ENGINEERING NORTHWEST

6168 NE Hwy 99 #103
Vancouver, WA 98665
PaulWilliamsPE@gmail.com
(360) 931-3122

Stormwater Technical Information Report (TIR)

Mt St Helens MC Club Kart Track

Castle Rock

Parcel 309320100
Property ID 3,043,582
75 PH 10
Castle Rock, WA 98611

January 31, 2024

3:05 PM - Nick Schmit

Certificate of the Engineer

Mt St Helens MC Club Kart Track

Castle Rock, Washington

Stormwater Technical Information Report

I hereby certify that these plans, and related design, were prepared in strict conformance with the City of Castle Rock's stormwater drainage development policies.

This TIR and the data contained herein were prepared by the undersigned whose seal, as a Professional Engineer licensed to practice as such, is affixed below. All information required by the City of Castle Rock and the 1992 Stormwater Management Manual for the Puget Sound Basin are included between this report and the associated stormwater plans.

Paul Williams, P.E.
Engineering Northwest PLLC
6168 NE Hwy 99 #103
Vancouver, WA 98665
360-931-3122
PaulWilliamsPE@gmail.com

1/31/24

Table of Contents

References

Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed 01/31/2024.

Washington State Department of Ecology. 1992. Stormwater Management Manual for the Puget Sound Basin.

Washington State Department of Ecology. 2019. Stormwater Management Manual for Western Washington (SWMMWW).

Joel W. Massman, Washington State Department of Transportation. 2003. A Design Manual for Sizing Infiltration Ponds.

Summary

The Mt St Helens Motorcycle Club Kart development, hereafter "project", proposes construction of an approximately ½-acre kart track on existing tax parcel number (TPN) 309320100. The site is reported by the assessor to have an area of 4.66 acres in the City of Castle Rock's jurisdiction and is zoned mixed use commercial/industrial. The site is situated southeast of the intersection of Westside Highway and PH 10, both identified as state route 411, and is assigned an address of 75 PH 10. This stormwater management report is prepared for submittal along with stormwater plans for the site.

The City of Castle Rock requires, per the Storm Drainage Standards, that "on-site detention systems shall be provided to ensure that stormwater flow rates following development do not exceed the predevelopment rates."

This development will adequately capture, treat, detain, and infiltrate it's runoff to maintain flows equal to or less than the existing peak flows up to the 100-year storm rate. Water quality treatment will be provided for stormwater runoff from impervious surfaces subject to vehicular (or kart) traffic. The proposed system will, at a minimum, provide basic water quality treatment prior to release or infiltration of stormwater runoff. The stormwater runoff will be entirely infiltrated on site, up to the 100-year event.

Design of the stormwater facilities for the project follows the guidelines and Best Management Practices (BMPs) outlined in the 1992 Puget Sound Stormwater Manual.

Site Conditions

Runoff from the site, that does not first infiltrate into the poorly graded sandy soils, flows overland easterly to Whipple Creek. Little to no contribution from off-site sources occurs due to the native infiltration rates and relatively flat grades, or due to abutting properties laying at a lower grade such as the right-of-way for Westside Highway.

The following stormwater management approach is proposed to meet the release rate requirements:

The project will infiltrate 100% of the stormwater runoff up to the 100-year storm event utilizing an infiltration trench constructed consistent with BMP T7.20 of the July 2019 edition of the Stormwater Management Manual for Western Washington (SWMMWW) following water quality treatment with a Compost Amended Vegetated Filter Strip (CAVFS) constructed consistent with BMP T7.40 of the SWMMWW. These BMPs borrowed from the modern manual will meet or exceed the requirements of the Puget Sound Manual for treatment or performance.

I-2 PSM – Minimum Requirements (MR) #1 - #11

I-2.5 MR #1: Erosion and Sediment Control

This project will include land-disturbing activities totaling less than one (1) acre and will comply with the Small Parcel Minimum Requirements as demonstrated on the associated plans. An abbreviated Stormwater Pollution Prevention Plan (SWPPP) is also prepared and submitted. A Construction Stormwater General Permit (CSWGP) permit is not required due to the small disturbed area.

I-2.6 MR #2: Preservation of Natural Drainage Systems

The project will not significantly impact existing natural drainage patterns. The site generally sheet flows and infiltrates into the native soil, eventually contributing to Whipple Creek off-site to the east. The development will infiltrate all runoff from the new hard surfaces in order to maintain this pattern.

I-2.7 MR #3: Source Control of Pollution

The maintenance of the proposed stormwater system and application of source-control measure(s) as directed by the SWPPP and erosion control plan will prevent sediment-laden stormwater runoff from leaving the site. The property owner and/or contractor will maintain the principal water quality system elements.

I-2.8 MR #4: Runoff Treatment BMPs

The proposed use requires basic treatment. To satisfy this requirement, BMP T7.40: CAVFS, taken from the SWMMWW is sized and sited appropriately to treat more than 90% of the total runoff volume. Infiltration is utilized in the BMP train, but only after this treatment BMP.

The state-approved-continuous-flow-model report included in Appendix B demonstrates that the CAVFS, when sized to minimally match the perimeter of the 60'x3' infiltration trench with an average width of four (4) feet, does exceed the 90% requirement for treatment. Generally, a CAVFS also provides enhanced treatment.

I-2.9 MR #5: Streambank Erosion Control

This requirement applies to situations where stormwater runoff is discharged directly or indirectly to a stream. Runoff from this project primarily infiltrates into the native soil, but may contribute indirectly through overland sheet flow to Whipple Creek.

The project implements BMP T7.20: Infiltration Trench of the SWMMWW to capture and infiltrate all runoff from the disturbed area up to the 100-year storm. This BMP is not sited within a vegetative buffer and the site is not subject to an existing basin plan. Runoff if treated prior to infiltration with a separate BMP. By infiltrating as such, the runoff from the development complies with the stream protection durations.

