Humber Design Group, Inc.

October 23, 2020

City of Milwaukie
Attn: Steve Adams, City Engineer
6101 SE Johnson Creek Blvd.
Milwaukie, Oregon 97206

RE: Hillside Master Plan – Conceptual Stormwater Review

Dear Steve,

The purpose of this letter is to provide clear summary of the concept level design assumptions that were utilized in the development of the Hillside Master Plan. Conceptual stormwater design is based on current stormwater codes for the City of Milwaukie and U.S. Department of Housing and Urban Development, which is an assumed funding source.

I have attached a preliminary utility plan for your review, along with storm facility calculations based on the City of Portland, "Stormwater Management Manual – 2020 Facility Sizes Proposed" and Santa Barbra Unit Hydrograph calculations for various typical stormwater management alternatives that may be utilized in the public and private developments. Along with this supplemental information, you will find a summary and overview narrative on the next page.

Please feel free to contact me regarding any questions or comments. I hope this facility and methodology will meet with your approval.

Sincerely,

Humber Design Group, Inc.

Kristian McCombs, PE
Associate, Project Engineer
503-946-5358
Kristian.McCombs@hdgpdx.com

Project Overview

- This project is located at 2889 SE Hillside Court, Milwaukie Oregon and is composed of multiple single family and duplex buildings, a multi-unit Hillside Manor building, and a community building on a single lot. Only the Hillside Manor building will remain.
- The existing campus is served by a network of public roads.
- Proposed project would include up to 600 housing units and some commercial space on across the 16 acres of property.
- The development will be split into 9 new private lots divided by 6 new reconfigured public street extensions.

Storm Criteria Utilized

Criteria from the "City of Milwaukie Public Works Standards", Dated October 1, 2019.

- Storm detention facilities shall be designed to provide storage up to the 25-year storm event, with save overflow conveyance of the 100-year storm event.
- Allowable post-developed discharge rate for the 2-, 5-, 10-, and 25-year storm events shall be that of the predevelopment discharge rate.
- All water quality facilities shall meet the City of Portland, Stormwater Management Manual as amended and adopted by the City of Milwaukie and requirements of Subsection 2.0050
- Safely direct the 100-year storm event away from structures, stored then conveyed to public or private storm systems.

Criteria from the "HUD/NOAA/NEPA Funding Requirements"

- In addition to City of Milwaukie standards, it is likely that HUD/NOAA/NEPA water quantity standards will be required to be met to meet funding requirements. Since infiltration may not feasible on the site, allowable post development discharge shall also be in accordance with HUD/NOAA/NEPA standards, and discharge from half the 2-year, and the 2, 5 and 10-year shall match the pre-developed rate.
- All stormwater quality treatment practices and facilities will be designed to accept and fully treat the volume of water equal to 50-percent of the cumulative rainfall from the 2-year, 24-hour storm for that site to meet HUD/NOAA/NEPA requirements.

Storm Overview

- Greenstreet planters meeting City of Milwaukie and HUD criteria for water quality and detention are assumed for all public roads. These green street planters are assumed to have orifices as required to meet flow control requirements at this time as it is the most conservative approach in regard to planter area sizing.
- Private lots will have private stormwater facilities independently designed and located on each site. We have included preliminary conceptual designs that reflect some of the possible configurations these may take.
- After treatment and detention, water will be conveyed to a new public storm system network that has been sized convey the larger of either the 25-year SBUH storm or the 10-year Rational storm.
- The public system has two proposed discharge locations into the existing City of Milwaukie system, but these systems may discharge into the Meek Street Pipe Installation CIP project by the time of development.
- Events larger than the 100-year will be managed away from buildings and safely conveyed away from structures in the public ROW and is assumed that private sites shall be designed to meet this criterion.

