AP CONSULTING ENGINEERS PLLC
CIVIL ENGINEERING

PRELIMINARY STORMWATER SITE PLAN

FEBRUARY 15, 2023
APCE PROJECT #2023007

PREPARED FOR:
SUNRISE HILLS SUBDIVISION
22XX SAPP ROAD SW
TUMWATER, WA 98512
PARCEL #12827330000

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PRELIMINARY SUNRISE HILLS SUBDIVISION STORMWATER SITE PLAN

SECTION 1 – PROPOSED PROJECT DESCRIPTION

This report accompanies the drainage review plan prepared for the Sunrise Hills Subdivision project on parcel number 12827330000 in Tumwater, Washington, at 22XX Sapp Road SW which has the following legal description: Lot 5 of Section 27, Township 18 North, Range 2 West, W.M., except the south 528 feet of the east 330 feet and except county road known as Sapp Road along the south boundary in Thurston County, Washington.

The project has been designed to meet the requirements of the 2022 City of Tumwater Drainage and Erosion Control Manual (TDECM).

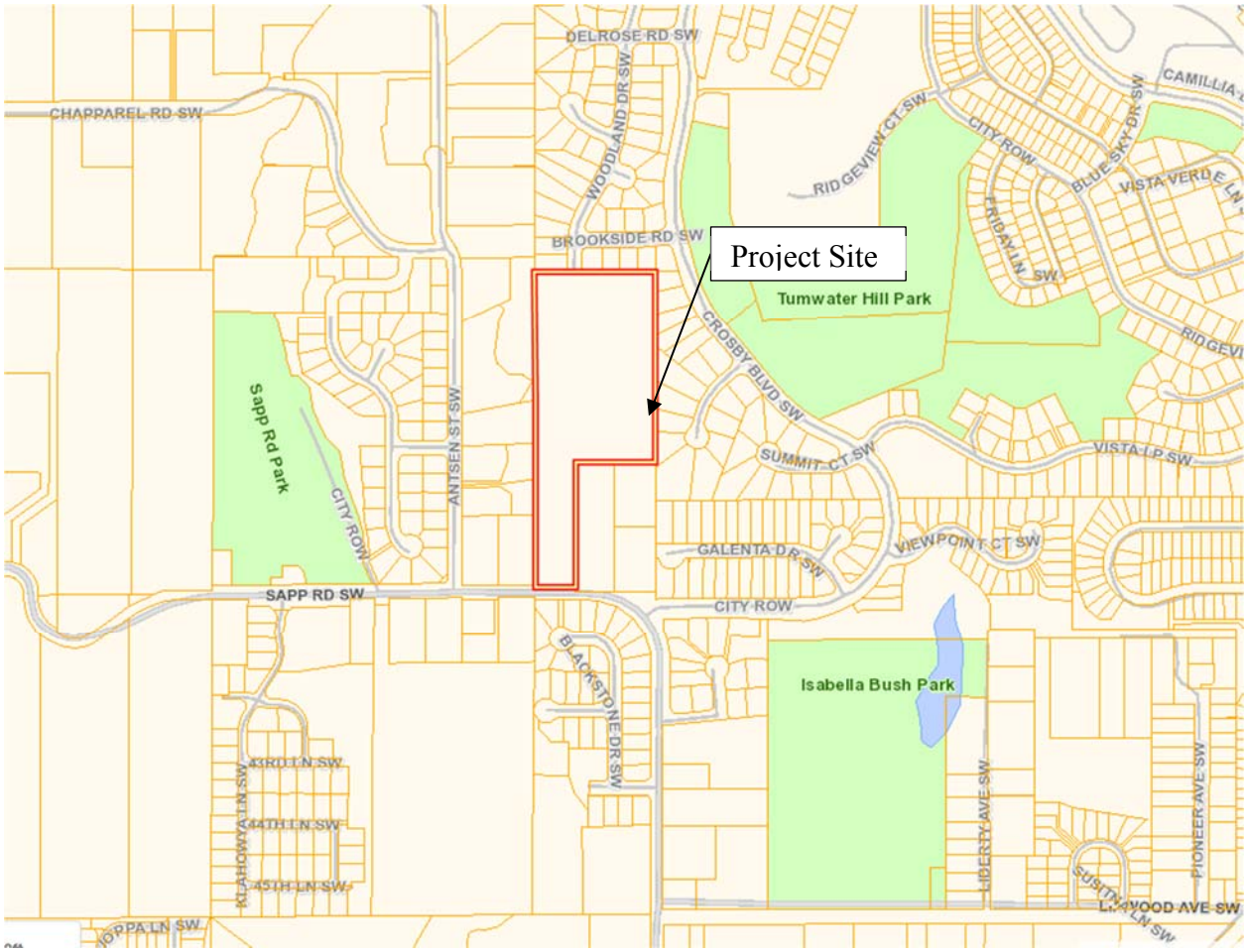


FIGURE 1 – Vicinity Map

The existing 10.7-acre site is a residential lot with no existing improvements. The neighboring parcels on all sides are residential lots, some of which are developed and some of which are not. The south edge of the property has frontage on Sapp Road SW and the north edge of the property is intersected by Woodland Drive SW.

The project will consist of the construction of infrastructure improvements to support a new 36-lot subdivision which is expected to include two new public roads, multiple shared private accesses, and utility improvements. Stormwater runoff from the proposed project will be infiltrated on-site in an infiltration pond.

All minimum requirements will need to be applied to all new and replaced hard surfaces and converted vegetation areas for this project, given that this property does not contain 35% or more of existing impervious coverage, and will result in 5,000 square feet, or more, of new plus replaced hard surface area, based on Figure 2.1 of Volume I of the 2022 City of Tumwater Drainage and Erosion Control Manual. Discussion of project minimum requirements follows.

Minimum Requirement #1: Preparation of a Stormwater Site Plan
This document has been prepared in order to comply with the requirement to provide a Stormwater Site Plan.

Minimum Requirement #2: Construction Stormwater Pollution Prevention
This project results in greater than 2,000 square feet of new and replaced impervious surface and therefore, requires a Construction SWPPP. A Construction SWPPP will be prepared and included in Appendix B at the time of the final plat engineering permit application.

Minimum Requirement #3: Source Control of Pollution
All known, available, and reasonable source control BMPs will be included in Appendix A of this report at the time of the final plat engineering permit application as information for the property owners.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
Under existing conditions stormwater runoff sheet flows generally towards the southern and western edge of the property. Stormwater collected from the proposed improvements will be fully infiltrated on-site.

Minimum Requirement #5: On-Site Stormwater Management
This project proposes to infiltrate 100% of runoff in order to meet the LID performance standards outlined in Section 2.4.6 or the 2022 City of Tumwater Drainage and Erosion Control Manual.

Minimum Requirement #6: Runoff Treatment
The project will provide runoff treatment in compliance with Minimum Requirement #6 since there will be more than 5,000 square feet of effective pollution-generating impervious surface. A 12'x24' Oldcastle BioPod will be installed upstream of infiltration and will treat all runoff.

Minimum Requirement #7: Flow Control
This project results in greater than 10,000 square feet of impervious surface and therefore, requires flow control. The project will provide flow control facilities that will be designed to infiltrate 100% of stormwater runoff.

Minimum Requirement #8: Wetlands Protection
There are no known wetlands on this project site or on any of the neighboring lots. Also, the project does not, to the best of our knowledge, discharge to a wetland.

Minimum Requirement #9: Operation and Maintenance
An operation & maintenance manual will be included in Appendix A of this report at the time of the final plat engineering permit application that meets the requirements of the City's stormwater manual.

Minimum Requirement #10: Financial Liability
Required bonds will be obtained prior to project approval during the site final plat engineering permit process.

Minimum Requirement #11: Off-Site Analysis
An off-site analysis has been completed and is included in Section 3 of this report.

SECTION 2 - EXISTING CONDITIONS DESCRIPTION

The existing cover on the site consists almost entirely of forested and vegetated land. Slopes vary across the site and range from around 5% to around 50% with a few small areas exceeding 50%, but predominantly slope southwest. It is possible that stormwater may enter the site from the neighboring parcels to the north and the east along the property line, but no concentrated points of discharge to this site are known to exist. Existing stormwater runoff from the site sheet flows across the existing vegetation and leaves the property across the western and southern property lines.

No utilities are known to exist on the property. Public water, sewer, and stormwater utilities exist immediately adjacent to the property.

On-site soils in the proposed infiltration area are identified by Parnell Engineering, LLC as Indianola loamy sand. A copy of the geotechnical report is included in Appendix D.

Based on surveyed topography steep slopes appear to be present on-site and publicly available GIS identifies potential landslide hazard areas on-site. No additional sensitive or critical areas are known to exist on or immediately adjacent to the property. No fuel tanks are known to exist on the property. No septic systems are known to exist on or within 100 feet of the property. No superfund areas are known to exist in the vicinity of the project. No basin plans are known to exist that would affect the property. No basin

plans, flood studies, groundwater studies, wetland designations, sensitive area designations, environmental impact statements, environmental checklists, lake restoration plans, or water quality reports are known to have impacts for this property, at this time. No 100-year flood hazard zones are known to impact the property. No wellhead protection areas are known to exist on the property.

The existing conditions for the basin are summarized in the table in Chapter 4 of this report.

SECTION 3 – VICINITY ANALYSIS & SUBBASIN DESCRIPTION

Downstream Basin of Threshold Discharge Area:

A downstream analysis has been prepared using information from Thurston County GIS.

Stormwater will be collected and infiltrated on-site. Runoff from small portions of the site that may not be possible to collect, or from the infiltration system in the event of an overflow, will discharge from the south and/or west edge of the site as it does under existing conditions. Runoff will continue to sheet flow until it reaches Sapp Road SW. From the southwest corner of the property runoff will flow in a series of ditches and culverts for about 820 feet along the north side of Sapp Road SW until it reaches Percival Creek. It will then flow north in Percival Creek until it has reached a point one-quarter of a mile downstream of the project site.

No existing or potential constrictions, capacity deficiencies, flooding problems, overtopping, scouring, bank sloughing, sedimentation, significant destruction of aquatic habitat (e.g., siltation, stream incision), public or private easements could be observed or are known to exist along the downstream drainage system.

A downstream map will be provided in Appendix F.

Upstream Tributary Basin:

Run-on from the undeveloped parcels to the east is proposed to be routed around site to the existing conveyance system in the right-of-way. Due to topography, run-on from the south and west is not expected. Run-on from the developed parcels to the north and east is not expected to be significant because the existing development was constructed with stormwater controls in place. There are no known concentrated run-on flows to the site from the adjacent properties.

CHAPTER 4 – FLOW CONTROL & WATER QUALITY FACILITY SIZING

Threshold Discharge Areas

There is one threshold discharge area for this project, which encompasses 466,977 square feet of the project site. A Threshold Discharge Area Table will be included in Appendix C of this report.

Predeveloped Site Hydrology

Cover characteristics for the existing and historic conditions of the project site are as summarized in the table below.