I-2.10 MR #6: Wetlands

This requirement applies only to situations where stormwater discharges directly or indirectly through a conveyance system into a wetland. There is no wetland receiving runoff from this project, directly or indirectly.

I-2.11 MR #7: Water Quality Sensitive Areas

The runoff from this development is treated prior to release into the infiltration trench. The proposed CAVFS system will provide filtering benefits via the soil mix and vegetation. Adequate treatment is provided for the site.

I-2.12 MR#8: Off-Site Analysis and Mitigation

This project proposes to capture, treat, and infiltrate all runoff generated by the disturbed areas. The development will result in no off-site impacts requiring analysis for water quality impacts because no runoff will leave these areas up to at least the 100-year storm.

I-2.13 MR #9: Basin Planning

There is no adopted and implemented basin plan for this site used to modify the Minimum Requirements.

I-2.14 MR #10: Operation and Maintenance

An Operation and Maintenance manual for the proposed BMPs is compiled and included as Appendix C of this report to satisfy this requirement. The proposed stormwater management system is entirely privately owned and maintained. The owner of the lot is responsible for maintenance of these systems.

I-2.15 MR #11: Financial Liability

The property owner will own and be responsible for the maintenance of the stormwater systems constructed with this development.

I-2.16: Exceptions to the Minimum Requirements

No exceptions are sought with this development.

On-Site Hydrologic Soil Groups

Per the Web Soil Survey (NRCS), the only soil type within the proposed development area is "Cowlitz extremely gravelly sand, disturbed, 0 to 5 percent slopes." A summary of the reported properties and qualities for this soil type are provided below:

- Typical profile extremely gravelly sand to 11 inches, very gravelly sand to 60 inches.
- Slopes 0 to 5 percent.
- More than 80 inches depth to restrictive features.
- Drainage class of somewhat excessively drained.
- Capacity of the most limiting layer to transmit water (*Ksat*) is high to very high (5.95 to 19.98 in/hr).
- Depth to water table is estimated to exceed 80 inches.
- Frequency of flooding is none.
- Frequency of ponding is none.
- Available water supply to 60 inches depth is very low (about 2.4 inches).

A report from NRCS is included in Appendix A showing the area of interest.

New Impervious Surface Area

This project will create new impervious surfaces for the kart track and required parking totaling approximately 0.50 acres. The total site area is approximately 4.66 acres as available from the assessor's office. The site has existing hard surface areas covering approximately 2.24 acres as gravel maneuvering areas, concrete areas, and building roofs. Based on these areas, the site will have a coverage of approximately 59%, including 11% as new impervious surfaces.

Altered Runoff Characteristics

On-site drainage will not be significantly altered with the proposed development. The existing condition generally infiltrates into the native soil rather than flow large distances overland due to the nature of the soil type. The developed condition will continue to infiltrate runoff.

Ultimate Build-Out

This proposal represents the full build-out scenario of the area of interest.

Design Storms

The stormwater systems for this development are designed with event volumes derived from the extended timeseries data accessed through the approved-continuous-flow-model software. Only a Mean-Annual Precipitation (MAP) input is required to provide accurate design storm volumes. That MAP value is determined by the software through a latitude and longitude input to be 48 inches. An isopluvial map of the MAP for the software is included in Appendix A. Runoff rates from the modeled

basins are derived from this value, as well as the water quality rate. A report from the model is included in Appendix B.

Site-Specific Infiltration Testing

Two test pits were excavated to a depth of five (5) feet on the site in the vicinity of the proposed stormwater systems. A soil sample was taken at each location for evaluation by a particle size distribution analysis to determine saturated infiltration rates (*Ksat)* following the testing methodologies of the SWMMWW. No significant change in soil profile was observed to the five (5) feet sample depth.

Following a particle size distribution analysis (included in Appendix B), *Ksat* can be determined by the following relationship (Massman, 2003):

$$\log_{10} K_{sat} = -1.57 + 1.9D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08f_{fines}$$

Where D_{10}, D_{60}, and D_{90} are the grain sizes for which 10%, 60%, and 90% of the sample is more fine and f_{fines} is the fraction of soil by weight that passes the #200 sieve. The resulting K_{sat} is in $^{cm}/_{s}$. ($1\ ^{cm}/_{s} = 1{,}417\ ^{in}/_{hr}$)

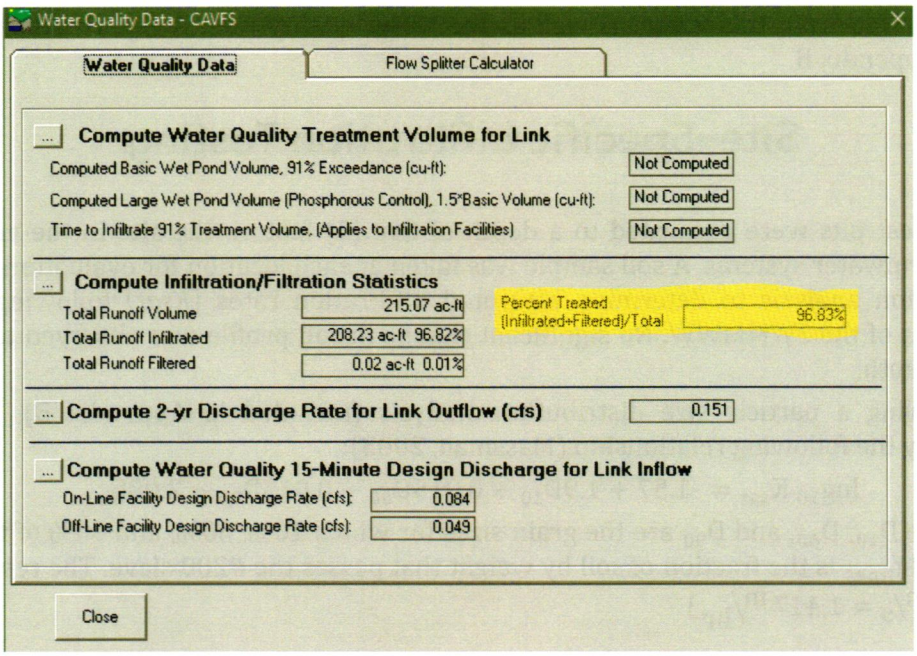
TP-1	Depth (ft)	D10	D60	D90	Fines	Ksat (cm/s)	Ksat (iph)
Layer 1	5	0.14	0.26	0.48	0.02	0.0449	**63.6**

