7 OAKS ENGINEERING

PRELIMINARY STORMWATER MANAGEMENT REPORT

FOR

CRATER AVENUE
at
4910 CRATER AVENUE
KEIZER, OREGON

February 10th, 2024

PREPARED BY:

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APPENDICES

I. PURPOSE OF REPORT

This report describes the proposed improvements compliance with the City of Keizer's Design Standards (February 2023) – Chapter 400.

II. PROJECT DESCRIPTION

The site is located at 4910 Crater Avenue N. To the north and south the are private properties. The property will have one proposed two-story triplex with 3-car garage. On the western side of the property there is a proposed two-story triplex with 3-car garage.

A. EXISTING CONDITION

On the existing site, currently there is one single family residential home on the property. The site has a gravel driveway which leads to the single-family home. Trees can be seen on the east side of the property and one direct west of the residential home.

The existing site has a gentle slope that travels from west to east of the property. The site seems to have some infiltration into the ground.

The existing site is not located within the FEMA flood zone per FEMA flood map 41047C0331G, effective on 1/19/2000.

GEOTECHNICAL FINDINGS:

Geopacific Engineering prepared the Geotechnical Report, Project No. 24-6649, dated October 16, 2024, and concluded the following:

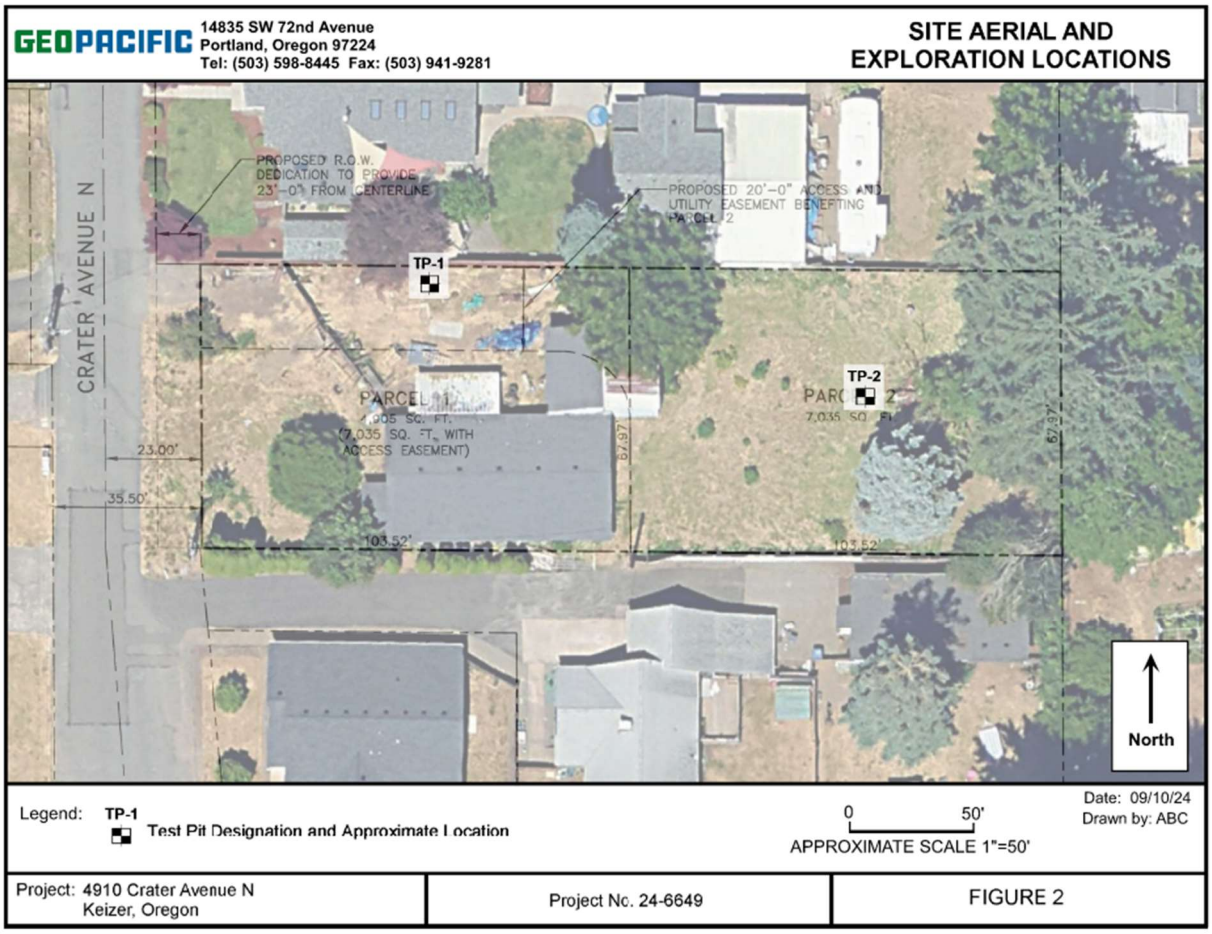
Groundwater was not encountered at an explored depth of 10', however, groundwater is anticipated at a depth of 20' to 40'.

Infiltration testing was performed at a depth of 4' and 8', with a resulting unfactored rate of 2.88 in/hr and 2.16 in/hr. As a result of these findings, infiltration is considered feasible.