TABLE 1: PREDEVELOPED CONDITIONS

	Description	Area (ft^2)	Total (ft^2)
Pervious	Forest	466,977	466,977
		Total	466,977

Developed Site Hydrology

Project Summary

Site cover characteristics for the proposed improvements to the project site and all relevant basins, both on-site and off-site, are summarized in the tables below and a basin map will eventually be included in Appendix C.

TABLE 2: DEVELOPED CONDITIONS

	Description	Area (ft^2)	Total (ft^2)
Impervious	On-site Infrastructure	50,929	168,664
	On-site Residential	110,287	
	Pond	7,448	
Pervious	On-site Landscaping	165,440	165,440
		Total	334,104

The entire property is currently forested. On-site stormwater management BMPs will be applied, as feasible, to this project. This project contains no significant sub-basins.

Based on Section 2.4.6 of the TDECM, because the project triggers Minimum Requirements 1 through 11 and will meet the LID Performance Standard by infiltrating all runoff, this project will not be required to implement BMPs for on-site stormwater management.

On-Site Stormwater Management System – Minimum Requirement #5
BMP feasibility will be discussed at a later stage of this project. No BMP credits have currently been applied towards reducing the size of the proposed infiltration pond.

Water Quality System – Minimum Requirement #6
The project will provide water quality treatment since there will be more than 5,000 square feet of new or replaced effective pollution-generating impervious surfaces constructed as part of the project.

The project's receiving water is Percival Creek to the west of the property. There are no Category 5 - 303d-listed waterbodies within one quarter of a mile downstream of the property.

The proposed development is a single-family residential development and is, therefore, not included in the list of types of areas that "typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil" which are required to provide oil control facilities.

Due to soil characteristics, it is not practicable to provide runoff treatment by infiltrating into the native soil. A 12'x24' Oldcastle BioPod will be installed upstream of infiltration to provide water quality treatment. The BioPod has a maximum treatment flowrate of 0.860 cfs, greater than the water quality flowrate calculated with WWHM, at 0.748 cfs.

The project is not known to be located in a watershed that has been determined to be sensitive to phosphorus or are being managed to control phosphorus and, therefore, no phosphorus treatment BMPs are required for this project.

Because the project is a single-family residential development, it is not included in the list of project types that require enhanced treatment BMPs.

Flow Control System – Minimum Requirement #7
This project has been designed to meet the Flow Control Performance Standard. Developed discharge durations will match predeveloped durations over the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.

Under developed conditions, the site is anticipated to have the following proposed surfaces: the future residential lot impervious (110,287 square feet; 2.532 acres), on-site infrastructure improvements impervious (50,929 square feet; 1.169 acres), pond surface (7,448 square feet; 0.171 acres), and on-site landscaping area (165,440 square feet; 3.798 acres). The Post-Construction Soil Quality and Depth BMP (BMP T5.13), as detailed in Chapter 6 of Volume V of the TDECM, will be applied to all new lawn and landscaping areas and, therefore, these areas will be modeled as pasture in WWHM.

TABLE 3: WWHM INPUTS

WWHM Inputs	Total (ac)	Modeled as			
		Impervious (ac)	Lawn (ac)	Pasture (ac)	Forest (ac)
ON-SITE TO POND					
Residential Lot Impervious	2.532	2.532	0.000	0.000	0.000
On-site Infrastructure	1.169	0.193	0.000	0.000	0.000
On-site Landscaping	3.798	0.000	0.000	3.798	0.000
Pond Water Surface	0.171	0.171	0.000	0.000	0.000
TOTAL	**1.588**	**1.105**	**0.000**	**3.798**	**0.000**

The infiltration facility is designed to provide a live storage volume of 27,225 cubic feet (0.625-acre feet) at a storage depth of 4.5 feet. Detailed WWHM results are included in Appendix C.

The Geotechnical report prepared by Parnell Engineering, LLC identified the depths of un-infiltratable soils at several locations around the proposed pond. Soil log #1 is the only one located within the extents of the pond. This layer was found at an elevation of 165.83 feet. In order to maintain 3 feet of separation from the pond bottom to this layer, the infiltration pond was designed to have a bottom elevation of 168.85 feet. This was the highest elevation that un-infiltratable soils was observed at, which was similar to soil log #5, where the ground surface is two feet higher and which is just slightly north of where the pond will be installed. Based on this information, the entire pond bottom is expected to be above the impermeable layer. This report is included in Appendix D.

SECTION 5 – AESTHETIC CONSIDERATIONS FOR FACILITIES

A stormwater infiltration pond will be utilized for stormwater mitigation. All relevant City of Tumwater landscaping, setback, and screening requirements will be met. More detailed consideration of the aesthetics of the proposed facilities will be addressed that the time of the final plat engineering permit application.

SECTION 6 – CONVEYANCE SYSTEM ANALYSIS & DESIGN

All new conveyance pipe will have capacity to convey the on-site 100-year peak runoff rate through them. Detailed calculations using the current WWHM Model will be provided at the time of the final plat engineering permit application.

SECTION 7 – COVENANTS, DEDICATIONS, EASEMENTS

All applicable covenants, dedications, and easements will be finalized as part of the final plat engineering permit application.

SECTION 8 – AGREEMENTS & GUARANTEES

Maintenance, operation bonding, and other financial guarantees are required and will be provided at the time of the final plat engineering permit application.

SECTION 9 – OTHER PERMITS OR CONDITIONS PLACE ON THE PROJECT

No additional permits or conditions are known to have been placed on the project at this time.

APPENDIX C:
HYDRAULIC /HYDROLOGIC ANALYSIS AND MODELING RESULTS

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Sunrise Hills infiltration
Site Name:	
Site Address:	
City:	
Report Date:	2/15/2023
Gage:	Courthouse
Data Start:	1955/10/01
Data End:	2011/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Forest, Mod	7.499
Pervious Total	7.499
Impervious Land Use	acre
Impervious Total	0
Basin Total	7.499

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Pasture, Mod	3.798
Pervious Total	3.798

Impervious Land Use	acre
ROADS MOD	2.013
ROOF TOPS FLAT	1.688
Impervious Total	3.701
Basin Total	7.499

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 58.00 ft.
Bottom Width: 80.00 ft.
Depth: 6 ft.
Volume at riser head: 0.6245 acre-feet.
Infiltration On
Infiltration rate: 8.64
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 750.452
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 750.452
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 4.5 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

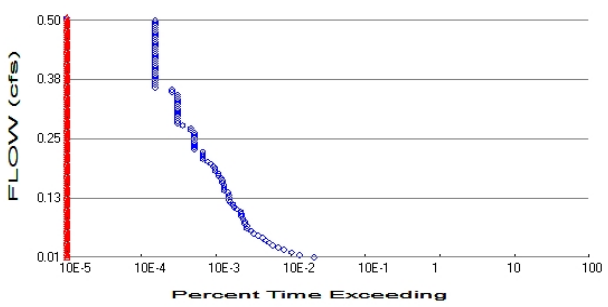
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.106	0.000	0.000	0.000
0.0667	0.107	0.007	0.000	0.928
0.1333	0.108	0.014	0.000	0.928
0.2000	0.109	0.021	0.000	0.928
0.2667	0.109	0.028	0.000	0.928
0.3333	0.110	0.036	0.000	0.928
0.4000	0.111	0.043	0.000	0.928
0.4667	0.112	0.051	0.000	0.928
0.5333	0.113	0.058	0.000	0.928
0.6000	0.114	0.066	0.000	0.928
0.6667	0.115	0.073	0.000	0.928
0.7333	0.116	0.081	0.000	0.928
0.8000	0.116	0.089	0.000	0.928
0.8667	0.117	0.097	0.000	0.928
0.9333	0.118	0.105	0.000	0.928
1.0000	0.119	0.113	0.000	0.928
1.0667	0.120	0.121	0.000	0.928
1.1333	0.121	0.129	0.000	0.928
1.2000	0.122	0.137	0.000	0.928
1.2667	0.123	0.145	0.000	0.928
1.3333	0.124	0.153	0.000	0.928
1.4000	0.125	0.161	0.000	0.928
1.4667	0.125	0.170	0.000	0.928
1.5333	0.126	0.178	0.000	0.928
1.6000	0.127	0.187	0.000	0.928
1.6667	0.128	0.195	0.000	0.928
1.7333	0.129	0.204	0.000	0.928

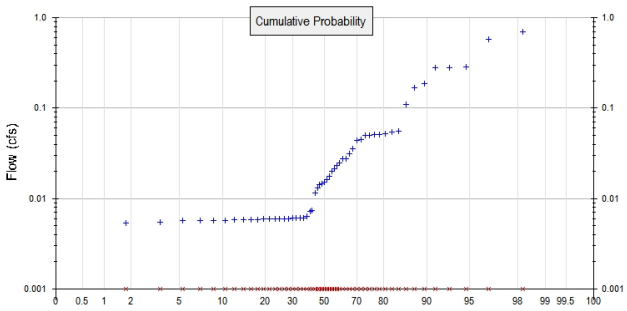
1.8000	0.130	0.213	0.000	0.928
1.8667	0.131	0.221	0.000	0.928
1.9333	0.132	0.230	0.000	0.928
2.0000	0.133	0.239	0.000	0.928
2.0667	0.134	0.248	0.000	0.928
2.1333	0.135	0.257	0.000	0.928
2.2000	0.136	0.266	0.000	0.928
2.2667	0.137	0.275	0.000	0.928
2.3333	0.138	0.284	0.000	0.928
2.4000	0.139	0.293	0.000	0.928
2.4667	0.140	0.303	0.000	0.928
2.5333	0.141	0.312	0.000	0.928
2.6000	0.142	0.321	0.000	0.928
2.6667	0.142	0.331	0.000	0.928
2.7333	0.143	0.341	0.000	0.928
2.8000	0.144	0.350	0.000	0.928
2.8667	0.145	0.360	0.000	0.928
2.9333	0.146	0.370	0.000	0.928
3.0000	0.147	0.379	0.000	0.928
3.0667	0.148	0.389	0.000	0.928
3.1333	0.149	0.399	0.000	0.928
3.2000	0.150	0.409	0.000	0.928
3.2667	0.151	0.419	0.000	0.928
3.3333	0.152	0.430	0.000	0.928
3.4000	0.153	0.440	0.000	0.928
3.4667	0.154	0.450	0.000	0.928
3.5333	0.155	0.460	0.000	0.928
3.6000	0.156	0.471	0.000	0.928
3.6667	0.157	0.481	0.000	0.928
3.7333	0.158	0.492	0.000	0.928
3.8000	0.160	0.503	0.000	0.928
3.8667	0.161	0.513	0.000	0.928
3.9333	0.162	0.524	0.000	0.928
4.0000	0.163	0.535	0.000	0.928
4.0667	0.164	0.546	0.000	0.928
4.1333	0.165	0.557	0.000	0.928
4.2000	0.166	0.568	0.000	0.928
4.2667	0.167	0.579	0.000	0.928
4.3333	0.168	0.590	0.000	0.928
4.4000	0.169	0.601	0.000	0.928
4.4667	0.170	0.613	0.000	0.928
4.5333	0.171	0.624	0.064	0.928
4.6000	0.172	0.636	0.333	0.928
4.6667	0.173	0.647	0.703	0.928
4.7333	0.174	0.659	1.115	0.928
4.8000	0.175	0.670	1.509	0.928
4.8667	0.176	0.682	1.834	0.928
4.9333	0.178	0.694	2.060	0.928
5.0000	0.179	0.706	2.227	0.928
5.0667	0.180	0.718	2.371	0.928
5.1333	0.181	0.730	2.506	0.928
5.2000	0.182	0.742	2.635	0.928
5.2667	0.183	0.754	2.757	0.928
5.3333	0.184	0.766	2.875	0.928
5.4000	0.185	0.779	2.988	0.928
5.4667	0.186	0.791	3.096	0.928
5.5333	0.187	0.804	3.201	0.928
5.6000	0.189	0.816	3.303	0.928