TP-2	Depth (ft)	D10	D60	D90	Fines	Ksat (cm/s)	Ksat (iph)
Layer 1	5	0.11	0.29	7.4	0.048	0.0280	**39.7**

The lower K_{sat} of 39.7 inches per hour between the two test pits is selected as conservative. For the design rate utilized in the modeling, a correction factor must be applied. Factors for site variability, test method, and degree of influent control are selected as 0.8, 0.8, and 0.9, respectively, for a total correction factor of 0.576 and a design infiltration rate of **22.8** inches per hour.

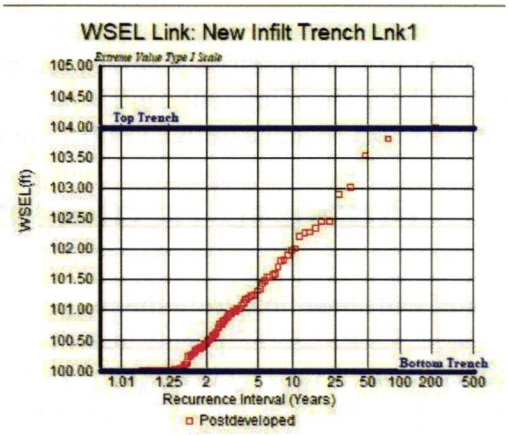
Proposed Treatment BMPs

Stormwater runoff will sheet flow from the proposed PGHS areas and be intercepted by the proposed SWMMWW BMP T7.40 CAVFS facility prior to entering the infiltration trench. Water quality (WQ) treatment is accomplished for the CAVFS system by flow through the amended soil. The percentage of volume of flow that does pass through the CAVFS is modeled and reported by the continuous flow model to demonstrate compliance. The CAVFS is sized utilizing this model until the treated rate meets the requirements, in this case 90%.



Water Quantity Control

The SWMMWW BMP T7.20 infiltration trench proposed for quantity control is sized utilizing the same continuous-flow-model to demonstrate that 100% of the stormwater runoff up to the 100-year storm is infiltrated. By detaining and infiltrating up to this event, water quantity control is achieved for stream protection durations.



Facility Maintenance

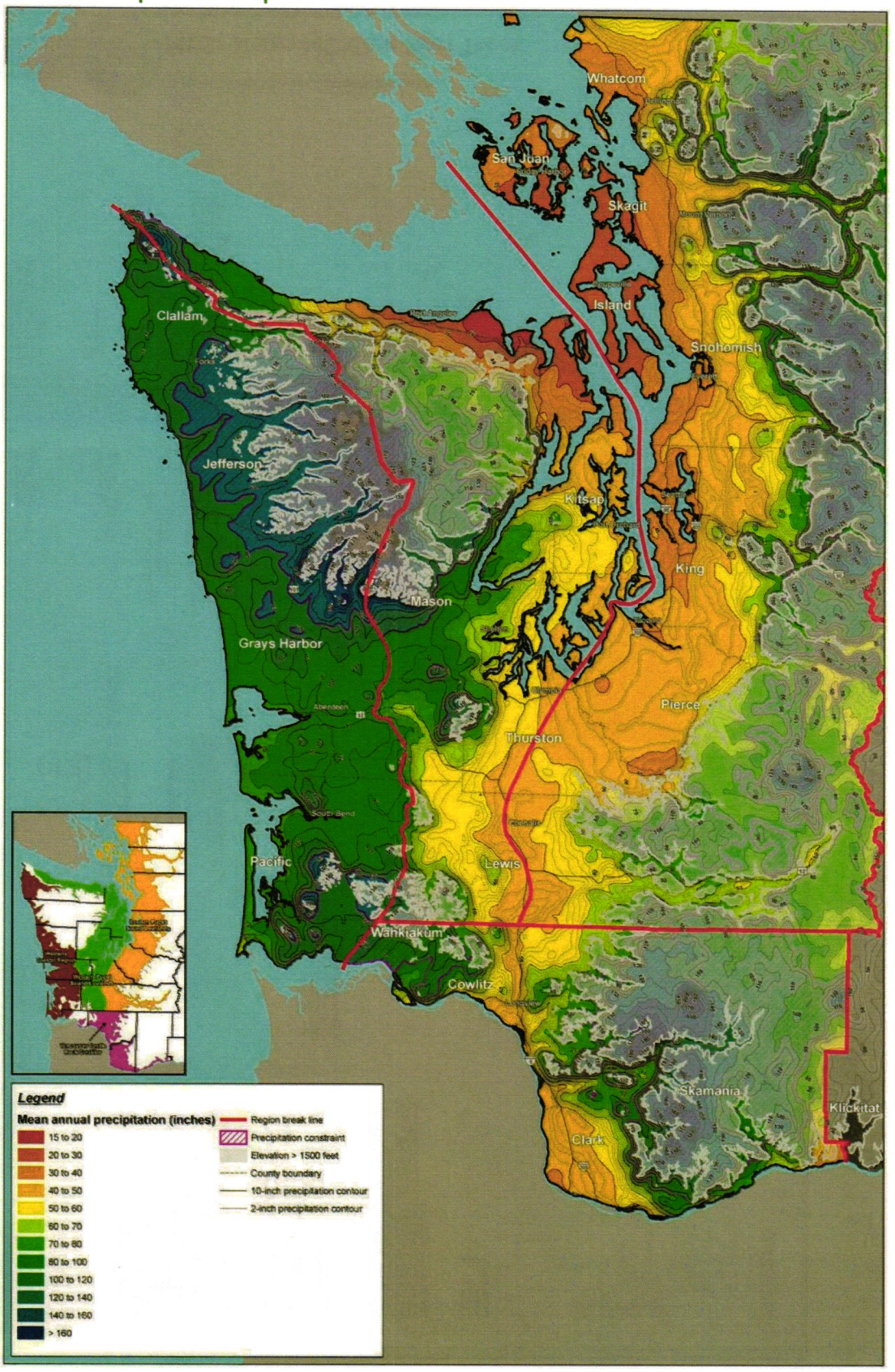
The long-term maintenance of the stormwater systems associated with this project are the responsibility of the property owner. Maintenance and inspection of these systems can be completed as directed in the Operations and Maintenance manual included in Appendix C.

