evidence of soil entering the structure through cracks, or maintenance inspection personnel determines that the structure is not structurally sound.	Manhole/chamber is sealed and structurally sound.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No soil or water enters and no water discharges at the joint of inlet/outlet pipes.

NO. 9 – FENCING

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Erosion or holes under fence	Erosion or holes more than 4 inches high and 12-18 inches wide permitting access through an opening under a fence.	No access under the fence.
Wood Posts, Boards and Cross Members	Missing or damaged parts	Missing or broken boards, post out of plumb by more than 6 inches or cross members broken	No gaps on fence due to missing or broken boards, post plumb to within 1½ inches, cross members sound.
	Weakened by rotting or insects	Any part showing structural deterioration due to rotting or insect damage	All parts of fence are structurally sound.
	Damaged or failed post foundation	Concrete or metal attachments deteriorated or unable to support posts.	Post foundation capable of supporting posts even in strong wind.
Metal Posts, Rails and Fabric	Damaged parts	Post out of plumb more than 6 inches.	Post plumb to within 1½ inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
	Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Fabric mesh openings within 50% of grid size.

NO. 10 – GATES/BOLLARDS/ACCESS BARRIERS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Chain Link Fencing Gate	Damaged or missing members	Missing gate.	Gates in place.
		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
		Missing stretcher bar, stretcher bands, and ties.	Stretcher bar, bands, and ties in place.
	Locking mechanism does not lock gate	Locking device missing, non-functioning or does not link to all parts.	Locking mechanism prevents opening of gate.
	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Fabric mesh openings within 50% of grid size.
Bar Gate	Damaged or missing cross bar	Cross bar does not swing open or closed, is missing or is bent to where it does not prevent vehicle access.	Cross bar swings fully open and closed and prevents vehicle access.
	Locking mechanism does not lock gate	Locking device missing, non-functioning or does not link to all parts.	Locking mechanism prevents opening of gate.
	Support post damaged	Support post does not hold cross bar up.	Cross bar held up preventing vehicle access into facility.
Bollards	Damaged or missing	Bollard broken, missing, does not fit into support hole or hinge broken or missing.	No access for motorized vehicles to get into facility.
	Does not lock	Locking assembly or lock missing or cannot be attached to lock bollard in place.	No access for motorized vehicles to get into facility.
Boulders	Dislodged	Boulders not located to prevent motorized vehicle access.	No access for motorized vehicles to get into facility.
	Circumvented	Motorized vehicles going around or between boulders.	No access for motorized vehicles to get into facility.

NO. 11 – GROUNDS (LANDSCAPING)

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. **A hazard tree identified by a qualified arborist must be removed as soon as possible.**	No hazard trees in facility.
	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.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.

NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	At least 12-foot of width on access road.
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken on missing modular block.	Access road surface restored so road infiltrates.

NO. 16 – WETPOND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Any trash and debris accumulated on the wetpond site.	Wetpond site free of any trash or debris.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Side Slopes of Dam, Berm, internal berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of dams, berms or slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat to dam, berm or embankment integrity, are not interfering with access or maintenance or leaves do not cause a plugging problem they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
Top or Side Slopes of Dam, Berm, internal berm or Embankment	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
	Irregular surface on internal berm	Top of berm not uniform and level.	Top of berm graded to design elevation.
Pond Areas	Sediment accumulation (except first wetpool cell)	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth.
	Sediment accumulation (first wetpool cell)	Sediment accumulations in pond bottom that exceeds the depth of sediment storage (1 foot) plus 6 inches.	Sediment storage contains no sediment.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
	Water level (all wetpool cells)	Cell level(s) drops more than 12 inches in any 7-day period.	Cell level(s) drops less than 12 inches in any 7-day period.
	Algae mats (first wetpool cell)	Algae mats develop over more than 10% of the water surface should be removed.	Algae mats removed (usually in the late summer before Fall rains, especially in Sensitive Lake Protection Areas.)

NO. 16 – WETPOND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
	Design planting and vegetation survival and maintenance	Sparse or dying design planting, or when design plantings are not thriving across 80% or more of the design vegetated areas within the pond; invasive vegetation e.g., cattails	Design plantings and vegetation are thriving and appropriately spaced across 80% or more of the design vegetated areas within the pond; invasives removed including root clumps
Gravity Drain	Inoperable valve	Valve will not open and close.	Valve opens and closes normally.
	Valve won't seal	Valve does not seal completely.	Valve completely seals closed.
Emergency Overflow Spillway	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.
	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Spillway restored to design standards.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 19 – SAND FILTER POND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Trash and debris accumulated on facility site.	Trash and debris removed from facility site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover (not in the treatment area)	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Pre-Treatment (if applicable)	Sediment accumulation	Sediment accumulations in pond bottom that exceeds the depth of sediment storage (1 foot) plus 6 inches.	Sediment storage contains no sediment.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
	Water level	Cell empty, doesn't hold water.	Water retained in first cell for most of the year.
	Algae mats	Algae mats develop over more than 10% of the water surface should be removed.	Algae mats removed (usually in the late summer before Fall rains, especially in Sensitive Lake Protection Areas.)
Pond Area	Sediment accumulation	Sediment or crust depth exceeds ½-inch over 10 % of surface area of sand filter.	No sediment or crust deposit on sand filter that would impede permeability of the filter section.
	Grass (if applicable)	Grass becomes excessively tall (greater than 6 inches) or when nuisance weeds and other vegetation start to take over or thatch build up occurs.	Mow vegetation and/or remove nuisance vegetation.
Side Slopes of Pond	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of dams, berms or slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat to dam, berm, or embankment integrity or not interfering with access or maintenance, they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.