Table 1 - Summary of Infiltration Test Results

Test Location	Depth (feet)	Soil Type	Infiltration Rate (in/hr)
TP-2	4.0	Sandy Lean CLAY (CL)	2.88
TP-2	8.0	Poorly Graded SAND with Silt (SP)	2.16

Boring Log Map – Geotechnical Report



B. PROPOSED CONDITION

The proposed development will be divided into two parcels, with a proposed 22' access drive aisle and proposed stormwater improvements. Additionally, Crater Avenue will be improved to it's ultimate right of way, with a 10.5' dedication, new curb, gutter, sidewalk, and parkway, as well as two proposed driveways.

The proposed drainage pattern will generally follow the existing site's gentle slope which travels west to east of the property. The raingarden infiltration systems will be in the southeast and southern portion of the lots. The rain gardens have been sized to fully infiltrate the 100-year storm event. The raingarden infiltration system has been sized for the ultimate future build out design. Additionally, a perimeter curb was placed along the property line where the top of curb elevation is set above the lowest existing street grade elevation, to allow for secondary overland release.

III. METHODOLOGY

The City of Keizer's Design Standards (February 2023) – Chapter 400 were implemented for the design of the onsite stormwater system, as follows:

Projects greater than 5,000 square feet of new or replaced impervious surface are required to meet the full requirements for treatment, flow control, and retention of stormwater as provided below. This proposed project exceeds this new or replaced 5,000 square feet of impervious area.

Stormwater Treatment:
The entire WQE will be required to retain and treat and shall conform to NPDES, TMDL and WPCF requirements and reduce the discharge of the listed pollutants to the Waters of the State. All treatment facilities will be designed to utilize the GSI to the MEF.

Stormwater Retention:
The hierarchy to be followed in determining project specific applicable facility retention requirements based on the Design Infiltration Rates for the site or the Point of Connection as follows:

1. **Design Infiltration Rate greater than 2 inches per hour:**
   The project facility shall retain and treat the entire WQE. The project facility shall retrain all stormwater runoff from design storm events up to and including 100-year design storm event with no released allowed.
2. **Project is in an Unserved Stormwater Area (regardless of design infiltration rate):**
   The project facility shall retain and treat the entire WQE. The project facility shall retrain all stormwater runoff from design storm events up to and including 100-year design storm event with no released allowed.
3. **Design Infiltration Rate between 0.75 inches and 2 inches per hour:**
   The facility shall retrain and treat the entire WQE. In addition, the facility shall retain stormwater runoff for the 5-year, 10-year, 25-year design storm events with an allowable release rate up to the predeveloped 5-year design storm event. Runoff for the 50-year and 100-year design storm events shall be retained with an allowable release rate up to the predeveloped 25-year design storm event.
4. **Design Infiltration Rate less than 0.75 inches per hour:**
   The facility shall retain and treat the entire WQE to the MEF. The facility shall also retrain stormwater runoff for the 5-year, 10-year, 25-year, 50-year, and 100-year design storm events, not allowing any increase in runoff for all storm events listed.
5. **"Critical Basin" Point of Connection (regardless of design infiltration rate):**
   The facility shall retrain and treat the entire WQE to the MEF. The facility shall also retain stormwater runoff for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year design storm events, not allowing any increase in runoff for all storm events listed.

Flow Control Requirements:

To meet the requirement to retain all stormwater runoff to the MEF, certain sites may need to include flow control to be implemented as part of the design. In other situations, it simply benefits the overall system to provide flow control prior to treatment or retention systems.

GSI FACILITY PLANTING REQUIREMENTS:

SOILS/GROWING MEDIUM REQUIREMENTS

The soil and growing medium installed in the stormwater facility shall meet the following requirements:

1. The minimum depth of the growing medium or amended soil shall be per design – minimum depth is 12 inches.
2. The growing medium or amended soil should be a mix of loamy soil, sand, and compost (30 – 40 percent compost, by volume), and shall be loose, friable, well-mixed, homogenous, free of wood pieces, plastic, and other foreign matter, and have no visible free water when placed in the facility. The pH of the mix shall be between 5 and 8.
3. The final infiltration rate of the bottom of the facility must be tested and confirmed to be equal to or greater than the Design Infiltration Rate for the facility.
4. After planting, the remaining areas of the facility shall be surfaced with 2 to 3 inches of either 1-1/2"-3/4" clean round rock (allowed throughout the facility) and/or hardwood chips (allowed only above the high-water level in the facility).
5. Weed-free certification is required for all imported growing medium, soil, surface material, and seed mixes.

FACILITY PLANTING CALENDAR

To ensure the best chances of successful plant establishment, all planting should take place between October 15th and May 15th; unless regular watering is provided to ensure the plantings are viable in drier months. In addition, air temperatures during planting must be between 32- and 90-degrees Fahrenheit.

IRRIGATION REQUIREMENTS

In-ground automated irrigation systems are required for all GSI facilities and must be designed and installed to meet these requirements:

1. Water the entire plant area of the facility with 1 inch of water per week through from the beginning of July through the end October, throughout the warranty period, to establish the facility plantings.
2. Water infrequently but deeply to help the plants become as drought tolerant as possible.
3. Continued irrigation after the establishment period is at the discretion of the owner.