Appendix A

Project Maps

Pre-Project Aerial

MGSFlood MAP Isopluvial Map



Stormwater Plan

General Information

Applicant: - Same as engineer -

Contact: - Same as engineer -

Owner: Mt St Helens Motorcycle Club
PO Box 555
Castle Rock, WA 98611

Engineer: Engineering Northwest PLLC
6368 NE Hwy 99 STE 103
Vancouver, WA 98665
Contact: Paul Williams, P.E.
Phone: (360) 931-3122
Email: PaulWilliamsPE@Gmail.com

Site information
Address: 75 PH 10
Castle Rock, WA 98611
Tax Parcel: 309320100
Gross Area: 4.66 AC
Zoning: Mixed Use
S.T.R.: S10 T9N R2W WM

Existing use
Outbuildings

Proposed use
Kart track

Site Summary

Parcel Area	4.66 AC
Existing Impervious	2.24 AC
New Impervious	0.58 AC

Wet Weather Conditions

Significant variation and degree of erosion control efforts will be dictated by weather conditions. The contractor should be prepared to provide additional erosion control provisions and efforts during winter and wet weather conditions beyond that normally required during summer and dry weather conditions. Fine grained and unconsolidated soils on sloping sites may become unstable when subject to excessive moisture.

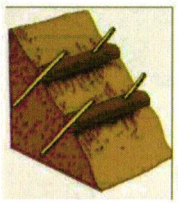
A sediment trap is required if construction occurs during wet weather months or if runoff is leaving the site any time of the year during construction, per standard detail E2.40.

Erosion Notes

a) All material handling on site must comply with BMP C150, BMP C151, and BMP C154.
b) Place plastic covering over all soil stockpiles complying with BMP C123 or straw complying with BMP C121.
c) Sequence construction schedule to comply with BMP C162.
d) See SWPPP for additional erosion control measures.
e) BMP's not called out on this plan may be used at developer's discretion as additional erosion control measures.
f) Wherever feasible, preserve native vegetation per BMP C101.
g) Treat all disturbed areas per BMP C125 Topsoil and compost all disturbed soils.

General Notes – Storm Drain Construction

1. All workmanship and materials shall be in accordance with City Standards and the most current copy of the State of Washington Standard Specifications for Road, Bridge and Municipal Construction (WSDOT).
2. Temporary erosion/water pollution measures shall be required in accordance with Section 1-07.15 of the Standard Specifications.
3. Contractor shall be responsible for complying with all other permits and other requirements by the City or other governing authority or agency as may be applicable.
4. A preconstruction meeting shall be held with the City prior to the start of construction.
5. All storm drains and retention/detention areas shall be staked for grade and alignment by an engineering or surveying firm capable of performing such work, and currently licensed in the State of Washington to do so.
6. Contractor shall provide traffic control plan(s) as required in accordance with MUTCD.
7. Call underground locate line at 811 a minimum of 72 hours prior to any excavations.
8. Where connections require "field verifications," connection points will be exposed by contractor and fittings verified 48 hours prior to distributing shut-down notices.

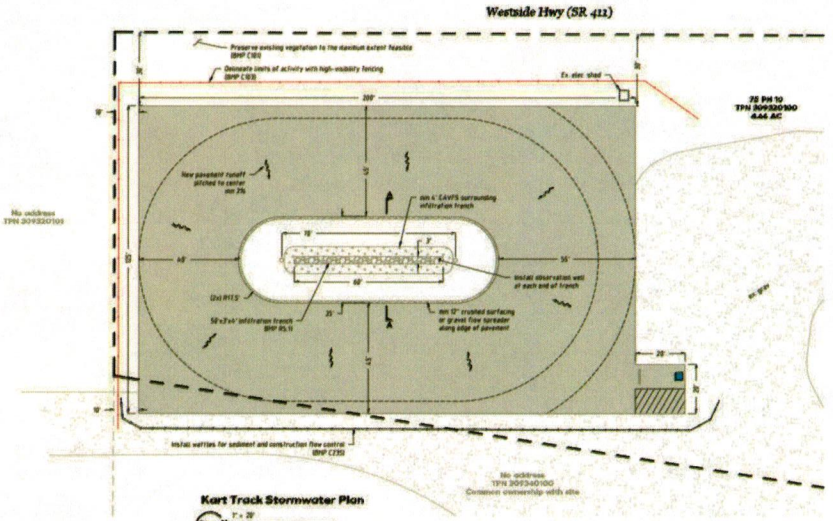


Notes:
- Install wattles perpendicular to flow direction and parallel to contour lines.
- Dig a narrow trench to a depth of 3 to 5 inches in clay soils, or 5 to 7 inches in loose soils, steep slopes, or areas with high rainfall.
- Install the wattles snugly into the trenches and abut tightly end-to-end. Do not overlap.
- Install stakes at each end of each wattle, and at 4-ft on center for the entire length of each wattle. Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle for removal.
- Wooden stakes should have min dimensions of 2"x2"x3". Willow cuttings or ½" rebar may also be used for stakes.
- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall and on slopes sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

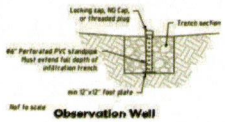
BMP C235: Wattles
Not to scale

Infiltration Facilities Note

Construction runoff, or sediment laden runoff, shall not be allowed to flow into the proposed infiltration facilities. Contractor shall employ inlet protections as applicable to protect infiltration facilities during construction. Contaminated facilities shall be repaired prior to final acceptance.