5.6667	0.190	0.829	3.402	0.928
5.7333	0.191	0.842	3.497	0.928
5.8000	0.192	0.854	3.591	0.928
5.8667	0.193	0.867	3.682	0.928
5.9333	0.194	0.880	3.770	0.928
6.0000	0.195	0.893	3.857	0.928
6.0667	0.196	0.906	3.942	0.928

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 7.499
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 3.798
Total Impervious Area: 3.701

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.017446
5 year	0.059517
10 year	0.122538
25 year	0.281964
50 year	0.500502
100 year	0.859172

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	0.028	0.000
1957	0.007	0.000
1958	0.023	0.000
1959	0.016	0.000
1960	0.053	0.000
1961	0.044	0.000
1962	0.006	0.000
1963	0.050	0.000
1964	0.050	0.000
1965	0.051	0.000

1966	0.006	0.000
1967	0.280	0.000
1968	0.045	0.000
1969	0.006	0.000
1970	0.007	0.000
1971	0.056	0.000
1972	0.581	0.000
1973	0.006	0.000
1974	0.169	0.000
1975	0.006	0.000
1976	0.027	0.000
1977	0.006	0.000
1978	0.015	0.000
1979	0.006	0.000
1980	0.013	0.000
1981	0.035	0.000
1982	0.025	0.000
1983	0.021	0.000
1984	0.187	0.000
1985	0.006	0.000
1986	0.012	0.000
1987	0.052	0.000
1988	0.006	0.000
1989	0.006	0.000
1990	0.054	0.000
1991	0.286	0.000
1992	0.006	0.000
1993	0.015	0.000
1994	0.005	0.000
1995	0.006	0.000
1996	0.707	0.000
1997	0.006	0.000
1998	0.006	0.000
1999	0.018	0.000
2000	0.006	0.000
2001	0.005	0.000
2002	0.020	0.000
2003	0.014	0.000
2004	0.281	0.000
2005	0.005	0.000
2006	0.006	0.000
2007	0.111	0.000
2008	0.006	0.000
2009	0.006	0.000
2010	0.006	0.000
2011	0.031	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.7068	0.0000
2	0.5811	0.0000
3	0.2863	0.0000
4	0.2807	0.0000
5	0.2797	0.0000
6	0.1867	0.0000
7	0.1691	0.0000
8	0.1107	0.0000

9	0.0558	0.0000
10	0.0543	0.0000
11	0.0527	0.0000
12	0.0516	0.0000
13	0.0511	0.0000
14	0.0502	0.0000
15	0.0498	0.0000
16	0.0455	0.0000
17	0.0437	0.0000
18	0.0354	0.0000
19	0.0315	0.0000
20	0.0278	0.0000
21	0.0274	0.0000
22	0.0246	0.0000
23	0.0233	0.0000
24	0.0213	0.0000
25	0.0200	0.0000
26	0.0175	0.0000
27	0.0161	0.0000
28	0.0150	0.0000
29	0.0145	0.0000
30	0.0144	0.0000
31	0.0132	0.0000
32	0.0116	0.0000
33	0.0073	0.0000
34	0.0072	0.0000
35	0.0064	0.0000
36	0.0060	0.0000
37	0.0060	0.0000
38	0.0060	0.0000
39	0.0060	0.0000
40	0.0060	0.0000
41	0.0060	0.0000
42	0.0059	0.0000
43	0.0059	0.0000
44	0.0059	0.0000
45	0.0059	0.0000
46	0.0059	0.0000
47	0.0058	0.0000
48	0.0058	0.0000
49	0.0058	0.0000
50	0.0058	0.0000
51	0.0058	0.0000
52	0.0057	0.0000
53	0.0057	0.0000
54	0.0055	0.0000
55	0.0053	0.0000
56	0.0051	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0087	405	0	0	Pass
0.0137	256	0	0	Pass
0.0187	200	0	0	Pass
0.0236	160	0	0	Pass
0.0286	132	0	0	Pass
0.0336	113	0	0	Pass
0.0385	102	0	0	Pass
0.0435	91	0	0	Pass
0.0485	83	0	0	Pass
0.0534	72	0	0	Pass
0.0584	63	0	0	Pass
0.0634	58	0	0	Pass
0.0683	51	0	0	Pass
0.0733	51	0	0	Pass
0.0783	47	0	0	Pass
0.0832	47	0	0	Pass
0.0882	45	0	0	Pass
0.0932	43	0	0	Pass
0.0981	43	0	0	Pass
0.1031	42	0	0	Pass
0.1081	37	0	0	Pass
0.1130	34	0	0	Pass
0.1180	33	0	0	Pass
0.1230	30	0	0	Pass
0.1279	29	0	0	Pass
0.1329	29	0	0	Pass
0.1379	29	0	0	Pass
0.1428	28	0	0	Pass
0.1478	25	0	0	Pass
0.1528	25	0	0	Pass
0.1577	25	0	0	Pass
0.1627	24	0	0	Pass
0.1677	24	0	0	Pass
0.1726	23	0	0	Pass
0.1776	21	0	0	Pass
0.1826	21	0	0	Pass
0.1876	19	0	0	Pass
0.1925	19	0	0	Pass
0.1975	18	0	0	Pass
0.2025	17	0	0	Pass
0.2074	15	0	0	Pass
0.2124	13	0	0	Pass
0.2174	13	0	0	Pass
0.2223	13	0	0	Pass
0.2273	13	0	0	Pass
0.2323	10	0	0	Pass
0.2372	10	0	0	Pass
0.2422	10	0	0	Pass
0.2472	10	0	0	Pass
0.2521	10	0	0	Pass
0.2571	10	0	0	Pass
0.2621	10	0	0	Pass
0.2670	10	0	0	Pass

0.2720	9	0	0	Pass
0.2770	9	0	0	Pass
0.2819	7	0	0	Pass
0.2869	6	0	0	Pass
0.2919	6	0	0	Pass
0.2968	6	0	0	Pass
0.3018	6	0	0	Pass
0.3068	6	0	0	Pass
0.3117	6	0	0	Pass
0.3167	6	0	0	Pass
0.3217	6	0	0	Pass
0.3266	6	0	0	Pass
0.3316	6	0	0	Pass
0.3366	6	0	0	Pass
0.3415	6	0	0	Pass
0.3465	6	0	0	Pass
0.3515	5	0	0	Pass
0.3564	5	0	0	Pass
0.3614	3	0	0	Pass
0.3664	3	0	0	Pass
0.3713	3	0	0	Pass
0.3763	3	0	0	Pass
0.3813	3	0	0	Pass
0.3863	3	0	0	Pass
0.3912	3	0	0	Pass
0.3962	3	0	0	Pass
0.4012	3	0	0	Pass
0.4061	3	0	0	Pass
0.4111	3	0	0	Pass
0.4161	3	0	0	Pass
0.4210	3	0	0	Pass
0.4260	3	0	0	Pass
0.4310	3	0	0	Pass
0.4359	3	0	0	Pass
0.4409	3	0	0	Pass
0.4459	3	0	0	Pass
0.4508	3	0	0	Pass
0.4558	3	0	0	Pass
0.4608	3	0	0	Pass
0.4657	3	0	0	Pass
0.4707	3	0	0	Pass
0.4757	3	0	0	Pass
0.4806	3	0	0	Pass
0.4856	3	0	0	Pass
0.4906	3	0	0	Pass
0.4955	3	0	0	Pass
0.5005	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.6403 acre-feet
On-line facility target flow:	0.7971 cfs.
Adjusted for 15 min:	0.7971 cfs.
Off-line facility target flow:	0.4467 cfs.
Adjusted for 15 min:	0.4467 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Trapezoidal Pond 1 POC	☐	682.91			☐	100.00			
Total Volume Infiltrated		682.91	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

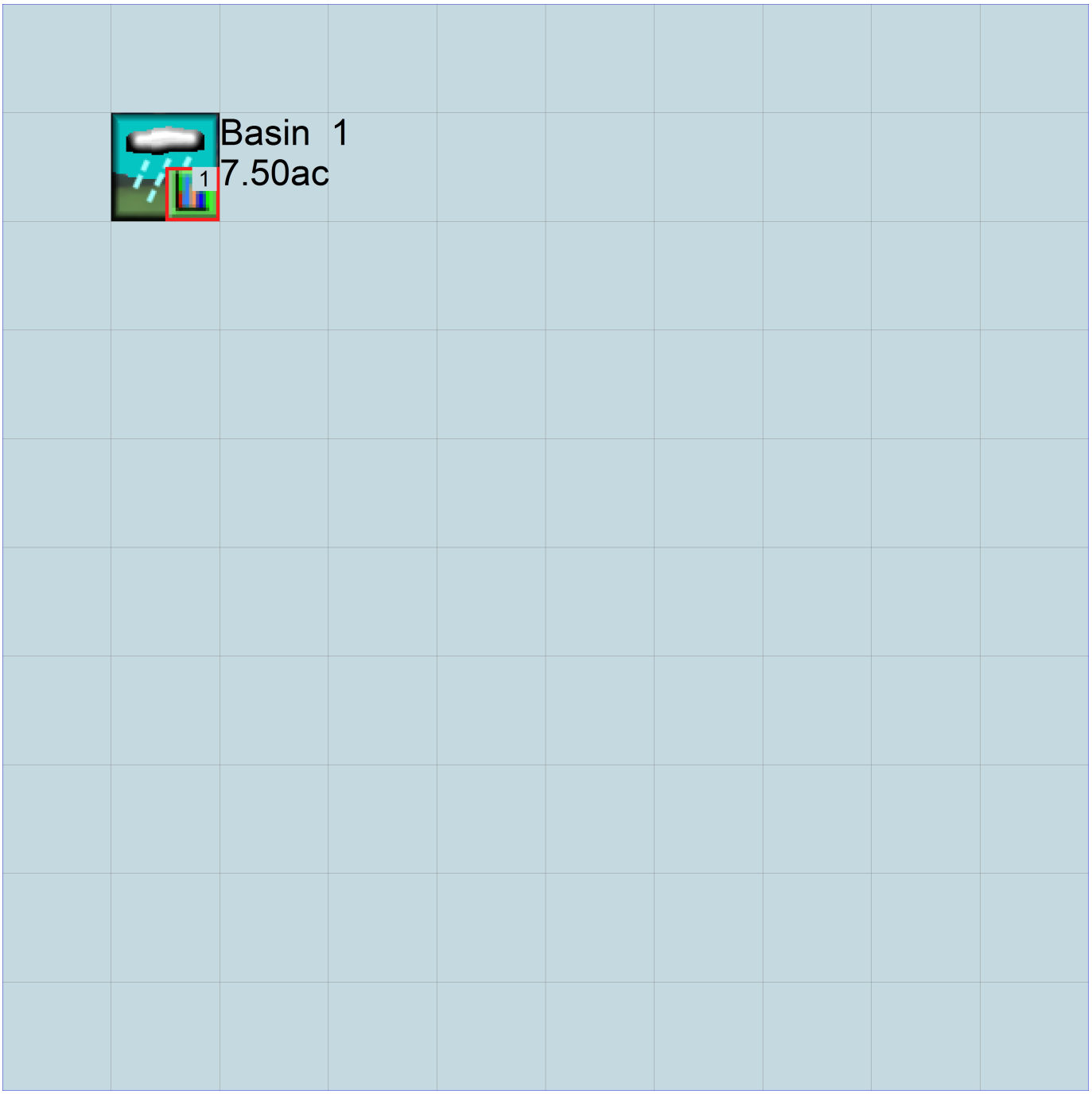
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2011 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Sunrise Hills infiltration.wdm
MESSU       25   PreSunrise Hills infiltration.MES
            27   PreSunrise Hills infiltration.L61
            28   PreSunrise Hills infiltration.L62
            30   POCSunrise Hills infiltration1.dat
END FILES