WARRANTY MAINTENANCE PERIOD

All new public GSI stormwater facilities will be subject to a warranty period including a performance security. These facilities must be maintained to ensure the facility is functioning properly. To successfully complete the warranty period the facility must meet the following conditions:

1. At least 80% of the plants (percentage of cover for grasses, sedges, groundcover and perennials; percentage of trees and shrubs by count) must be alive and in good health.
2. The facility must be free of weeds and invasive plants (as defined by Marion County Soil and Water Conservation District).
3. The facility must be free of trash, debris, and excess dead foliage or clippings.
4. All inlets and outlets shall be clear and operational, without erosion or channelization throughout or downstream of the facility.

Any conditions not met will be required to be remediated prior to release of the performance security.

IV. CALCULATIONS

The development will be designed in accordance with the Design Standards in Division 004, Appendix D. The Santa Barbara Urban Hydrograph (SBUH) method will be the selected methodology used in the computer program HydroCAD Version 10.20. The following parameters were inputted;

Storm Type: Type 1A Rainfall Distribution
Soil Group: Group B

Curve Number:

CURVE NUMBERS	
Pre-Development	**CN**
Brush, Poor	67
Gravel Surface	96
Impervious	98

CURVE NUMBERS	
Post-Development	**CN**
Grass Cover, Fair	69
Impervious	98

Rainfall Depth:

Return Interval	Peak 24-Hour Rainfall
Water Quality Storm Event	1.38 inches
2-YR Storm Event	2.20 inches
5-YR Storm Event	2.70 inches
10-YR Storm Event	3.20 inches
25-YR Storm Event	3.60 inches
50-YR Storm Event	4.10 inches
100-YR Storm Event	4.40 inches

V. SUMMARY

In conclusion, a proposed infiltration planter on each lot. The infiltration planters has been sized to handle the entire 100-year storm event with no overflow. Below is a summary of calculations. Additionally, a perimeter curb was placed along the property line where the top of curb elevation is set above the lowest existing street grade elevation, to allow for secondary overland release.

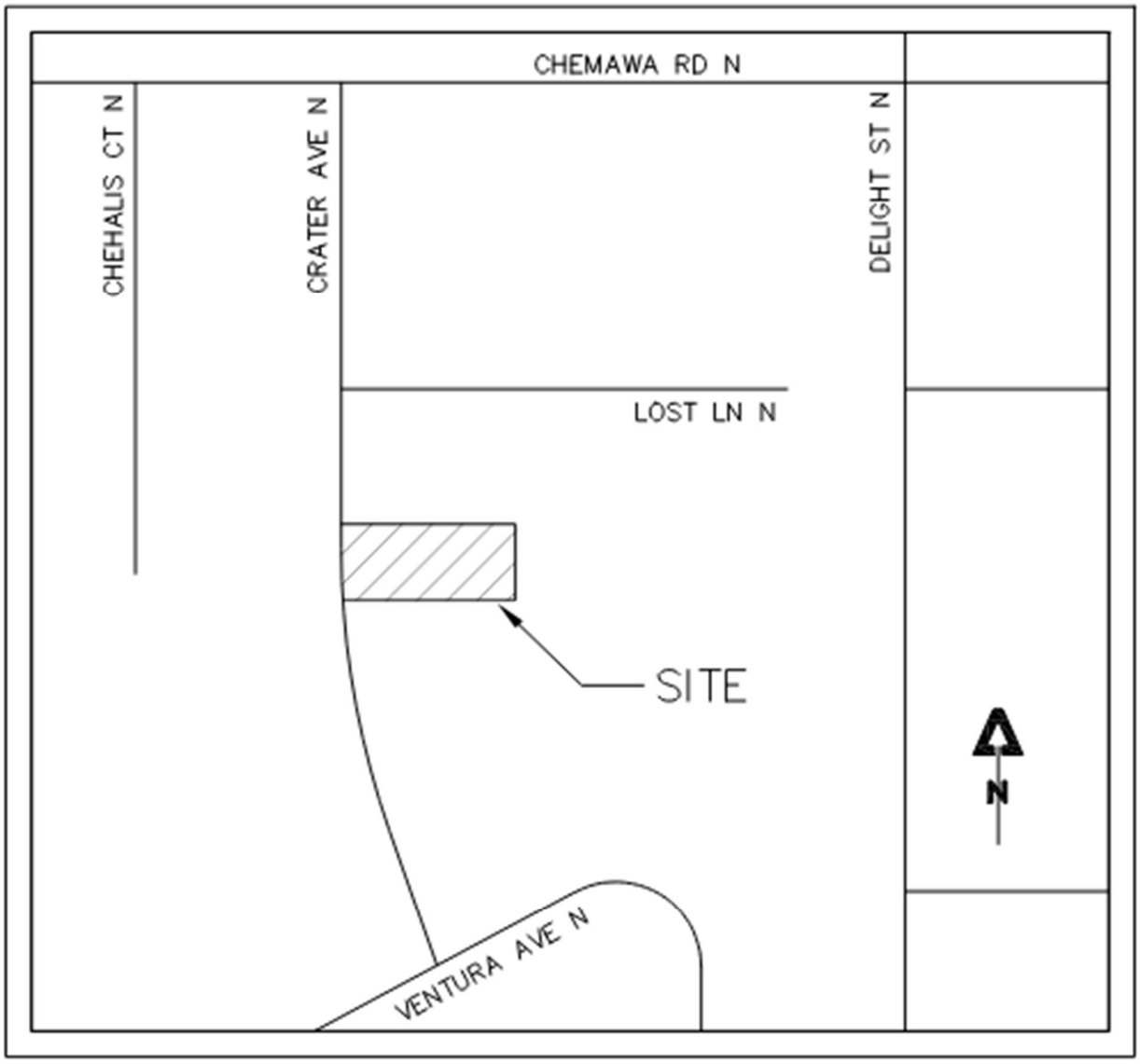
CATCHMENT AND FACILITY TABLE						
CATCHMENT/ FACILITY ID	**TOTAL AREA (SF)/(AC.)**	**IMPERVIOUS AREA (SF)**	**PERVIOUS AREA (SF)**	**OWNERSHIP (PRIVATE/ PUBLIC)**	**FACILITY TYPE**	**FACILITY SIZE (BOTTOM) SF**
LOT A	7,215	5,051	2,165	PRIVATE	RAIN-GARDEN INFILTRATION	793
LOT B	7,080	4,956	2,124	PRIVATE	RAIN-GARDEN INFILTRATION	737
TOTAL ONSITE	**14,295**	**10,007**	**4,289**			