Kart Track Stormwater Plan
1" = 20'



Not to scale

Observation Well

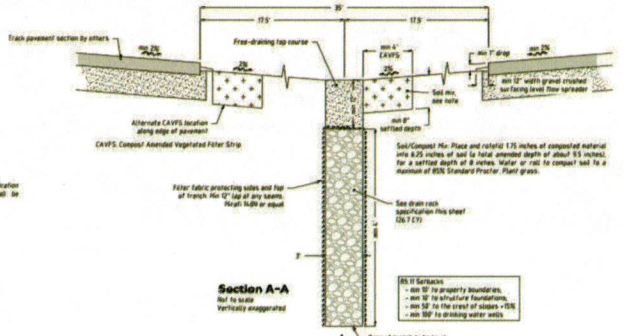
Drain Rock Specification

The aggregate material for the drain rock sections shall meet WSDOT Specification 9-03.12(5) that ranges from 3/4" to 1-1/2" diameter. Void spaces shall be approximately 40 percent. See grading table below.

Sieve Size	% Passing
1-1/2"	95 - 100
1"	50 - 100
3/4"	0 - 20
3/8"	0 - 2
#200	0 - 1.5

Infiltration Facilities Note

Construction runoff, or sediment laden runoff, shall not be allowed to flow into the proposed infiltration facilities. Contractor shall employ inlet protections as applicable to protect infiltration facilities during construction. Contaminated facilities shall be repaired prior to final acceptance.



SW2

Project: 2301TSP
Date: ----
Drafted: NVS
Designed: PCW
Page: 2 of 2

Northwest Utilities
1-800-424-5555
"It's the law"
Call 48 hours before you dig.

Revisions

Erosion Control & Source Control Pollution Plan

Mt St Helen MC Club Kart Track

ENGINEERING NORTHWEST
CONSULTING ENGINEERS & PLANNERS
6368 NE HWY 99 STE 103, VANCOUVER 98665
(360) 931-3122

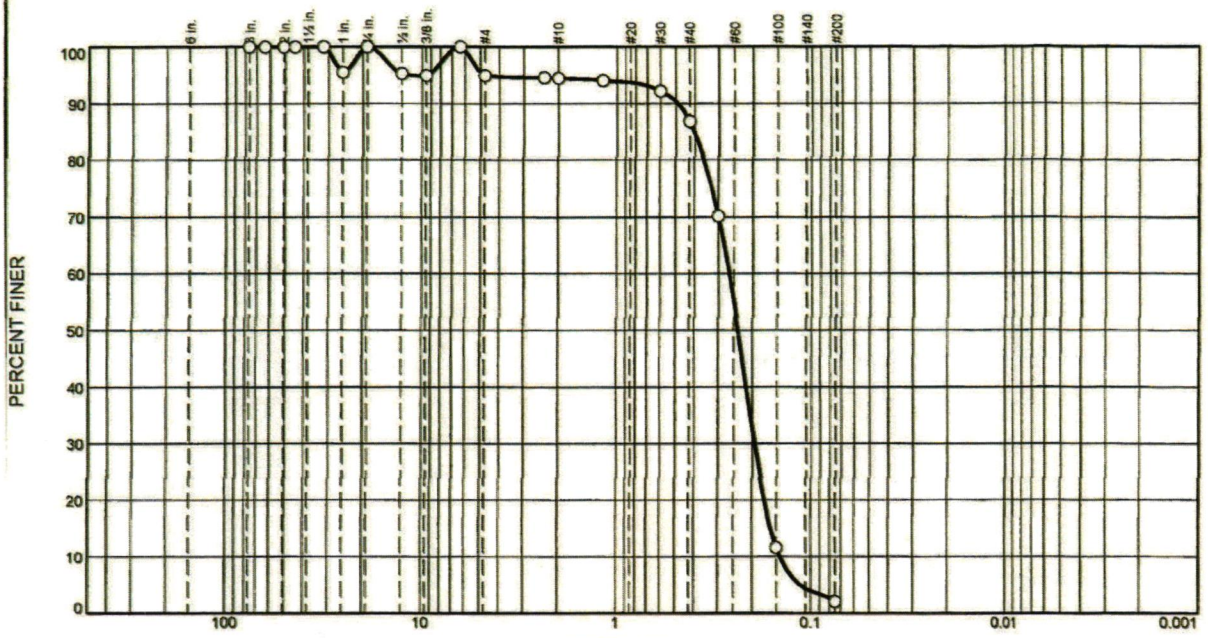
Appendix B

Reports

Particle Size Distribution Report – Test Pit 1

Particle Size Distribution Report

AASHTO T 27 & T 11



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	5.5	7.7	84.8	2.0	

Test Results (AASHTO T 27 & T 11)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3"	100.0			
2 1/2"	100.0			
2"	100.0			
1 3/4"	100.0			
1 1/4"	100.0			
1"	95.5			
3/4"	100.0			
1/2"	95.3			
3/8"	94.9			
1/4"	100.0			
#4	94.9			
#8	94.6			
#10	94.5			
#16	94.1			
#30	92.2			
#40	86.8			
#50	70.2			
#100	11.6			
#200	2.0			

* (no specification provided)

Material Description

poorly graded sand

Atterberg Limits

PL= np LL= nv PI=

Classification

USCS= SP AASHTO= A-3

Test Remarks

Location: TP-1 @ -5' BGS
Sample Number: 1

Sample Date: 1-5-2024

swt

Soil and Water Technologies, Inc.
1101 Broadway, Suite 216
Vancouver, WA 98660
PH: (360) 200-6053
www.swt.biz