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

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2               0         5         2       400       0.1       0.3     0.996
  END PWAT-PARM2

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

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    2              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   2                       7.499     COPY   501     12
PERLND   2                       7.499     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

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

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2011 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Sunrise Hills infiltration.wdm
MESSU       25   MitSunrise Hills infiltration.MES
            27   MitSunrise Hills infiltration.L61
            28   MitSunrise Hills infiltration.L62
            30   POCSunrise Hills infiltration1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       5
      IMPLND       2
      IMPLND       4
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    5     A/B, Pasture, Mod       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    5         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    5         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    5         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    5             0         5       1.5       400       0.1       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    5             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    5          0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    5             0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2      ROADS/MOD              1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
    4         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
    4         0    0    0    0    0
  END IWAT-PARM1

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

```
    2            400      0.05       0.1      0.08
    4            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
    4              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
    4              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   5                       3.798     RCHRES   1      2
PERLND   5                       3.798     RCHRES   1      3
IMPLND   2                       2.013     RCHRES   1      5
IMPLND   4                       1.688     RCHRES   1      5

******Routing******
PERLND   5                       3.798     COPY     1     12
IMPLND   2                       2.013     COPY     1     15
IMPLND   4                       1.688     COPY     1     15
PERLND   5                       3.798     COPY     1     13
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
    1     Trapezoidal Pond-007    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *      *  *  *  *  *         ***
    1       0  1  0  0    4  5  0  0  0       0  0  0  0  0         2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.106520  0.000000  0.000000  0.000000
  0.066667  0.107366  0.007130  0.000000  0.928000
  0.133333  0.108216  0.014316  0.000000  0.928000
  0.200000  0.109069  0.021558  0.000000  0.928000
  0.266667  0.109925  0.028858  0.000000  0.928000
  0.333333  0.110785  0.036215  0.000000  0.928000
  0.400000  0.111647  0.043630  0.000000  0.928000
  0.466667  0.112513  0.051102  0.000000  0.928000
  0.533333  0.113383  0.058632  0.000000  0.928000
  0.600000  0.114255  0.066219  0.000000  0.928000
  0.666667  0.115131  0.073866  0.000000  0.928000
  0.733333  0.116010  0.081570  0.000000  0.928000
  0.800000  0.116893  0.089334  0.000000  0.928000
  0.866667  0.117778  0.097156  0.000000  0.928000
  0.933333  0.118667  0.105038  0.000000  0.928000
  1.000000  0.119559  0.112979  0.000000  0.928000
  1.066667  0.120455  0.120979  0.000000  0.928000
  1.133333  0.121353  0.129039  0.000000  0.928000
  1.200000  0.122255  0.137160  0.000000  0.928000
  1.266667  0.123160  0.145340  0.000000  0.928000
  1.333333  0.124069  0.153581  0.000000  0.928000
  1.400000  0.124981  0.161883  0.000000  0.928000
  1.466667  0.125896  0.170245  0.000000  0.928000
  1.533333  0.126814  0.178669  0.000000  0.928000
  1.600000  0.127736  0.187154  0.000000  0.928000
  1.666667  0.128660  0.195700  0.000000  0.928000
  1.733333  0.129588  0.204309  0.000000  0.928000
  1.800000  0.130520  0.212979  0.000000  0.928000
  1.866667  0.131454  0.221711  0.000000  0.928000
  1.933333  0.132392  0.230506  0.000000  0.928000
  2.000000  0.133333  0.239364  0.000000  0.928000
  2.066667  0.134278  0.248284  0.000000  0.928000
  2.133333  0.135225  0.257268  0.000000  0.928000
  2.200000  0.136176  0.266314  0.000000  0.928000
  2.266667  0.137130  0.275425  0.000000  0.928000
  2.333333  0.138088  0.284599  0.000000  0.928000
  2.400000  0.139049  0.293836  0.000000  0.928000
  2.466667  0.140013  0.303139  0.000000  0.928000
  2.533333  0.140980  0.312505  0.000000  0.928000
  2.600000  0.141950  0.321936  0.000000  0.928000
  2.666667  0.142924  0.331432  0.000000  0.928000
  2.733333  0.143901  0.340993  0.000000  0.928000
```

```
  2.800000  0.144882  0.350619  0.000000  0.928000
  2.866667  0.145865  0.360310  0.000000  0.928000
  2.933333  0.146852  0.370067  0.000000  0.928000
  3.000000  0.147842  0.379891  0.000000  0.928000
  3.066667  0.148835  0.389780  0.000000  0.928000
  3.133333  0.149832  0.399735  0.000000  0.928000
  3.200000  0.150832  0.409758  0.000000  0.928000
  3.266667  0.151835  0.419846  0.000000  0.928000
  3.333333  0.152842  0.430002  0.000000  0.928000
  3.400000  0.153851  0.440225  0.000000  0.928000
  3.466667  0.154864  0.450516  0.000000  0.928000
  3.533333  0.155880  0.460874  0.000000  0.928000
  3.600000  0.156900  0.471300  0.000000  0.928000
  3.666667  0.157923  0.481794  0.000000  0.928000
  3.733333  0.158949  0.492357  0.000000  0.928000
  3.800000  0.159978  0.502988  0.000000  0.928000
  3.866667  0.161011  0.513687  0.000000  0.928000
  3.933333  0.162046  0.524456  0.000000  0.928000
  4.000000  0.163085  0.535293  0.000000  0.928000
  4.066667  0.164128  0.546201  0.000000  0.928000
  4.133333  0.165173  0.557177  0.000000  0.928000
  4.200000  0.166222  0.568224  0.000000  0.928000
  4.266667  0.167274  0.579340  0.000000  0.928000
  4.333333  0.168330  0.590527  0.000000  0.928000
  4.400000  0.169388  0.601784  0.000000  0.928000
  4.466667  0.170450  0.613112  0.000000  0.928000
  4.533333  0.171516  0.624511  0.064540  0.928000
  4.600000  0.172584  0.635981  0.333520  0.928000
  4.666667  0.173656  0.647522  0.703432  0.928000