CATCHMENT AND FACILITY TABLE						
CATCHMENT/ FACILITY ID	**TOTAL AREA (SF)/(AC.)**	**IMPERVIOUS AREA (SF)**	**PERVIOUS AREA (SF)**	**OWNERSHIP (PRIVATE/ PUBLIC)**	**FACILITY TYPE**	**FACILITY SIZE (BOTTOM) SF**
LOT A	9,883	7,681	2,202	PRIVATE	RAIN-GARDEN INFILTRATION	650
LOT B	4,162	2,310	1,852	PRIVATE	RAIN-GARDEN INFILTRATION	450
TOTAL ONSITE	**14,045**	**9,991**	**4,054**			

WATER QUALITY TREATMENT REQUIREMENTS				
CATCHMENT/ FACILITY ID	**WQV (IN)**	**WQV (CF)**	**80% OF WQV**	**RAIN GARDEN ALLOWABLE VOLUME**
A	1.38	764	615	1,170
B	2.38	392	314	810

PRE VS. POST CONSTRUCTION FLOW RATES		
FACILITY ID	PEAK FLOW RATE (CFS)	
	100 YEAR STORM	
PROJECT SITE	POST (NO BMP)	POST (W/BMP)
LOT A	0.19	0
LOT B	0.11	0

APPENDIX A – MAPS



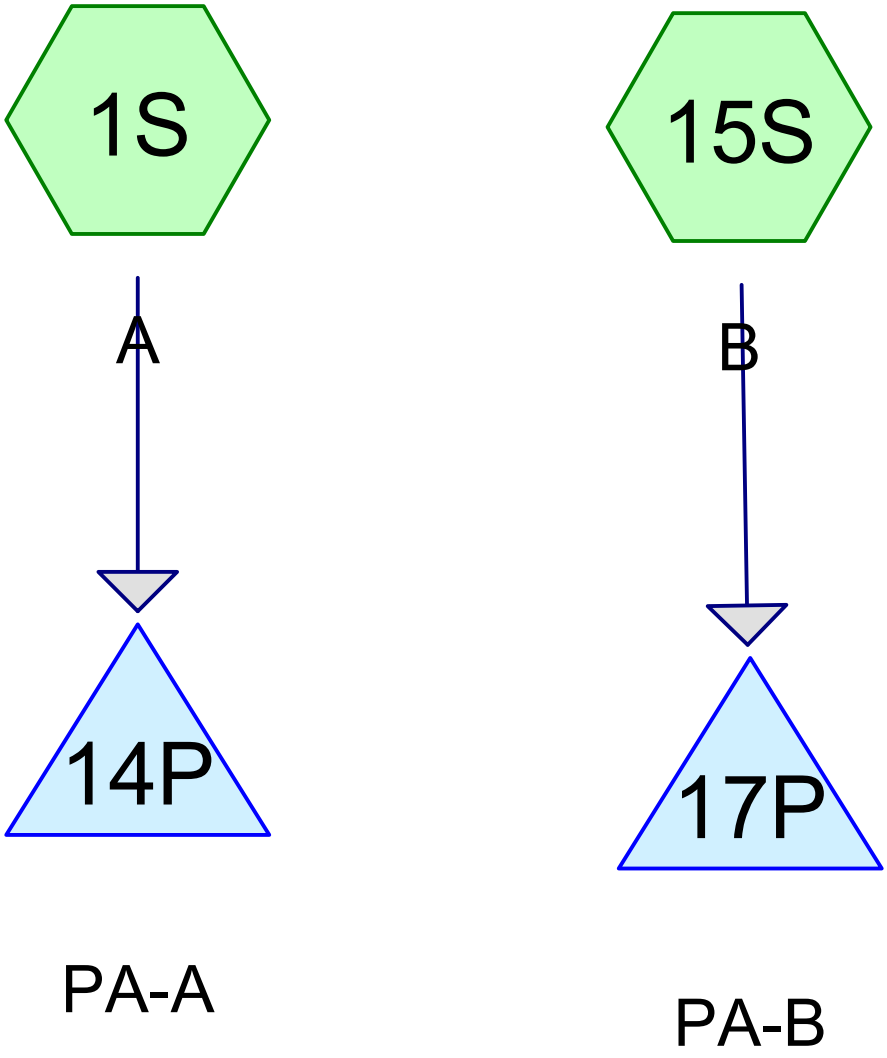
VICINITY MAP

NOT TO SCALE

APPENDIX B – CALCULATIONS

POST DEVELOPMENT

THE ELEVATIONS SHOWN HEREIN ARE ARBITARY AND USED FOR CALCULATION PURPOSES ONLY



Subcat Reach Pond Link

Routing Diagram for 00355_Post-Development
Prepared by 7 Oaks Engineering, Inc, Printed 2/7/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-Yr	Type IA 24-hr		Default	24.00	1	4.40	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.093	79	<50% Grass cover, Poor, HSG B (1S, 15S)