Client: Engineering Northwest
Project: GoKart Track

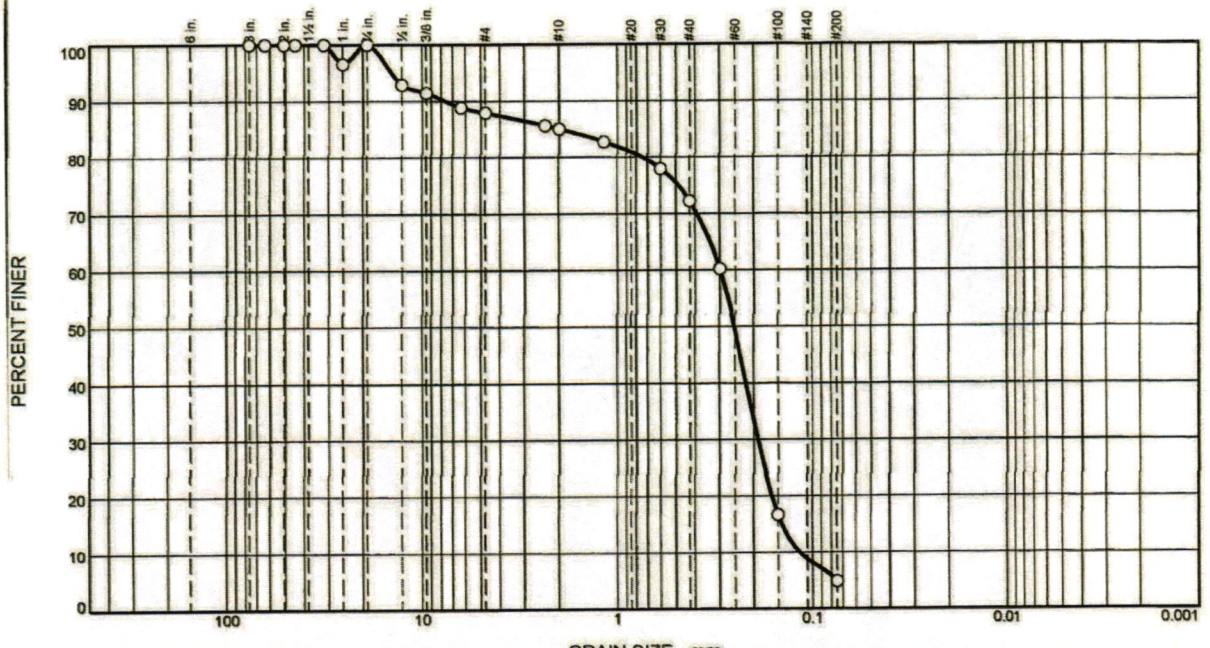
Project No: 0002400 **Figure** PSD-1

ested By: KH

Particle Size Distribution Report – Test Pit 2

Particle Size Distribution Report

AASHTO T 27 & T 11



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	15.0	12.7	67.5	4.8	

Test Results (AASHTO T 27 & T 11)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3"	100.0			
2 1/2"	100.0			
2"	100.0			
1 3/4"	100.0			
1 1/4"	100.0			
1"	96.6			
3/4"	100.0			
1/2"	92.9			
3/8"	91.4			
1/4"	88.8			
#4	87.9			
#8	85.7			
#10	85.0			
#16	82.8			
#30	78.0			
#40	72.3			
#50	60.2			
#100	16.7			
#200	4.8			

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= NV PI=

Classification

USCS= SP AASHTO= A-3

Test Remarks

Location: TP-2 @ -5' BGS
Sample Number: 2

Sample Date: 1-5-2024

swt

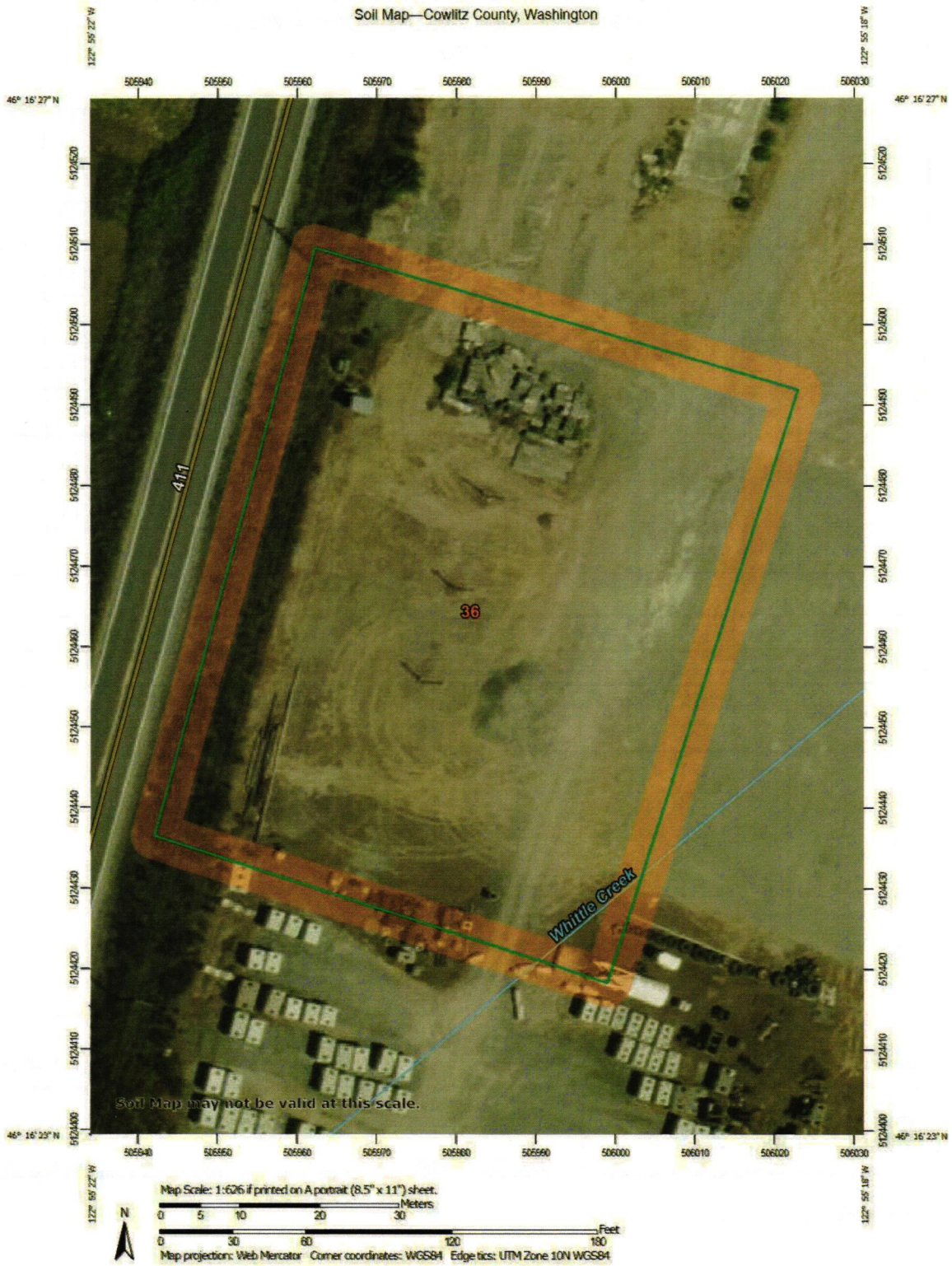
Soil and Water Technologies, Inc.
1101 Broadway, Suite 216
Vancouver, WA 98660
PH: (360) 200-8693
www.swt.ski