  4.733333  0.174731  0.659135  1.115035  0.928000
  4.800000  0.175809  0.670820  1.509672  0.928000
  4.866667  0.176891  0.682577  1.834531  0.928000
  4.933333  0.177975  0.694406  2.060036  0.928000
  5.000000  0.179063  0.706307  2.227125  0.928000
  5.066667  0.180155  0.718281  2.370955  0.928000
  5.133333  0.181249  0.730328  2.506546  0.928000
  5.200000  0.182347  0.742447  2.635170  0.928000
  5.266667  0.183448  0.754641  2.757800  0.928000
  5.333333  0.184553  0.766907  2.875206  0.928000
  5.400000  0.185660  0.779248  2.988001  0.928000
  5.466667  0.186771  0.791662  3.096691  0.928000
  5.533333  0.187885  0.804151  3.201694  0.928000
  5.600000  0.189003  0.816714  3.303360  0.928000
  5.666667  0.190123  0.829351  3.401989  0.928000
  5.733333  0.191247  0.842064  3.497839  0.928000
  5.800000  0.192375  0.854851  3.591131  0.928000
  5.866667  0.193505  0.867714  3.682060  0.928000
  5.933333  0.194639  0.880652  3.770797  0.928000
  6.000000  0.195776  0.893666  3.857493  0.928000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1             PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76          PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76          IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
```

```
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

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

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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX D:
OTHER SPECIAL REPORTS

Sunrise Hills

Soils Report For Drainage Purposes

Site Address: Sapp Road SW, Tumwater, WA 98501
TPN: 12827330000

Prepared For: Chul Kim
454 Southwest 297th St.
Federal Way, WA 98023
206-835-6300
Contact: Chul Kim

Prepared By: Parnell Engineering,LLC
10623 Hunters Lane S.E.
Olympia, WA 98513
(360) 491-3243
Contact: William Parnell, P.E.

PE

PARNELL ENGINEERING,LLC

SOIL EVALUATION REPORT
FORM 1: GENERAL SITE INFORMATION

PROJECT TITLE: Sunrise Hills
PE PROJECT NO.:15112
PREPARED BY: William Parnell, P.E.

SHEET: 1 OF 2
DATE: 8/1/15

1. SITE ADDRESS: Sapp Road, Tumwater, WA 98501 TPN: 12827330000

2. PROJECT DESCRIPTION: Final Plat for 35 lot residential subdivision.

3. SITE DESCRIPTION: The 11~ acre project site is currently undeveloped. Site topography is nearly level to slightly sloping on the southwest portion of the site in the area of a proposed stormwater facility. Overall site relief varies in elevation from a low of 162 feet at the southwest property corner to a high of 300 feet along the northeastern property line with a general overall slope direction of northeast to southwest.

Site vegetation consists of a moderate density scotch bloom growth and field grass understory on the southern portion of the site with a conifer and deciduous forest covering the remaining site to the north.

The project site is bounded by developed residential property to the west, north and northeast, an undeveloped parcel to the southeast and Sapp Road SW to the south.

The on-site soils are mapped by the NRCS as a combination of Indianola loamy sand on the southern portion, an Everett very gravelly sandy loam on the central and northern portion and a Schneider very gravelly loam on the northeastern portion of the project site. The Indianola series soils mapped in the area of the proposed stormwater infiltration facility are generally very deep, somewhat excessively well drained soils formed in sandy glacial drift.

4. SUMMARY OF SOILS WORK PERFORMED: Six test pits were excavated by backhoe to a maximum depth of 234" below existing grade in the vicinity of a proposed stormwater infiltration facility. Soils were inspected by entering and visually logging each test pit to a depth of four feet. Soils beyond four feet were inspected by examining backhoe tailings. Falling head percolation tests were completed adjacent to test pits # 2, #3, #4 and #6. Test pit soil log data sheets and infiltration test results are included in this report.

5. ADDITIONAL SOILS WORK RECOMMENDED: Additional soils work should not be necessary unless drainage infiltration facilities are located outside the general area encompassed by the soil test pits.

6. FINDINGS: The Natural Resource Conservation Service soil survey for Thurston County mapped the on-site soils in the area of the proposed stormwater facility as an Indianola loamy sand (47). All test pits generally confirmed the Indianola series designation generally profiling a loamy fine sand surface soil overlying a fine to medium sand substratum. The substratum sands were slightly loose. Variations in the substratum soils consisted of silt loam horizons which will tend to impede infiltration rates when encountered.

Winter water table was not present and obvious indicators were not visible. A soils report completed by Pacific Rim Soil & Water in March 2004 indicated no presence of a long duration water table in the same general area to a depth of 168" below grade.

Falling head percolation tests completed adjacent to test pits #2 (85" below existing grade), #3 (85" below existing grade), #4 (82" below existing grade) and #6 (80" below existing grade) yielded infiltration rates of 57.6 in/hr, 65.45 in/hr, 12.41 in/hr and 102.9 in/hr respectively.

7. RECOMMENDATIONS: The Indianola soil series is a somewhat excessively drained soil that formed in sandy glacial drift. Infiltration rates are generally rapid in the substratum soils. The specified substratum C-horizon soils should be targeted for all stormwater point discharge infiltration facilities as noted in the attached soil log data sheets. Design infiltration rate calculations using adjusted infiltration rate formulas for I_{design} resulted in calculated I_{design} values of 8.35 in/hr for test pit #2, 9.49 in/hr for test pit #3, 1.8 in/hr for test pit #4 and 14.9 in/hr for test pit

#6. For stormwater infiltration facility design purposes, use a recommended average of the four test results for an $I_{design-ave} \leq 8.64$ in/hr.
I_{design} calculations assumed a separation depth of 3 feet above any underlying silt loam horizon, a facility width of 50 feet and an infiltration facility preceded by a specific water quality facility. Please refer to the attached soil logs, soil log location map and falling head percolation test results with I_{design} calculations.
During construction, care must be taken to prevent the erosion of exposed soils. Drainage facility infiltration surfaces must be properly protected from contamination by the fine-grained upper horizon soils and from compaction by construction site activities. Soils not properly protected will cause stormwater infiltration facilities to prematurely fail.