0.229	98	Paved parking, HSG B (1S, 15S)
0.323	**93**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.323	HSG B	1S, 15S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.323		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.093	0.000	0.000	0.000	0.093	<50% Grass cover, Poor	1S, 15S
0.000	0.229	0.000	0.000	0.000	0.229	Paved parking	1S, 15S
0.000	**0.323**	**0.000**	**0.000**	**0.000**	**0.323**	**TOTAL AREA**	

Time span=0.01-48.00 hrs, dt=0.01 hrs, 4800 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: A Runoff Area=9,883 sf 77.72% Impervious Runoff Depth=3.75"
Tc=5.0 min CN=79/98 Runoff=0.21 cfs 0.071 af

Subcatchment 15S: B Runoff Area=4,167 sf 55.44% Impervious Runoff Depth=3.33"
Tc=5.0 min CN=79/98 Runoff=0.08 cfs 0.027 af

Pond 14P: PA-A Peak Elev=103.97' Storage=1,150 cf Inflow=0.21 cfs 0.071 af
Outflow=0.03 cfs 0.071 af

Pond 17P: PA-B Peak Elev=102.67' Storage=211 cf Inflow=0.08 cfs 0.027 af
Outflow=0.02 cfs 0.027 af

Total Runoff Area = 0.323 ac Runoff Volume = 0.097 af Average Runoff Depth = 3.62"
28.89% Pervious = 0.093 ac 71.11% Impervious = 0.229 ac

Summary for Subcatchment 1S: A

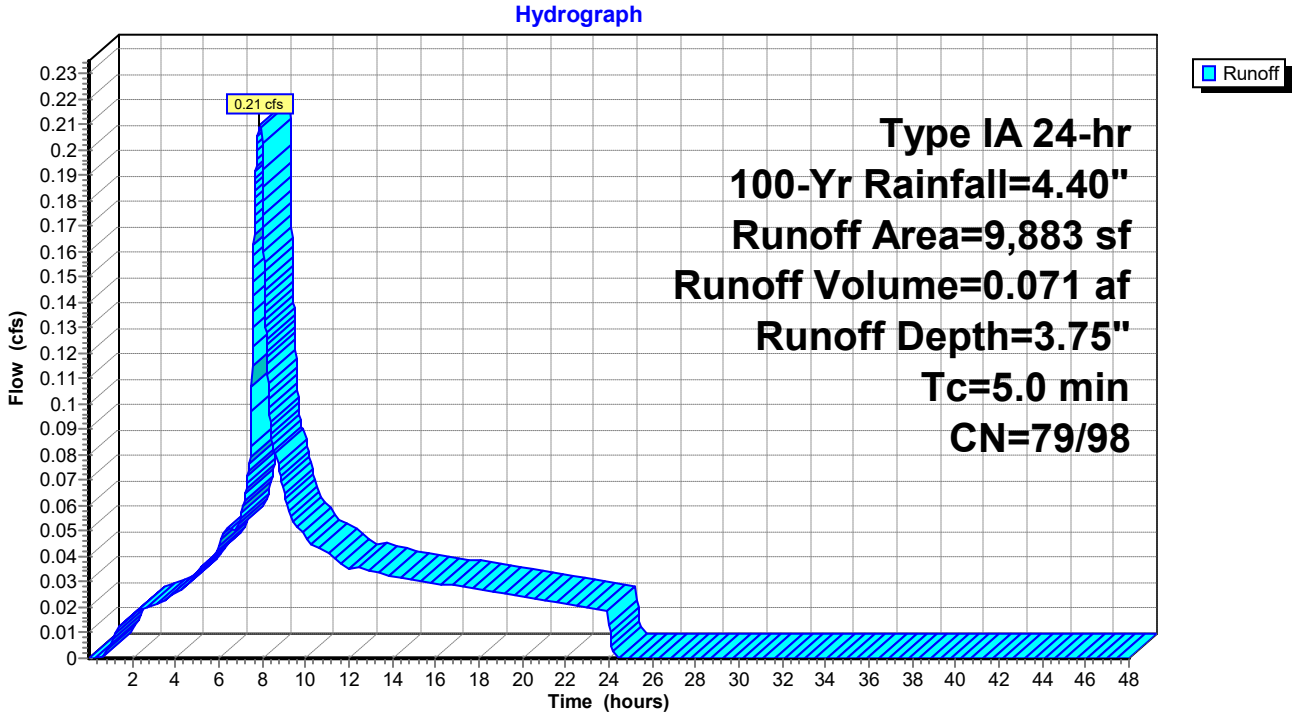
Runoff = 0.21 cfs @ 7.89 hrs, Volume= 0.071 af, Depth= 3.75"
Routed to Pond 14P : PA-A