Design information

Rainfall Events:

- WQ (PDX) = 1.60-inch, 24 hour, Assuming 2020 Portland SWMM Rate
- WQ (HUD) = 50% of volume of 2-year storm for HUD use 2.40-inches of rainfall
- 2 year = 2.40-inches of rainfall
- 5 year = 2.90-inches of rainfall
- 10 year = 3.40-inches of rainfall
- 25 year = 3.90-inches of rainfall
- 100 year = 4.40-inches of rainfall

Refer to the attached calculation sheet for additional information.

Infiltration Rate:
To be determined. The majority of the site is Woodburn Silt Loam, 3 to 8 percent slopes with Hydrologic Soils Group C soils which leads us to believe that significant infiltration may be unachievable in the surface level soils.

Water Quantity Values:

- For public green street planters or private surface vegetated facilities, the City of Portland, Bureau of Environmental Services Memo regarding "Stormwater Management Manual 2020 Facility Sizes Proposed" was utilizes for conceptual sizing. Based on the memo attached, surface vegetated facilities with offsite discharge and underdrain should be sized at 8-9% of the catchment area. **Refer to Supporting Documents D and F for additional information.**
- Basin B was used as for an example calculation for utilizing underground detention for meeting City of Milwaukie and HUD stormwater criteria on a private site.

On site example calculation for generic Underground Detention System (based onbasin area B):
Predeveloped basin = 60,000 sq. ft. CN = 76 Woods/Grass Combination
Post developed = 60,000 sq ft. 85% Impervious CN = 98, 15% Pervious CN = 79 grass cover
Example Detention System = (5) 100' 48" diameter pipes with multiple orifice control.
Refer to Supporting Documents G.

Water Quality Values:

- For public green street planters or private surface vegetated facilities, the City of Portland, Bureau of Environmental Services Memo regarding "Stormwater Management Manual 2020 Facility Sizes Proposed" was utilizes for conceptual sizing. Based on the memo attached, surface vegetated facilities with offsite discharge and underdrain should be sized at 8-9% of the catchment area. **Refer to Supporting Documents D and F for additional information. If detention in not required, the sizing can be downsized.**
- Basin B was used as for an example calculation for utilizing mechanical proprietary systems for meeting City of Milwaukie and HUD stormwater criteria on a private site.

On site example calculation for generic proprietary mechanical system (based on basin area B):
Predeveloped basin = 60,000 sq. ft.
Post developed = 60,000 sq ft. Assumed all impervious
Per City of Portland SWMM – Proprietary mechanical systems are sized using Rational Method
Q=CiA; where C=0.9 for impervious, i = 0.19 in/hr, and A = area in acres.
Example Contech StormFilter System = (18) 18" tall ZPG filter cartridges.
Refer to Supporting Documents D and F for additional information. If detention is not required, the sizing can be downsized.

Engineering Conclusion:

Based on compliance with City of Milwaukie standards, HUD funding requirements, and proper engineering techniques, the preliminary calculations demonstrated in this letter support the engineering opinion that the stormwater can be effectively managed for the proposed Hillside Master Plan. This preliminary analysis provides a sample roadmap of various stormwater solutions (based on 2020 standards) that can be further developed during the public and private design processes.

Support Documentation Index

Exhibit C

Humber Design Group, Inc.
117 SE Taylor Street
Suite 202
Portland, OR 97214
P: 503-946-6690
F: 503-946-3112
www.hdgpdx.com

STORMWATER CONVEYANCE CALCULATIONS

* This spreadsheet is based on King County SBUH method.

Design Storm: 25 YR
Storm Duration: 24 HRS
Precipitation: 3.9 IN
Manning's "n" 0.013 (FOR PVC STORM PIPE)