I hereby certify that I prepared this report, and conducted or supervised the performance of related work. I certify that I am qualified to do this work. I represent my work to be complete an accurate within the bounds of uncertainty inherent to the practice of soils science, and to be suitable for its intended use.

SIGNED: William Parnell

DATE: 8/1/15

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills PE PROJECT NO.:15112 PREPARED BY: William Parnell, P.E.			SHEET: 1 OF 6 DATE: 7/27/15	
SOIL LOG: #1 LOCATION: 50 ft. north and 35 ft. west of the southwest property corner				
1. TYPES OF TEST DONE: None	2. NRCS SOILS SERIES: Indianola (47)	3. LAND FORM: Terrace		
4. DEPOSITION HISTORY: Sandy Glacial Drift	5. HYDROLOGIC SOIL GROUP: A	6. DEPTH OF SEASONAL HW: Unknown		
7. CURRENT WATER DEPTH: Greater Than Bottom of Hole	8. DEPTH TO IMPERVIOUS LAYER: Greater than bottom of hole	9. MISCELLANEOUS: Gently Sloping		
10. POTENTIAL FOR:		Erosion	Runoff	Ponding
		Minimal	Slow	Minimal
11. SOIL STRATA DESCRIPTION: See Following chart				
12. SITE PERCOLATION RATE: See FSP				
13. FINDINGS & RECOMMENDATIONS: The horizons from 129"-234" were 0.5' – 1.0' thick lenses alternating between a massive silt loam and a massive fine sand. Infiltration will be restricted in the C3, C4, C5, C6 and C7+ horizons to 234".				

Soils Strata Description
Soil Log #1

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 3"	10YR4/2	LmFSa	<6	<3	<1	SG	-	-	-	mf	2-6	4
Bw	3"- 16"	10YR4/3	LmFSa	<6	<1	<1	SG	-	-	-	mf	2-6	6
BC	16"- 28"	10YR5/3	LmFSa	<6	-	<1	SG	-	-	-	ff	6-20	6
C1	28"- 38"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	ff	6-20	20
C2	38"- 68"	10YR5/1	MSa	<1	-	<1	SG	-	-	-	-	>20	20
C3	68"- 73"	10YR6/2	Lm	<25	-	<1	2SBK	-	-	-	-	.6-2.0	1
C4	73"-105"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	-	6-20	20
C5	105"-121"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	-	.6-2.0	0.6
C6	121"-129"	10YR5/1	FSa	<4	-	<1	SG	-	-	-	-	6-20	0.6
C7+	129"-234"	10YR5/2- 10YR5/1	SiLm FSa	<28 <5	- -	<1 <1	Mas Mas	- -	- -	- -	- -	.6-2.0 .6-2.0	0.6 0.6

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills
PE PROJECT NO.:15112
PREPARED BY: William Parnell, P.E.

SHEET: 2 OF 6
DATE: 7/27/15

SOIL LOG: #2
LOCATION: 130 ft. north and 25 ft. west of the southwest property corner

1. TYPES OF TEST DONE: Falling Head Percolation	2. NRCS SOILS SERIES: Indianola (47)	3. LAND FORM: Terrace
4. DEPOSITION HISTORY: Sandy Glacial Drift	5. HYDROLOGIC SOIL GROUP: A	6. DEPTH OF SEASONAL HW: Unknown
7. CURRENT WATER DEPTH: Greater Than Bottom of Hole	8. DEPTH TO IMPERVIOUS LAYER: Greater than bottom of hole	9. MISCELLANEOUS: Gently Sloping

10. POTENTIAL FOR:	Erosion	Runoff	Ponding
	Minimal	Slow	Minimal

11. SOIL STRATA DESCRIPTION: See Following chart

12. SITE PERCOLATION RATE: See FSP

13. FINDINGS & RECOMMENDATIONS: A falling head percolation test completed at 85" below the existing grade yielded an infiltration rate of 57.6 in/hr. Design infiltration rate calculations using adjusted infiltration rate formulas for Idesign resulted in a calculated Idesign = 8.35 in/hr. Use an average Idesign infiltration rate less than or equal to 8.64 in/hr for drainage infiltration facilities located in the C3 horizon soils (Idesign average for test pits #2, #3, #4 and #6). Infiltration will be restricted in the BC, C2, C4, C5 and C6 horizons.

Soils Strata Description
Soil Log #2

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 8"	10YR4/2	LmVFSa	<12	<3	<1	1SBK	-	-	-	fm	2-6	2
Bw	8"- 21"	10YR5/2	LmVFSa	<12	<1	<1	1SBK	-	-	-	fm	2-6	3
BC	21"- 38"	10YR6/4	Lm	<25	-	<1	2SBK	-	-	-	fm	2-6	2
C1	38"- 67"	10YR5/2	LmFSa	<12	-	<1	1SBK	-	-	-	fm	2-6	3
C2	67"- 77"	10YR5/4	SiLm	<28	-	<1	3SBK	F1F	-	-	fm	.6-2.0	0.6
C3	77"-146"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	-	6-20	Idesign = 8.35
C4	146"-168"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	=	.6-2.0	0.1
C5	168"-174"	10YR5/1	FSa	<4	-	<1	Mas	-	-	-	-	6-20	0.1
C6	174"-192"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	=	.6-2.0	0.1

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills PE PROJECT NO.:15112 PREPARED BY: William Parnell, P.E.			SHEET: 3 OF 6 DATE: 7/27/15	
SOIL LOG: #3 LOCATION: 125 ft. north and 100 ft. west of the southwest property corner				
1. TYPES OF TEST DONE: Falling Head Percolation	2. NRCS SOILS SERIES: Indianola (47)	3. LAND FORM: Terrace		
4. DEPOSITION HISTORY: Sandy Glacial Drift	5. HYDROLOGIC SOIL GROUP: A	6. DEPTH OF SEASONAL HW: Unknown		
7. CURRENT WATER DEPTH: Greater Than Bottom of Hole	8. DEPTH TO IMPERVIOUS LAYER: Greater than bottom of hole	9. MISCELLANEOUS: Gently Sloping		
10. POTENTIAL FOR:		Erosion	Runoff	Ponding
		Minimal	Slow	Minimal
11. SOIL STRATA DESCRIPTION: See Following chart				
12. SITE PERCOLATION RATE: See FSP				
13. FINDINGS & RECOMMENDATIONS: A falling head percolation test completed at 85" below the existing grade yielded an infiltration rate of 65.45 in/hr. Design infiltration rate calculations using adjusted infiltration rate formulas for Idesign resulted in a calculated Idesign = 9.49 in/hr. Use an average Idesign infiltration rate less than or equal to 8.64 in/hr for drainage infiltration facilities located in the C3, C4 and C5 horizon soils (Idesign average for test pits #2, #3, #4 and #6). The C2 horizon consisted of alternating lenses of VFSa and SiLm. Infiltration will be restricted in the C1, C2 and C6 horizons.				

Soils Strata Description
Soil Log #3

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 12"	10YR4/2	LmVFSa	<12	<3	<1	1SBK	-	-	-	mf	2-6	3
Bw	12"- 17"	10YR5/3	LmVFSa	<12	<1	<1	2SBK	-	-	-	ff	2-6	2
BC	17"- 36"	10YR5/2	LmVFSa	<12	-	<1	2SBK	-	-	-	ff	2-6	2
C1	36"- 55"	10YR6/2	Lm	<25	-	<1	2SBK	-	-	-	ff	.6-2.0	1
C2	55"- 75"	10YR5/1 10YR5/2	VFSa SiLm	<5 <25	- -	<1 <1	SG Mas	- -	- -	- -	- -	2-6 .6-2.0	1 0.6
C3	75"- 90"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	-	6-20	Idesign = 9.49
C4	90"-132"	10YR5/1	MSa	<1	-	<1	SG	-	-	-	-	>20	Idesign = 9.49
C5	132"-174"	10YR5/1	M-FSa	<1	-	<1	SG	-	-	-	-	6-20	Idesign = 9.49
C6	174"-192"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	=	.6-2.0	0.1

Too Far North of TRACK A

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills PE PROJECT NO.:15112 PREPARED BY: William Parnell, P.E.			SHEET: 4 OF 6 DATE: 7/27/15	
SOIL LOG: #4 LOCATION: 40 ft. north and 110 ft. west of the southwest property corner				
1. TYPES OF TEST DONE: Falling Head Percolation	2. NRCS SOILS SERIES: Indianola (47)	3. LAND FORM: Terrace		
4. DEPOSITION HISTORY: Sandy Glacial Drift	5. HYDROLOGIC SOIL GROUP: A	6. DEPTH OF SEASONAL HW: Unknown		
7. CURRENT WATER DEPTH: Greater Than Bottom of Hole	8. DEPTH TO IMPERVIOUS LAYER: Greater than bottom of hole	9. MISCELLANEOUS: Gently Sloping		