Client: Engineering Northwest
Project: *GoKart Track*

Project No: 0002400 **Figure** PSD-2

Tested By: KH

NCRS Soil Map



USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

MGSFlood Report (Continuous Flow Model)

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.59
Program License Number: 202110006
Project Simulation Performed on: 01/29/2024 2:52 PM
Report Generation Date: 01/29/2024 2:52 PM

Input File Name: Kart.fld
Project Name: MC Club Kart Track
Analysis Title:
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 26
Precipitation Station : 97004805 Vancouver 48 in_5min 10/01/1939-10/01/2060
Evaporation Station : 971048 Vancouver 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** **WATERSHED DEFINITION** **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.583	0.583
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.583	0.583

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
A/B, Forest, Flat	0.583
Subbasin Total	0.583

----------**SCENARIO: POSTDEVELOPED**
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
A/B, Lawn, Flat 0.078
PARKING/FLAT 0.505

Subbasin Total 0.583

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 2

Link Name: R5.11 *(SWMMWW BMP T7.40)*
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	: Trench on Embankment Sideslope
Trench Length (ft)	: 60.00
Trench Width (ft)	: 3.00
Trench Depth (ft)	: 4.00
Trench Bottom Elev (ft)	: 100.00
Trench Rockfill Porosity (%)	: 30.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 22.81

Link Name: CAVFS
Link Type: Compost Amended Vegetated Filter Strip (CAVFS)
Downstream Link Name: R5.11 *(SWMMWW BMP T7.40)*

Compost Thickness (ft)	: 0.670
Compost Porosity (%)	: 10.000
Compost Hydraulic Conductivity (in/hr)	: 1.000
CAVFS Length (ft)	: 111.000
CAVFS Width (ft)	: 4.000
CAVFS Slope, Z (ft/ft)	: 50.000
Gravel Spreader Width (ft)	: 1.000
Gravel Hydraulic Conductivity (in/hr)	: 2.000
Gravel Porosity (%)	: 30.000
Soil Infiltration Rate (in/hr)	: 5.700

Precipitation and Evaporation NOT Applied to Surface of CAVFS

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 2

********** Subbasin: Subbasin 1 **********

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.217
5-Year	0.292
10-Year	0.343
25-Year	0.430
50-Year	0.469
100-Year	0.596
200-Year	0.669
500-Year	0.766

********** Link: R5.11 ********** Link Inflow Frequency Stats
Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.159
5-Year	0.233
10-Year	0.282
25-Year	0.368
50-Year	0.409
100-Year	0.534
200-Year	0.606
500-Year	0.701

********** Link: R5.11 ********** Link WSEL Stats *(SWMMWW BMP T7.40)*
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	100.015
1.11-Year	100.018
1.25-Year	100.031
2.00-Year	100.575

3.33-Year	101.129
5-Year	101.462
10-Year	102.118
25-Year	102.895
50-Year	103.700
100-Year	103.941

********** Link: CAVFS ********** Link Inflow Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.217
5-Year	0.292
10-Year	0.343
25-Year	0.430
50-Year	0.469
100-Year	0.596
200-Year	0.669
500-Year	0.766

********** Link: CAVFS ********** Link Outflow 1 Frequency Stats

Flood Frequency Data(cfs)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	0.159
5-Year	0.233
10-Year	0.282
25-Year	0.368
50-Year	0.409
100-Year	0.534
200-Year	0.606
500-Year	0.701

**********Groundwater Recharge Summary **********

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	162.992
Total:	162.992

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	25.850
Link: R5.11	10.154

Link: CAVFS 204.976

Total: 240.980

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 121)
Predeveloped: 1.347 ac-ft/year, Post Developed: 1.992 ac-ft/year

************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 2

********** Link: R5.11 **********

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.15 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.08 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 10.15
Inflow Volume Including PPT-Evap (ac-ft): 10.15
Total Runoff Infiltrated (ac-ft): 10.15, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.00
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 100.00%

********** Link: CAVFS **********

2-Year Discharge Rate : 0.159 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.08 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.05 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 215.07
Inflow Volume Including PPT-Evap (ac-ft): 215.07
Total Runoff Infiltrated (ac-ft): 204.98, 95.31%
Total Runoff Filtered (ac-ft): 0.03, 0.01%
Primary Outflow To Downstream System (ac-ft): 10.15
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00

Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 95.32%

**********Compliance Point Results **********

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: R5.11

*** Point of Compliance Flow Frequency Data ***
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.536E-04	2-Year	0.000
5-Year	4.683E-04	5-Year	0.000
10-Year	1.256E-03	10-Year	0.000
25-Year	7.463E-03	25-Year	0.000
50-Year	9.799E-03	50-Year	0.000
100-Year	1.314E-02	100-Year	0.000
200-Year	1.905E-02	200-Year	0.000
500-Year	2.686E-02	500-Year	0.000

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	0.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	0.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**** LID Duration Performance ****

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	0.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	0.0%	PASS

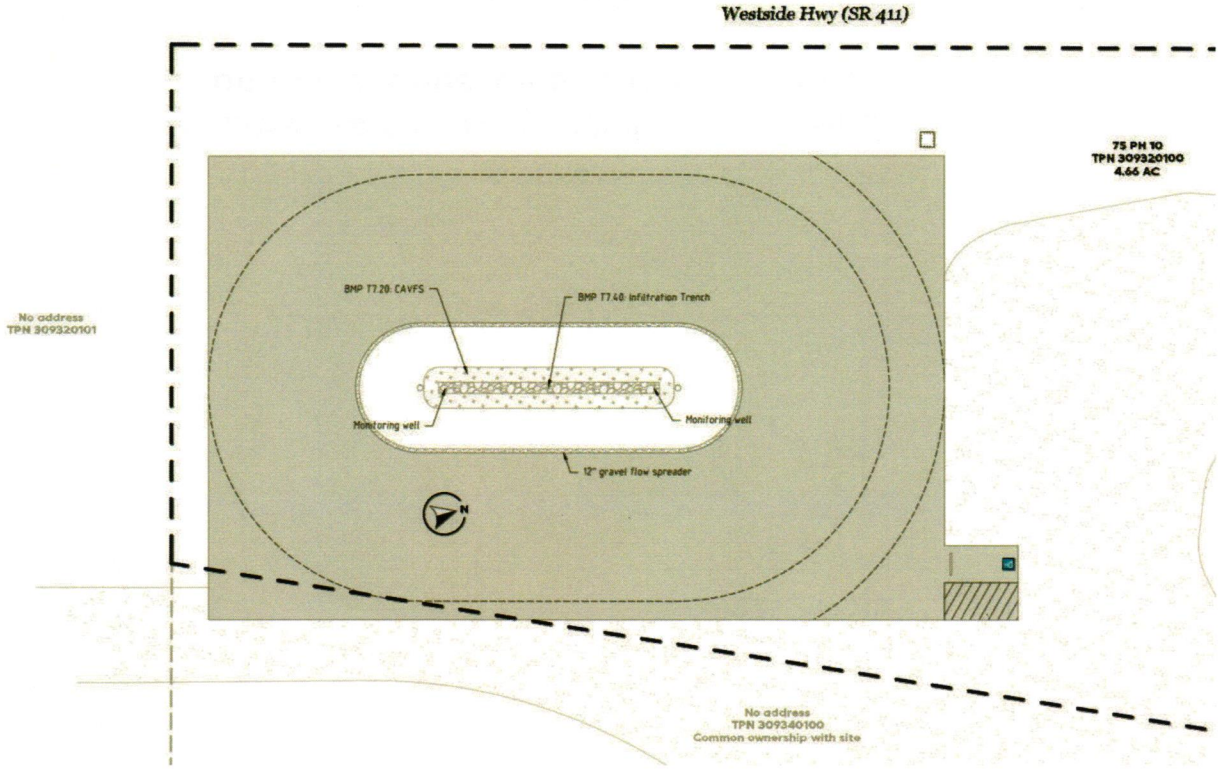
MEETS ALL LID DURATION DESIGN CRITERIA: PASS

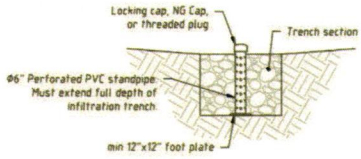
Appendix C

Operation and Maintenance Manual

(Tables derived from July 2019 edition of the SWMMWW)

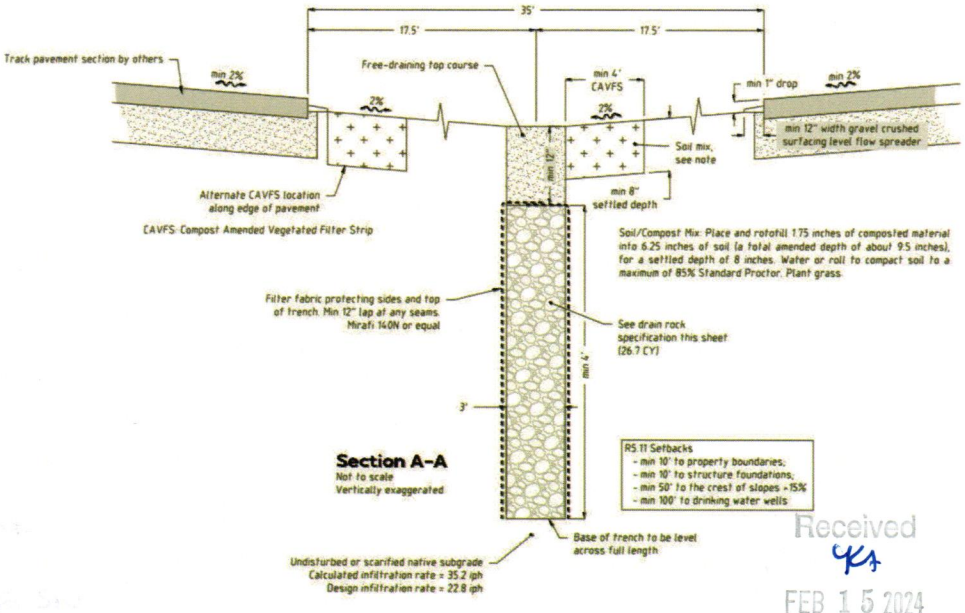
Map of Site Stormwater System





Not to scale

Observation Well



Section A-A
Not to scale
Vertically exaggerated

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.20: Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width