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.01-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
7,681	98	Paved parking, HSG B
2,202	79	<50% Grass cover, Poor, HSG B
9,883	94	Weighted Average
2,202	79	22.28% Pervious Area
7,681	98	77.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: A



Summary for Subcatchment 15S: B

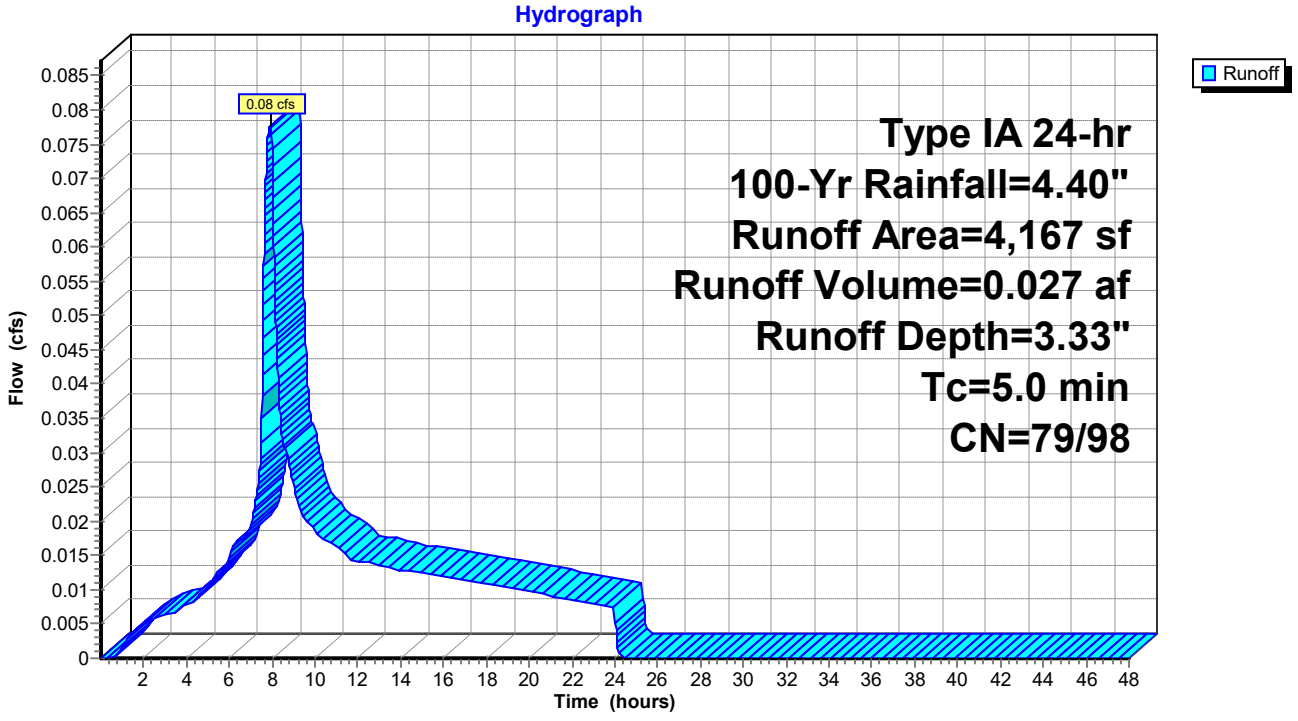
Runoff = 0.08 cfs @ 7.90 hrs, Volume= 0.027 af, Depth= 3.33"
Routed to Pond 17P : PA-B

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.01-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
2,310	98	Paved parking, HSG B
1,857	79	<50% Grass cover, Poor, HSG B
4,167	90	Weighted Average
1,857	79	44.56% Pervious Area
2,310	98	55.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 15S: B



Summary for Pond 14P: PA-A

Inflow Area = 0.227 ac, 77.72% Impervious, Inflow Depth = 3.75" for 100-Yr event
Inflow = 0.21 cfs @ 7.89 hrs, Volume= 0.071 af
Outflow = 0.03 cfs @ 18.67 hrs, Volume= 0.071 af, Atten= 88%, Lag= 646.7 min
Discarded = 0.03 cfs @ 18.67 hrs, Volume= 0.071 af

Routing by Stor-Ind method, Time Span= 0.01-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 103.97' @ 18.67 hrs Surf.Area= 650 sf Storage= 1,150 cf

Plug-Flow detention time= 467.2 min calculated for 0.071 af (100% of inflow)
Center-of-Mass det. time= 467.3 min (1,143.3 - 676.0)