LINE	INC. AREA (AC)	INC. % IMP.	CUM. AREA TOTAL (AC)	CUM. AREA PERV. (AC)	CN PER.	CUM. AREA IMP. (AC)	CN IMP.	TIME (MIN)	Q (CFS)	PIPE Dia. (IN)	SLOPE (FT/FT)	Qf (CFS)	Q/Qf (%)	Depth (in)	Depth/ Dia.	V (fps)	LENGTH (FT)	INC. TIME (MIN)
SE 31st Ave - South																		
LINE 2 (Basins E,9)	1.743	87.76	1.7430	0.2133	79	1.5297	98	5.00	1.66	12	0.0200	5.05	0.33	4.74	0.40	5.75	132.0	0.38
LINE 1 (Add Basins A,8)	1.700	87.82	3.4430	0.4204	79	3.0226	98	5.38	3.23	12	0.0220	5.30	0.61	6.78	0.57	7.07	309.0	0.73
LINE 17 (Add Basin 1)	0.168	100.00	3.6105	0.4204	79	3.1901	98	6.11	3.31	15	0.0295	11.12	0.30	5.61	0.37	7.89	35.0	0.07
(Connects to Existing 36" MEEK ST)																		
SE Hillside Court - East																		
LINE 3 (Basins B,D,7)	3.108	87.80	3.1080	0.3792	79	2.7288	98	5.00	2.96	12	0.0171	4.67	0.63	6.95	0.58	6.29	215.0	0.57
(Connects to LINE 5)																		
SE 29th Ave - Middle																		
LINE 4 (Possibly K?, 10)	1.660	89.06	1.6600	0.1816	79	1.4784	98	5.00	1.60	12	0.0171	4.67	0.34	4.84	0.40	5.38	215.0	0.67
(Connects to LINE 5)																		
SE 29th Ave - South																		
LINE 5 (Upstream = Line 3+4, Add =Basins 6,C)	1.873	89.60	6.6406	0.7555	79	5.8850	98	5.67	6.20	18	0.0078	9.30	0.67	10.75	0.60	5.62	335.0	0.99
(Connects to Existing 36" MEEK ST)																		
SE Hillside Court - West																		
Line 6 (Basin 5)	0.374	100.00	0.3739	0.0000	79	0.3739	98	5.00	0.38	12	0.0120	3.91	0.10	2.54	0.21	3.16	250.0	1.32
line 7 (Upstream = Line 6, Add Basin 4)	0.180	100.00	0.5538	0.0000	79	0.5538	98	5.00	0.57	12	0.0098	3.54	0.16	3.25	0.27	3.29	132.0	0.67
(Connects to Existing public 12" main)																		
SE Dwyer St																		
LINE 8 (Basin 13)	0.292	100.00	0.2920	0.0000	79	0.2920	98	5.00	0.30	12	0.0436	7.46	0.04	1.64	0.14	4.62	176.0	0.63
(Connects to LINE 10)																		

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Manning's "n" 0.013 (FOR PVC STORM PIPE)

LINE	INC. AREA (AC)	INC. % IMP.	CUM. AREA TOTAL (AC)	CUM. AREA PERV. (AC)	CN PER.	CUM. AREA IMP. (AC)	CN IMP.	TIME (MIN)	Q (CFS)	PIPE Dia. (IN)	SLOPE (FT/FT)	Qf (CFS)	Q/Qf (%)	Depth (in)	Depth/ Dia.	V (fps)	LENGTH (FT)	INC. TIME (MIN)
LINE 9 (Basin F,14)	1.239	87.76	1.2388	0.1516	79	1.0871	98	5.00	1.18	12	0.0250	5.65	0.21	3.73	0.31	5.68	146.0	0.43
(Connects to LINE 10)																		
LINE 10 (Upstream=Line 8+9, Add=Basins G,12)	1.836	87.75	3.3666	0.3765	79	2.9901	98	5.43	3.17	12	0.0310	6.29	0.50	6.04	0.50	8.01	274.0	0.57
(Connects to LINE 16)																		
SE 29th Ave at Dwyer St																		
LINE 16 (Upstream = Line 10, Add No Basins)	0.000	100.00	1.5308	0.1516	79	1.3792	98	5.43	1.45	12	0.0100	3.57	0.41	5.34	0.44	4.31	21.0	0.08
Line 11 (Upstream 16, Add Possibly K?)	1.212	86.74	4.2737	0.4640	79	3.8097	98	5.51	4.02	15	0.0050	4.58	0.88	10.93	0.73	4.20	108.0	0.43
(Connects to LINE 13)																		
SE 29th Ave -North																		
LINE 12 (Basin 15)	0.232	87.68	0.2318	0.0286	79	0.2032	98	5.00	0.22	15	0.0150	7.93	0.03	1.73	0.12	2.83	157.0	0.93
(Connects to LINE 13)																		
Easement through K																		
LINE 13 (Upstream = 11,12; Add Possible K?)	1.065	84.91	5.5705	0.6532	79	4.9172	98	5.93	5.13	18	0.0200	14.89	0.34	7.30	0.41	7.63	107.0	0.23
LINE 14 (Upstream = 13)	0.000	100.00	5.5705	0.6532	79	4.9172	98	6.16	5.09	18	0.1600	42.13	0.12	4.23	0.24	16.08	120.0	0.12
LINE 15 (Upstream = 14)	0.000	100.00	5.5705	0.6532	79	4.9172	98	6.28	5.06	18	0.0150	12.90	0.39	7.84	0.44	6.85	226.0	0.55
(Connects to Future CIP?)																		