NO. 19 – SAND FILTER POND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
Sand Filter Media	Plugging	Drawdown of water through the sand filter media, takes longer than 24 hours, and/or flow through the overflow pipes occurs frequently. A sieve analysis of >4% -100 or >2% -200 requires replacing sand filter media.	Sand filter media surface is aerated or the surface is scraped and replaced, and drawdown rate is normal.
	Prolonged flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Excess flows bypassed or confined to small portion of filter media surface.
	Short circuiting	Flows become concentrated over one section of the sand filter rather than dispersed or drawdown rate of pool exceeds 12 inches per hour.	Flow and percolation of water through the sand filter is uniform and dispersed across the entire filter area and drawdown rate is normal.
	Media thickness	Sand thickness is less than 18 inches.	Rebuild sand thickness to a minimum of 18 inches.
Underdrains and Clean-Outs	Sediment/debris	Underdrains or clean-outs partially plugged or filled with sediment and/or debris. Junction box/cleanout wyes not watertight.	Underdrains and clean-outs free of sediment and debris and are watertight.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Rock Pad	Missing or out of place	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad restored to design standards.
Flow spreader	Concentrated flow	Flow from spreader not uniformly distributed across sand filter.	Flows spread evenly over sand filter.

NO. 24 – CATCH BASIN INSERT

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Media Insert	Visible Oil	Visible oil sheen passing through media	Media inset replaced.
	Insert does not fit catch basin properly	Flow gets into catch basin without going through media.	All flow goes through media.
	Filter media plugged	Filter media plugged.	Flow through filter media is normal.
	Oil absorbent media saturated	Media oil saturated.	Oil absorbent media replaced.
	Water saturated	Catch basin insert is saturated with water, which no longer has the capacity to absorb.	Insert replaced.
	Service life exceeded	Regular interval replacement due to typical average life of media insert product, typically one month.	Media replaced at manufacturer's recommended interval.
	Seasonal maintenance	When storms occur and during the wet season.	Remove, clean and replace or install new insert after major storms, monthly during the wet season or at manufacturer's recommended interval.

NO. 27 – GRAVEL FILLED DISPERSION TRENCH BMP

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Preventative	Blocking, obstructions	Debris or trash limiting flow to dispersion trench or preventing spreader function.	Dispersion trench able to receive full flow prior to and during wet season.
Site	Trash and debris	Trash or debris that could end up in the dispersion trench is evident.	No trash or debris that could get into the dispersion trench can be found.
Pipes	Inlet is plugged	The entrance to the pipe is restricted due to sediment, trash, or debris.	The entrance to the pipe is not restricted.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Plugged	Sediment or other material prevents free flow of water through the pipe.	Water flows freely through pipes.
	Broken joint or joint leaks.	Damage to the pipe or pipe joints allowing water to seep out.	Pipe does not allow water to exit other than at the outlet to the trench.
	Cleanout caps	Cleanout caps are broken, missing, or buried.	Cleanout caps are accessible and intact.
Structure	Flow not reaching trench	Flows are not getting into the trench as designed.	Water enters and exits trench as designed.
	Perforated pipe plugged	Flow not able to enter or properly exit from perforated pipe.	Water freely enters and exits perforated pipe.
	Flow not spreading evenly at outlet of trench	Outlet flows channelizing or not spreading evenly from trench.	Sheet flow occurs at the outlet of the trench.
	Cleanout/inspection access does not allow cleaning or inspection of perforated pipe	The cleanout/inspection access is not available.	Cleanout/inspection access is available.
Filter Media	Filter media plugged	Filter media plugged.	Flow through filter media is normal.
Inspection	Frequency	Annually and prior to and following significant storms.	Inspect dispersion trench system for any defects of deficiencies.

NO. 28 – NATIVE VEGETATED SURFACE / NATIVE VEGETATED LANDSCAPE BMP

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Trash and debris accumulated on the native vegetated surface/native vegetated landscape site.	Native vegetated surface site free of any trash or debris.
Vegetation	Native vegetation type	Less than two species each of native trees, shrubs, and groundcover occur in the design area.	A minimum of two species each of native trees, shrubs, and groundcover is established and healthy.
	Native vegetated area	Less than 90% if the required vegetated area has healthy growth.	A minimum of 90% of the required vegetated area has healthy growth.
	Undesirable vegetation	Weeds, blackberry, and other undesirable plants are invading more than 10% of vegetated area.	Less than 10% undesirable vegetation occurs in the required native vegetated surface area.
Vegetated Area	Soil compaction	Soil in the native vegetation area compacted.	Less than 8% of native vegetation area is compacted.
	Insufficient area	Less than 3.5 square feet of native vegetation area for every 1 square foot of impervious surface.	A minimum of 3.5 square feet of native vegetation area for every 1 square foot of impervious surface.
	Excess slope	Slope of native vegetation area greater than 15%.	Slope of native growth area does not exceed 15%.
Inspection	Frequency	Annually	Inspect native vegetation area for any defects of deficiencies