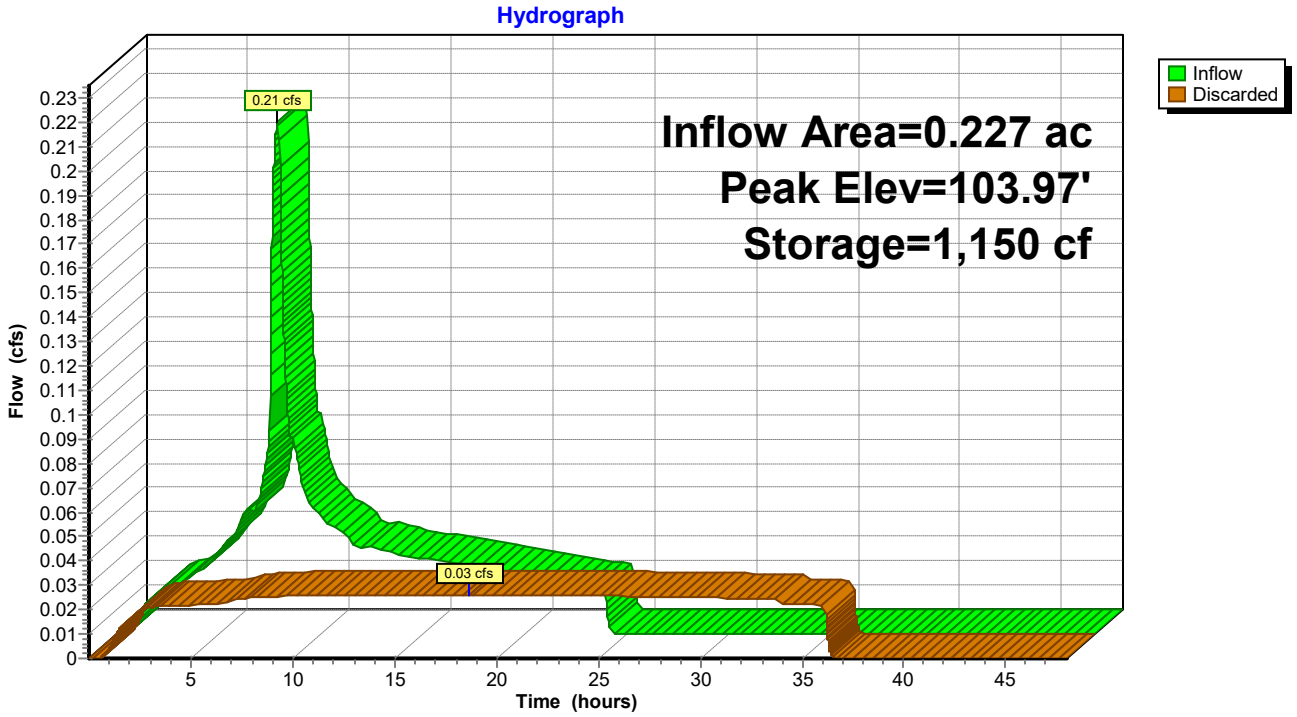
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	1,170 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
100.00	650	150.0	0.0	0	0	650
101.00	650	150.0	30.0	195	195	800
102.50	650	150.0	0.0	0	195	1,025
104.00	650	150.0	100.0	975	1,170	1,250

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**1.440 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 80.00'

Discarded OutFlow Max=0.03 cfs @ 18.67 hrs HW=103.97' (Free Discharge)
↑**1=Exfiltration** (Controls 0.03 cfs)

Pond 14P: PA-A


Hydrograph
Inflow
Discarded
Inflow Area=0.227 ac
Peak Elev=103.97'
Storage=1,150 cf
0.21 cfs
0.03 cfs
Flow (cfs)
Time (hours)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0.12
0.13
0.14
0.15
0.16
0.17
0.18
0.19
0.2
0.21
0.22
0.23
5
10
15
20
25
30
35
40
45

Summary for Pond 17P: PA-B

Inflow Area = 0.096 ac, 55.44% Impervious, Inflow Depth = 3.33" for 100-Yr event
Inflow = 0.08 cfs @ 7.90 hrs, Volume= 0.027 af
Outflow = 0.02 cfs @ 10.76 hrs, Volume= 0.027 af, Atten= 78%, Lag= 171.4 min
Discarded = 0.02 cfs @ 10.76 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 0.01-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.67' @ 10.76 hrs Surf.Area= 450 sf Storage= 211 cf

Plug-Flow detention time= 110.8 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 110.8 min (810.1 - 699.3)