EXHIBIT "D"

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

Stormwater Management Manual 2020 Facility Sizes—Proposed

Spring 2020

Storm system and location make a difference for engineered facilities.

This document summarizes typical stormwater facility sizes designed using the Presumptive or Performance Approach by geographic area of Portland based on the proposed requirements in the 2020 SWMM. It combines requirements that are changing and those that are staying the same. This fact sheet does not cover most single family sites that will continue to use the Simplified Approach.

Stormwater management is required

Stormwater management supports the City of Portland's (the City) livability and improves watershed health by mitigating the impacts of urbanization and protecting our storm systems, drainageways, and combined sewers.

The City requires stormwater management for projects involving 500 square feet or more of impervious area. ***This includes:***

- Some paving projects in the public right-of-way.
- Parcel-based development on properties.

The Stormwater Management Manual (SWMM) is one of the ways the City addresses state and federal regulations related to stormwater.

Updates to SWMM requirements

The City's Bureau of Environmental Services (BES) updates the SWMM to keep stormwater policy in step with changing conditions and technology advancements. ***Goals of the 2020 update:***

- Improve clarity.
- Continue to comply with regulations.
- Increase technical rigor and facility performance.

Facility size/design changes required by the SWMM 2020

Stormwater management requirements and solutions depend on multiple factors, including:

- Site location.
- Geologic characteristics.
- Available storm system infrastructure.

The proposed 2020 SWMM contains technical changes affecting facility size requirements:

- Increase the water-quality storm size.
- Increase the infiltration rate of the imported growing media.
- Requirements for more orifice control for facilities that discharge offsite.

The following information describes typical facility sizes designed under the proposed 2020 SWMM requirements by facility type. Different requirements may apply based on individual site characteristics or storm-system availability.

The City uses the Stormwater Management Manual (SWMM) to protect both watershed resources and infrastructure investments. As each development or improvement project meets the requirements of the manual, it contributes to these important citywide goals:

- Protect watershed health by requiring infiltration wherever feasible, to mimic pre-development hydrologic conditions.
- Protect groundwater resources by removing pollutants from stormwater before discharging it into the ground.
- Protect streams and rivers by providing water quality treatment and flow control for stormwater before discharging it to surface water.
- Minimize long-term costs to the City for treating stormwater through public wastewater treatment plants.
- Protect the capacity of downstream infrastructure.
- Minimize sewer overflows and basement sewer backups.