10. POTENTIAL FOR:		Erosion	Runoff	Ponding
		Minimal	Slow	Minimal
11. SOIL STRATA DESCRIPTION: See Following chart				
12. SITE PERCOLATION RATE: See FSP				
13. FINDINGS & RECOMMENDATIONS: A falling head percolation test completed at 82" below the existing grade yielded an infiltration rate of 12.41 in/hr. Design infiltration rate calculations using adjusted infiltration rate formulas for Idesign resulted in a calculated Idesign = 1.8 in/hr. Use an average Idesign infiltration rate less than or equal to 8.64 in/hr for drainage infiltration facilities located in the C4 horizon soils (Idesign average for test pits #2, #3, #4 and #6). Infiltration will be restricted in the C1, C3 and C5 horizons.				

Soils Strata Description
Soil Log #4

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 12"	10YR4/2	LmVFSa	<12	<3	<1	1SBK	-	-	-	mf	2-6	3
Bw	12"- 27"	10YR5/3	LmVFSa	<12	<1	<1	2SBK	-	-	-	fm	2-6	2
BC	27"- 44"	10YR5/2	LmVFSa	<12	-	<1	2SBK	-	-	-	fm	2-6	2
C1	44"- 54"	10YR6/2	Lm	<25	-	<1	2SBK	-	-	-	fm	.6-2.0	1
C2	54"- 66"	10YR5/2	LmFSa	<12	-	<1	1SBK	-	-	-	fm	2-6	3
C3	66"- 78"	10YR5/3	SiLm	<28	-	<1	3SBK	-	-	-	-	.6-2.0	0.1
C4	78"-174"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	-	6-20	Idesign = 1.8
C5	174"-192"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	-	.6-2.0	0.1

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills
PE PROJECT NO.:15112
PREPARED BY: William Parnell, P.E.

SHEET: 5 OF 6
DATE: 7/27/15

SOIL LOG: #5
LOCATION: 190 ft. north and 50 ft. west of the southwest property corner

1. TYPES OF TEST DONE: None	2. NRCS SOILS SERIES: Indianola (47)	3. LAND FORM: Terrace
4. DEPOSITION HISTORY: Sandy Glacial Drift	5. HYDROLOGIC SOIL GROUP: A	6. DEPTH OF SEASONAL HW: Unknown
7. CURRENT WATER DEPTH: Greater Than Bottom of Hole	8. DEPTH TO IMPERVIOUS LAYER: Greater than bottom of hole	9. MISCELLANEOUS: Gently Sloping

10. POTENTIAL FOR:	Erosion	Runoff	Ponding
	Minimal	Slow	Minimal

11. SOIL STRATA DESCRIPTION: See Following chart

12. SITE PERCOLATION RATE: See FSP

13. FINDINGS & RECOMMENDATIONS: Infiltration will be restricted in the C1, C4, C5 and C6 horizons.

Soils Strata Description
Soil Log #5

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 6"	10YR3/2	LmVFSa	<12	<3	<1	1SBK	-	-	-	mf	2-6	3
Bw	6"- 22"	10YR4/3	LmVFSa	<12	<1	<1	1SBK	-	-	-	ff	2-6	6
BC	22"- 32"	10YR4/4	LmVFSa	<12	-	<1	1SBK	-	-	-	ff	2-6	6
C1	32"- 42"	10YR6/2	SiLm	<28	-	<1	3SBK	-	-	-	ff	.6-2.0	0.6
C2	42"- 55"	10YR5/3	FSa	<1	-	<1	SG	-	-	-	-	6-20	20
C3	55"- 96"	10YR5/3	MSa	<1	-	<1	SG	-	-	-	-	>20	20
C4	96"-115"	10YR5/2	SiLm	<28	-	<1	Mas	F1F	-	-	-	.6-2.0	0.1
C5	115"-156"	10YR5/2	LmVFSa	<12	-	<1	Mas	-	-	-	-	.6-2.0	0.6
C6	156"-176"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	-	.6-2.0	0.1

SOIL EVALUATION REPORT
FORM 2: SOIL LOG INFORMATION

PROJECT TITLE: Sunrise Hills — SHEET: 6 OF 6
PE PROJECT NO.:15112 — DATE: 7/27/15
PREPARED BY: William Parnell, P.E.

SOIL LOG: #6
LOCATION: 80 ft. north and 60 ft. west of the southwest property corner

1. TYPES OF TEST DONE:	2. NRCS SOILS SERIES:	3. LAND FORM:
Falling Head Percolation	Indianola (47)	Terrace
4. DEPOSITION HISTORY:	5. HYDROLOGIC SOIL GROUP:	6. DEPTH OF SEASONAL HW:
Sandy Glacial Drift	A	Unknown
7. CURRENT WATER DEPTH:	8. DEPTH TO IMPERVIOUS LAYER:	9. MISCELLANEOUS:
Greater Than Bottom of Hole	Greater than bottom of hole	Gently Sloping

10. POTENTIAL FOR:	Erosion	Runoff	Ponding
	Minimal	Slow	Minimal

11. SOIL STRATA DESCRIPTION: See Following chart

12. SITE PERCOLATION RATE: See FSP

13. FINDINGS & RECOMMENDATIONS: A falling head percolation test completed at 80" below the existing grade yielded an infiltration rate of 102.9 in/hr. Design infiltration rate calculations using adjusted infiltration rate formulas for Idesign resulted in a calculated Idesign = 14.9 in/hr. Use an average Idesign infiltration rate less than or equal to 8.64 in/hr for drainage infiltration facilities located in the C2 horizon soils (Idesign average for test pits #2, #3, #4 and #6). Infiltration will be restricted in the C3, C5, and C7 horizons.

Soils Strata Description
Soil Log #6

Horz	Depth	Color	Texture	%CL	%ORG	CF	STR	MOT	IND	CEM	ROO	<X>	FSP
A	0"- 8"	10YR3/2	LmVFSa	<12	<3	<1	1SBK	-	-	-	mf	2-6	3
Bw	8"- 18"	10YR4/3	LmVFSa	<12	<1	<1	1SBK	-	-	-	ff	2-6	6
BC	18"- 36"	10YR4/4	LmVFSa	<12	-	<1	1SBK	-	-	-	ff	2-6	6
C1	36"- 62"	10YR5/1	FSa	<1	-	<1	SG	-	-	-	-	6-20	20
C2	62"-119"	10YR5/1	M-FSa	<1	-	<1	SG	-	-	-	-	>20	Idesign = 14.9
C3	119"-144"	10YR5/2	SiLm	<28	-	<1	3SBK	-	-	-	-	.6-2.0	0.6
C4	144"-153"	10YR5/1	VFSa	<10	-	<1	SG	-	-	-	-	2-6	0.6
C5	153"-162"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	-	.6-2.0	0.1
C6	162"-174"	10YR5/1	VFSa	<10	-	<1	SG	-	-	-	-	2-6	1.0
C7	174"-192"	10YR5/2	SiLm	<28	-	<1	Mas	-	-	-	-	.6-2.0	0.1

Abbreviations

Textural Class (Texture)	Structure (STR)	Grades of Structure
Cobbley -Cob	Granular - Gr	Strong - 3
Stoney - St	Blocky - Blky	Moderate - 2
Gravelly - Gr	Platy - Pl	Weak - 1
Sandy - Sa	Massive - Mas	
Loamy - Lm	Single Grained - SG	
Silty - Si	Sub-Angular Blocky - SBK	
Clayey - Cl		
Coarse - C		
Very - V		
Extremely - Ex		
Fine - F		
Medium - M		

Induration & Cementation (IND) (CEM)
Weak - Wk
Moderate - Mod
Strong - Str

Mottles (MOT)		
1 Letter Abundance	1st Number Size	2nd Letter Contrast
Few - F	Fine - 1	Faint - F
Common - C	Medium - 2	Distinct - D
Many - M	Coarse - 3	Prominent - P

Roots (ROO)	
1st Letter Abundance	2nd Letter Size
Few - f	Fine - f
Common - c	Medium - m
Many - m	Coarse - c

<X> - Generalized range of infiltration rates from SCS soil survey (<X>)

FSP - **Estimated Field Saturated Percolation rate based on horizon specific factors.**

Disregard this data - too far North of Track A

Falling Head Percolation Test

Sunrise Hills

Completed By : William Parnell, P.E.
Test Date : 7/27/2015
PE Job : #15112

Test Pit # **4** (completed @ 82" below existing ground surface)

Start (Min)	Stop (Min)	Elapsed Time (Min)	Total Drop (Inches)	Infiltration Rate (In/Hr)
0: 00' 00"	0: 16' 00"	0: 16' 00"	6	
0: 16' 30"	0: 38' 30"	0: 22' 00"	6	
Soaking Period				
1: 35' 30"	2: 01' 30"	0: 26' 00"	6	
2: 02' 30"	2: 30' 30"	0: 28' 00"	6	
2: 31' 00"	3: 00' 00"	0: 29' 00"	6	
3: 01' 00"	3: 30' 00"	0: 29' 00"	6	
3: 31' 30"	4: 00' 30"	0: 29' 00"	6	**12.41**

Design Infiltration Rate Calculation : Idesign

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$

$I_{measured}$ = 12.41 In/Hr

$F_{testing}$ = 0.50

$F_{geometry} = 4D/W + 0.05$ Where: D= Depth from the bottom of the proposed facility to the maximum wet season water table or nearest impervious layer, whichever is less. Assume D=3.0 feet.
W= Width of facility. Assume W=50.0 feet

$0.25 \leq F_{geometry} \leq 1.0$