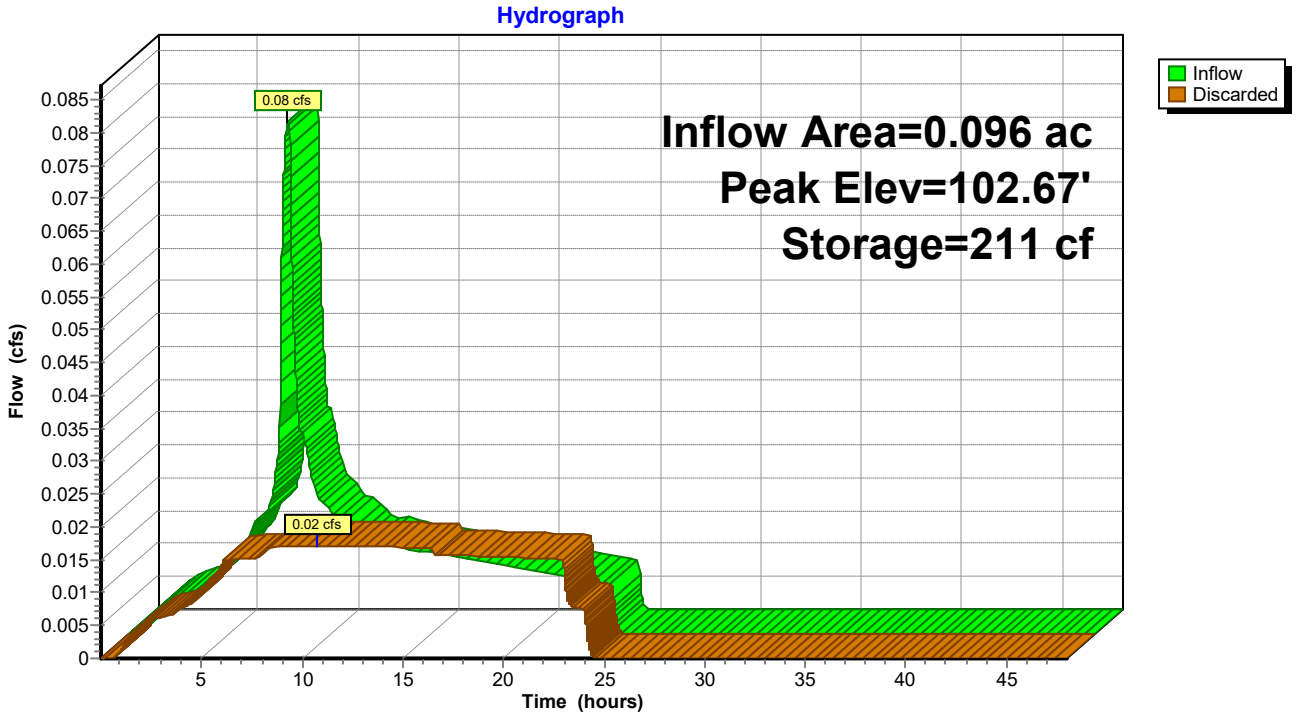
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	810 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
100.00	450	150.0	0.0	0	0	450
101.00	450	150.0	30.0	135	135	600
102.50	450	150.0	0.0	0	135	825
104.00	450	150.0	100.0	675	810	1,050

Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**1.440 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 80.00'

Discarded OutFlow Max=0.02 cfs @ 10.76 hrs HW=102.67' (Free Discharge)
↑**1=Exfiltration** (Controls 0.02 cfs)

Pond 17P: PA-B


Hydrograph
Inflow
Discarded
Inflow Area=0.096 ac
Peak Elev=102.67'
Storage=211 cf
0.08 cfs
0.02 cfs
Flow (cfs)
Time (hours)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
0.065
0.07
0.075
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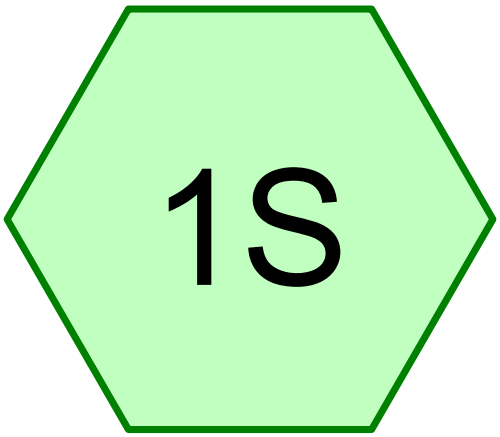
PRE DEVELOPMENT

THE ELEVATIONS SHOWN HEREIN ARE ARBITARY AND USED FOR CALCULATION PURPOSES ONLY



EX

Subcat Reach Pond Link

Routing Diagram for 00355_Pre-Development
Prepared by 7 Oaks Engineering, Inc, Printed 2/7/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-YR	Type IA 24-hr		Default	24.00	1	4.40	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.322	79	Pasture/grassland/range, Poor, HSG B (1S)
0.322	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.322	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.322		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.322	0.000	0.000	0.000	0.322	Pasture/grassland/range, Poor	1S
0.000	**0.322**	**0.000**	**0.000**	**0.000**	**0.322**	**TOTAL AREA**	

Time span=0.10-30.00 hrs, dt=0.01 hrs, 2991 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EX Runoff Area=14,045 sf 0.00% Impervious Runoff Depth=2.29"
Flow Length=225' Slope=0.0500 '/' Tc=13.4 min CN=79/0 Runoff=0.16 cfs 0.062 af

Total Runoff Area = 0.322 ac Runoff Volume = 0.062 af Average Runoff Depth = 2.29"
100.00% Pervious = 0.322 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: EX

Runoff = 0.16 cfs @ 8.00 hrs, Volume= 0.062 af, Depth= 2.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.10-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-YR Rainfall=4.40"

Area (sf)	CN	Description
14,045	79	Pasture/grassland/range, Poor, HSG B
14,045	79	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	225	0.0500	0.28		**Sheet Flow,** Range n= 0.130 P2= 2.40"

Subcatchment 1S: EX