$F_{geometry}=4(3/50)+0.05$
$F_{geometry}=0.29$ Use $F_{geometry}=0.29$

$F_{plugging}$= 0.7 for loams and sandy loams, 0.8 for loamy sands or fine sands, 0.9 for medium sands, 1.0 for coarse sands or cobbles or any soil type with infiltration facility preceded by a specific water quality facility.
Assume pre-treatment : Use $F_{plugging}=1.0$

I_{design} = 12.41 x 0.5 x 0.29 x 1.0 = 1.8 in/hr

For stormwater facility design purposes, use an average $I_{design} \leq$ **8.64 in/hr.**

Falling Head Percolation Test
Sunrise Hills

Completed By : William Parnell, P.E.
Test Date : 7/27/2015
PE Job : #15112

Test Pit # **2** (completed @ 85" below existing ground surface)

Start (Min)	Stop (Min)	Elapsed Time (Min)	Total Drop (Inches)	Infiltration Rate (In/Hr)
0: 00' 00"	0: 04' 30"	0: 04' 30"	6	
0: 05' 00"	0: 10' 45"	0: 05' 45"	6	
0: 11' 00"	0: 17' 30"	0: 06' 30"	6	
		Soaking Period		
2: 11' 00"	2: 17' 45"	0: 06' 45"	6	
		Soaking Period		
3: 04' 15"	3: 10' 15"	0: 06' 00"	6	
		Soaking Period		
3: 45' 30"	3: 52' 15"	0: 06' 15"	6	
3: 53' 00"	3: 59' 15"	0: 06' 15"	6	**57.6**

Design Infiltration Rate Calculation : Idesign

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$

$I_{measured}$ = 57.6 In/Hr

$F_{testing}$ = 0.50

$F_{geometry} = 4D/W + 0.05$ Where: D= Depth from the bottom of the proposed facility to the maximum wet season water table or nearest impervious layer, whichever is less. Assume D=3.0 feet.
$0.25 \leq F_{geometry} \leq 1.0$
W= Width of facility. Assume W=50.0 feet

$F_{geometry}=4(3/50)+0.05$
$F_{geometry}=0.29$ Use $F_{geometry}=0.29$

$F_{plugging}$= 0.7 for loams and sandy loams, 0.8 for loamy sands or fine sands, 0.9 for medium sands, 1.0 for coarse sands or cobbles or any soil type with infiltration facility preceded by a specific water quality facility.
Assume pre-treatment : Use $F_{plugging}=1.0$

I_{design} = 57.6 x 0.5 x 0.29 x 1.0 = 8.35 in/hr

For stormwater facility design purposes, use an average $I_{design} \leq$ **8.64 in/hr.**

Falling Head Percolation Test
Sunrise Hills

Completed By : William Parnell, P.E.
Test Date : 7/27/2015
PE Job : #15112

Test Pit # **3** (completed @ 85" below existing ground surface)

Start (Min)	Stop (Min)	Elapsed Time (Min)	Total Drop (Inches)	Infiltration Rate (In/Hr)
0: 00' 00"	0: 03' 30"	0: 03' 30"	6	
0: 04' 00"	0: 08' 45"	0: 04' 45"	6	
		Soaking Period		
0: 37' 15"	0: 41' 45"	0: 04' 30"	6	
		Soaking Period		
1: 12' 30"	1: 17' 15"	0: 04' 45"	6	
		Soaking Period		
2: 34' 00"	2: 38' 15"	0: 04' 15"	6	
		Soaking Period		
3: 10' 30"	3: 15' 45"	0: 05' 15"	6	
		Soaking Period		
3: 52' 30"	3: 58' 00"	0: 05' 30"	6	
3: 58' 30"	4: 04' 00"	0: 05' 30"	6	**65.45**

Design Infiltration Rate Calculation : Idesign

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$

$I_{measured}$ = 65.45 In/Hr $F_{testing}$ = 0.50

$F_{geometry} = 4D/W + 0.05$ Where: D= Depth from the bottom of the proposed facility to the maximum wet season water table or nearest impervious layer, whichever is less. Assume D=3.0 feet.

$0.25 \leq F_{geometry} \leq 1.0$ W= Width of facility. Assume W=50.0 feet

$F_{geometry}=4(3/50)+0.05$

$F_{geometry}=0.29$ Use $F_{geometry}=0.29$

$F_{plugging}$= 0.7 for loams and sandy loams, 0.8 for loamy sands or fine sands, 0.9 for medium sands, 1.0 for coarse sands or cobbles or any soil type with infiltration facility preceded by a specific water quality facility.
Assume pre-treatment : Use $F_{plugging}=1.0$

I_{design} = 65.45 x 0.5 x 0.29 x 1.0 = 9.49 in/hr

For stormwater facility design purposes, use an average $I_{design} \leq$ **8.64 in/hr.**

Falling Head Percolation Test
Sunrise Hills

Completed By : William Parnell, P.E.
Test Date : 7/27/2015
PE Job : #15112

Test Pit # **6** (completed @ 80" below existing ground surface)

Start (Min)	Stop (Min)	Elapsed Time (Min)	Total Drop (Inches)	Infiltration Rate (In/Hr)
0: 00' 00"	0: 02' 00"	0: 02' 00"	6	
0: 02' 30"	0: 05' 00"	0: 02' 30"	6	
0: 05' 15"	0: 08' 00"	0: 02' 45"	6	
0: 08' 15"	0: 11' 00"	0: 02' 45"	6	
		Soaking Period		
1: 07' 45"	1: 11' 00"	0: 03' 15"	6	
		Soaking Period		
2: 19' 15"	2: 22' 30"	0: 03' 15"	6	
		Soaking Period		
2: 54' 45"	2: 58' 00"	0: 03' 15"	6	
		Soaking Period		
3: 54' 45"	3: 58' 15"	0: 03' 30"	6	
3: 58' 30"	4: 02' 00"	0: 03' 30"	6	**102.9**

Design Infiltration Rate Calculation : Idesign

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$

$I_{measured}$ = 102.9 In/Hr

$F_{testing}$ = 0.50

$F_{geometry} = 4D/W + 0.05$ Where: D= Depth from the bottom of the proposed facility to the maximum wet season water table or nearest impervious layer, whichever is less. Assume D=3.0 feet.
W= Width of facility. Assume W=50.0 feet

$0.25 \leq F_{geometry} \leq 1.0$

$F_{geometry}=4(3/50)+0.05$
$F_{geometry}=0.29$ Use $F_{geometry}=0.29$

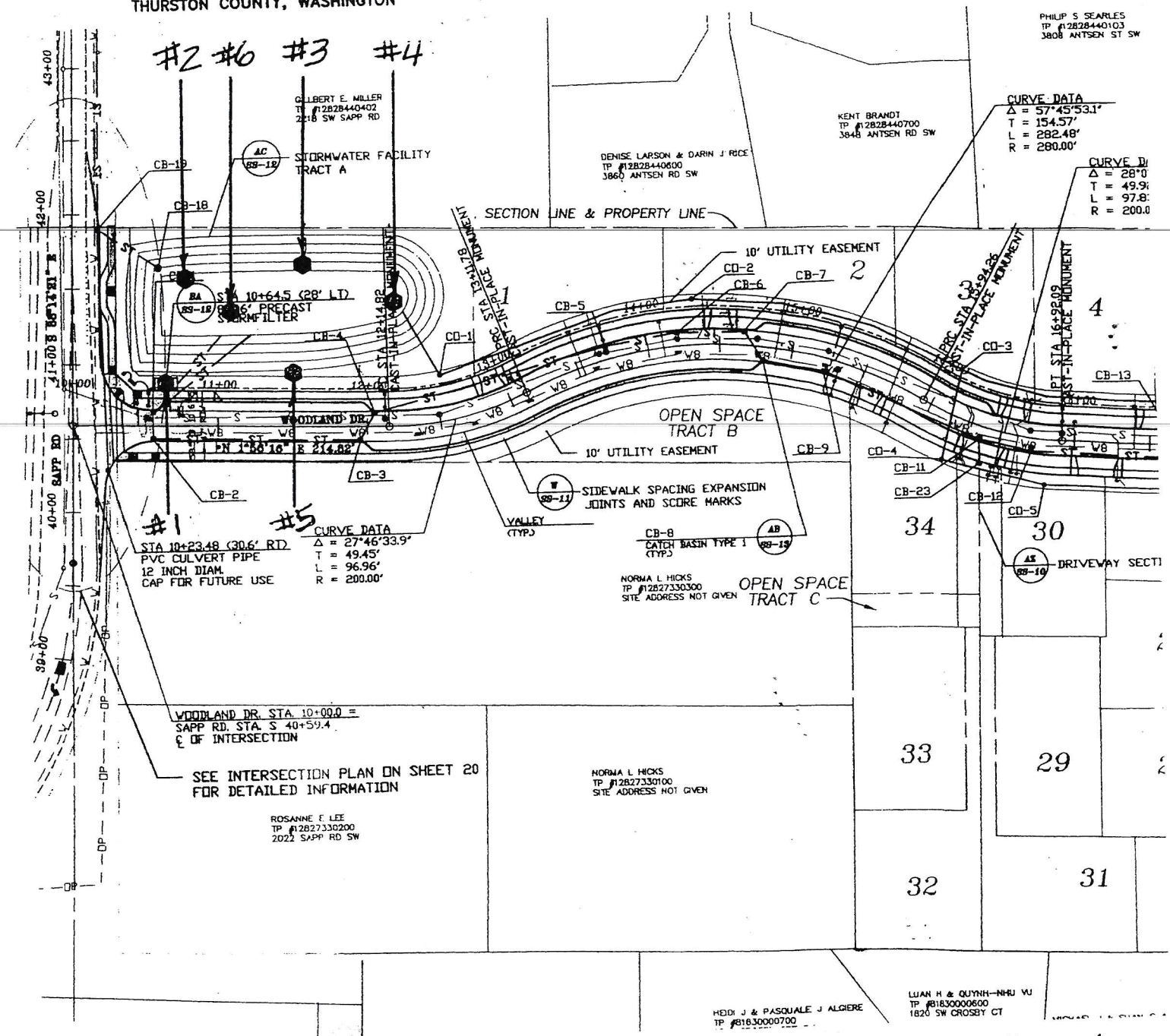
$F_{plugging}$= 0.7 for loams and sandy loams, 0.8 for loamy sands or fine sands, 0.9 for medium sands, 1.0 for coarse sands or cobbles or any soil type with infiltration facility preceded by a specific water quality facility.
Assume pre-treatment : Use $F_{plugging}=1.0$

I_{design} = 102.9 x 0.5 x 0.29 x 1.0 = 14.9 in/hr

For stormwater facility design purposes, use an average $I_{design} \leq$ **8.64 in/hr.**

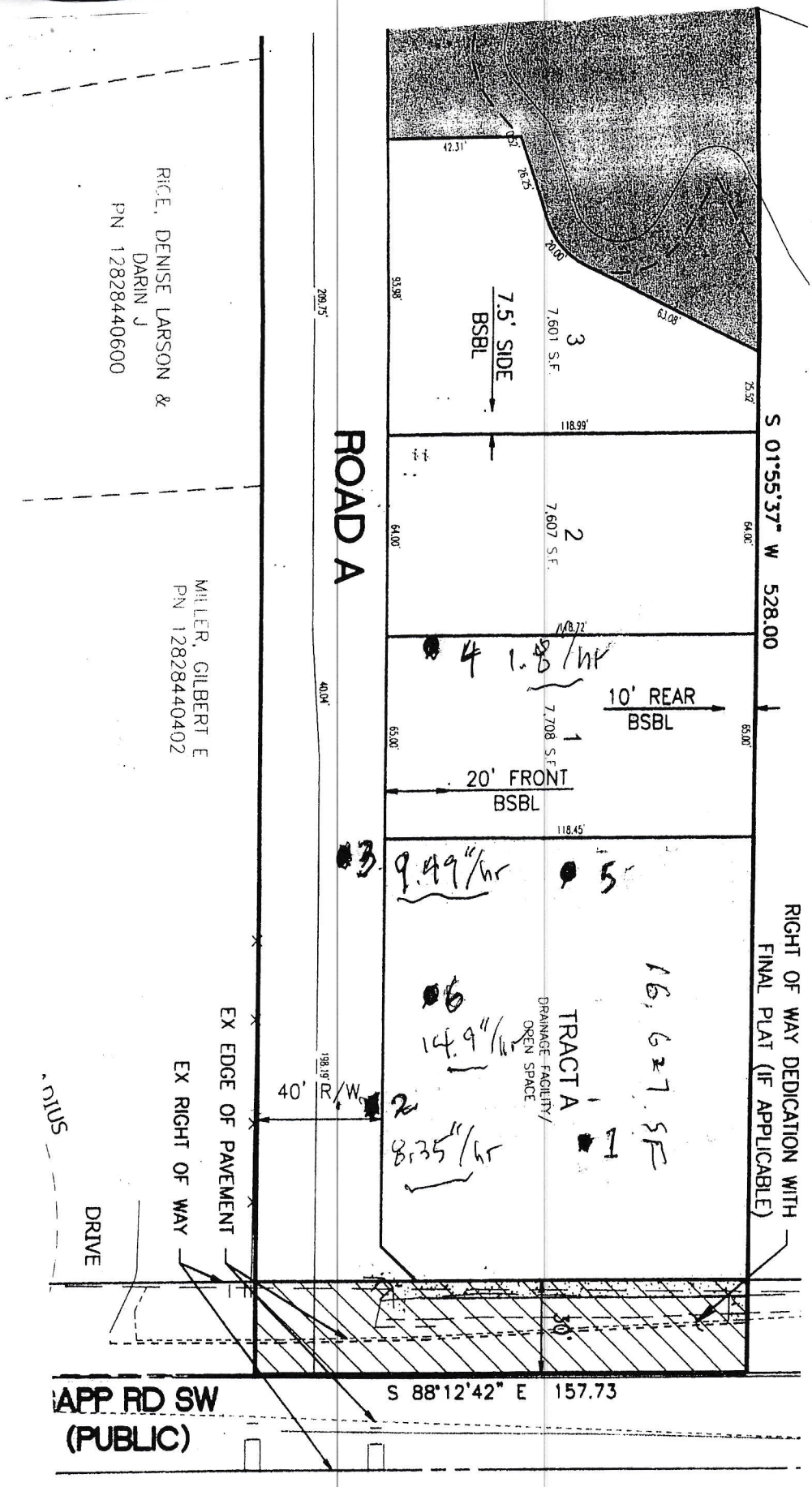
PORTION OF THE SW 1/4 OF SW 1/4 OF SECTION 27, TOWNSHIP 18N, RANGI

THURSTON COUNTY, WASHINGTON



EMBANKMENT NOTE:

... EMBANKMENT MATERIAL SHALL BE SELECT NATIVE MATERIAL OR



4 = 1.8"/hr — Too Far

3 = 9.49"/hr — 9.49"/hr

6 = 14.9"/hr — 14.9"/hr

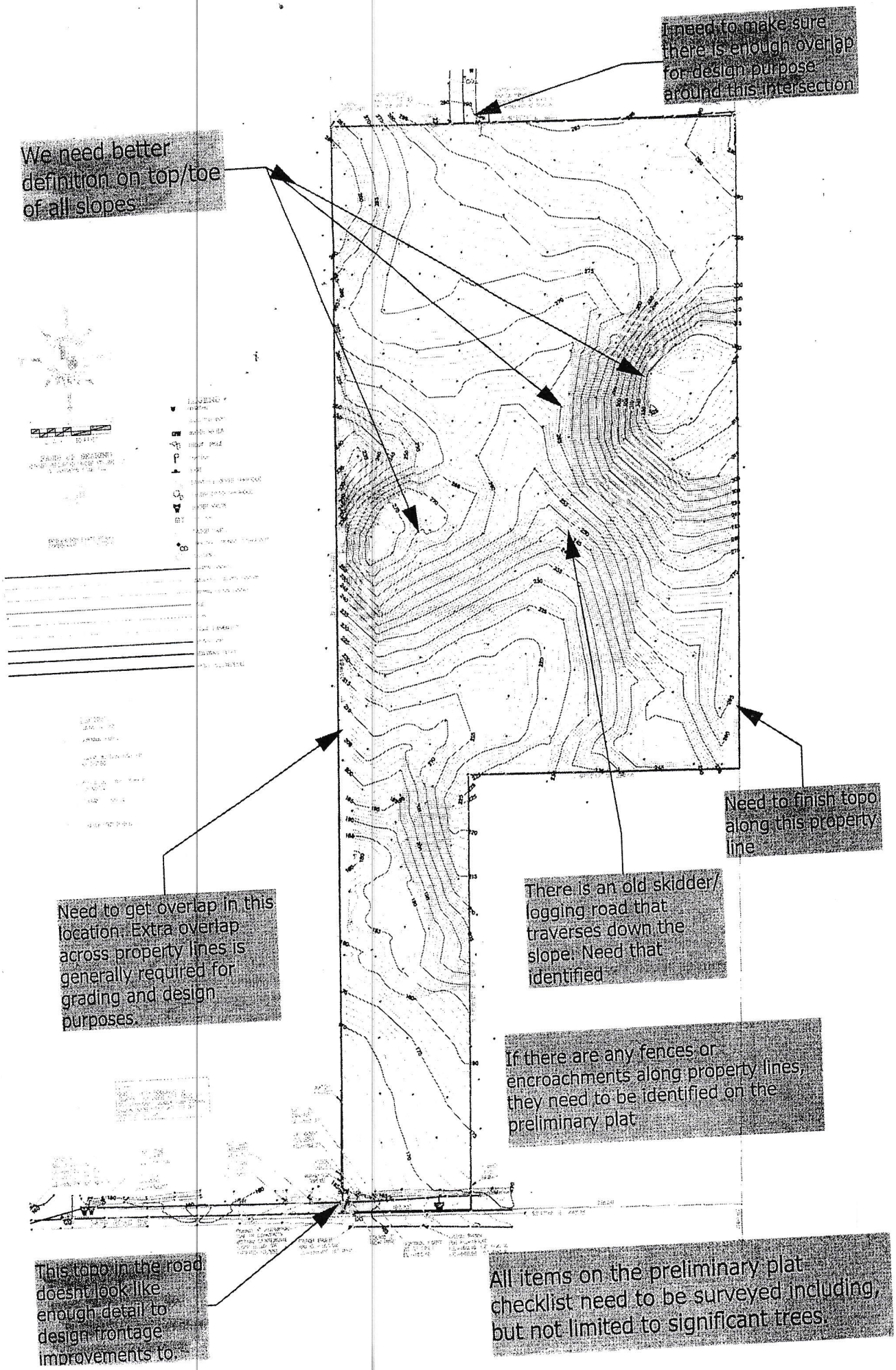
2 = 8.35"/hr — 8.35"/hr

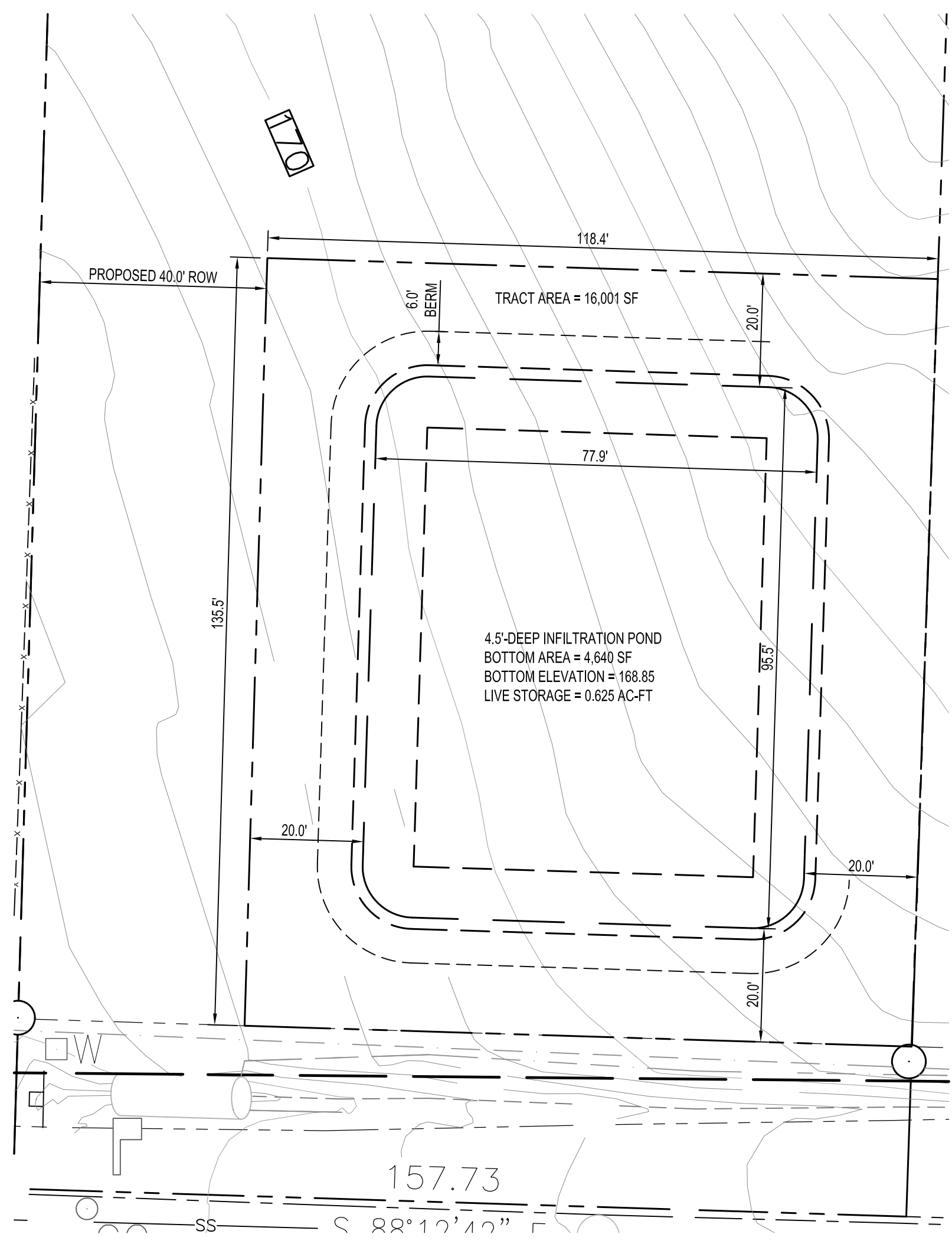
34.54"/hr — 32.74"/hr

AV = 8.635"/hr — 10.91"/hr

Recommend: 8.64"/hr

1 | SHEET TITLE: PRELIMINARY PLAT EXHI


I need to make sure there is enough overlap for design purpose around this intersection
We need better definition on top/toe of all slopes.
Need to finish topo along this property line
There is an old skidder/ logging road that traverses down the slope. Need that identified
Need to get overlap in this location. Extra overlap across property lines is generally required for grading and design purposes.
If there are any fences or encroachments along property lines, they need to be identified on the preliminary plat
This topo in the road doesnt look like enough detail to design frontage improvements to.
All items on the preliminary plat checklist need to be surveyed including, but not limited to significant trees.


170
118.4'
PROPOSED 40.0' ROW
6.0'
BERM
TRACT AREA = 16,001 SF
20.0'
77.9'
135.5'
4.5'-DEEP INFILTRATION POND
BOTTOM AREA = 4,640 SF
BOTTOM ELEVATION = 168.85
LIVE STORAGE = 0.625 AC-FT
95.5'
20.0'
20.0'
20.0'
W
157.73
SS
S 88°12'42" E