For more information:

Adrienne Aiona

503-823-2051

besstormmanual@portlandoregon.gov

portlandoregon.gov/bes/swmm

EXHIBIT "D"

Infiltration to groundwater to manage stormwater and reduce combined sewer overflows

REQUIREMENT (NO CHANGE):

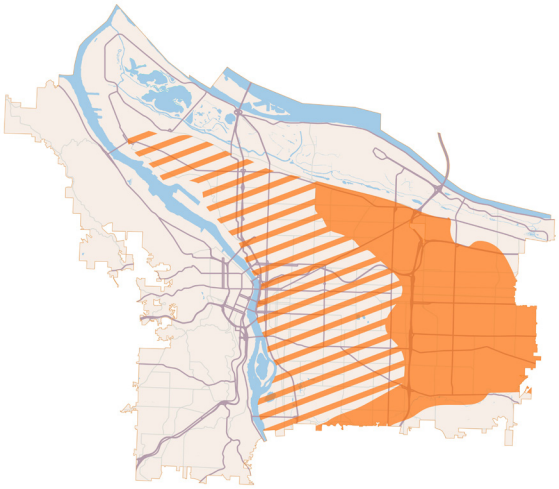
Fully infiltrate the 10-year storm event on sites with infiltration rates greater than 2 inches per hour.

FACILITY DESIGN CHANGES:

Surface vegetated:

- **Surface infiltration facilities will get smaller—**facilities will be sized based on an infiltration rate of 6 inches per hour for the imported growing media. This will decrease the footprint and increase feasibility of these facility types.
- **No setback will be required from the right-of-way property line—** This will increase opportunities for infiltration facilities and better align with zoning code landscape requirements.
- **Install surface infiltration facilities w/o rock to improve plant health—**Recommendation will be to install facilities without rock underneath, to improve plant health.

UICs: Additional guidance provided for deep infiltration testing and post-construction testing of drywells.



Infiltration

East of the Willamette River, infiltration is often the best option. The soils in parts of outer east Portland, and areas around I-205 (see map), include layers of coarse, fast-draining sediments deposited by the Missoula Floods. The geology is more mixed on the inner east side and in the northern neighborhoods, with good conditions for infiltration in some areas (see map).

Flow control—to maintain pipe capacity in the combined system

In the combined system, sites that discharge offsite must provide flow control to maintain pipe capacity.

REQUIREMENT (NO CHANGE):

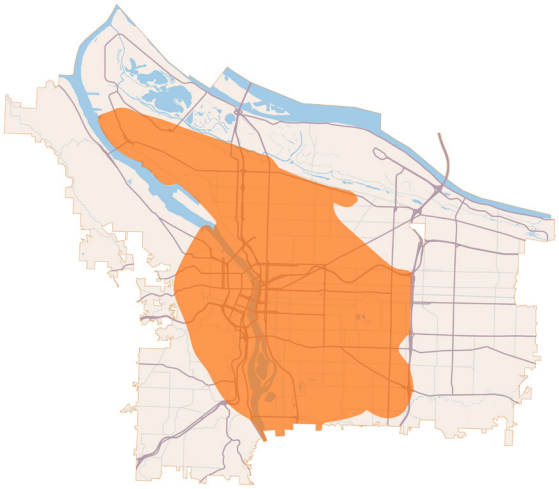
Control the post-development 25-year, 24-hour storm peak flow to the predevelopment 10-year, 24-hour peak flow.

FACILITY DESIGN CHANGES:

Surface vegetated with offsite discharge (with an underdrain):

- **Add orifice control to underdrained facilities—**Environmental Services will require orifices on more facilities for reliable flow control.
- Facility size will decrease to about 5% of the catchment area.
- Facilities with small catchment areas that cannot meet flow control requirements will be required to filter the 25-year, 24-hour event.
- **Change underdrain in lined facilities to improve plant health—** underdrain configuration requirements will change to reduce the amount of drain rock, improving plant health.

Structured detention: To be used in limited circumstances when approved by Environmental Services.



Flow control — CSO

Older parts of Portland have a combined sewer system (see map). It collects stormwater and sanitary flows in the same pipes and treats them at the same plant. When infiltration is not feasible, sites are required to provide flow control to preserve pipe capacity and to prevent sewer backups in large storm events.

EXHIBIT "D"

Water quality treatment—to protect the Willamette River and Columbia Slough

Water quality treatment required for sites discharging into large water bodies.

REQUIREMENT:

Provide water quality treatment for the "water-quality storm," which represents 90% of the average annual runoff.

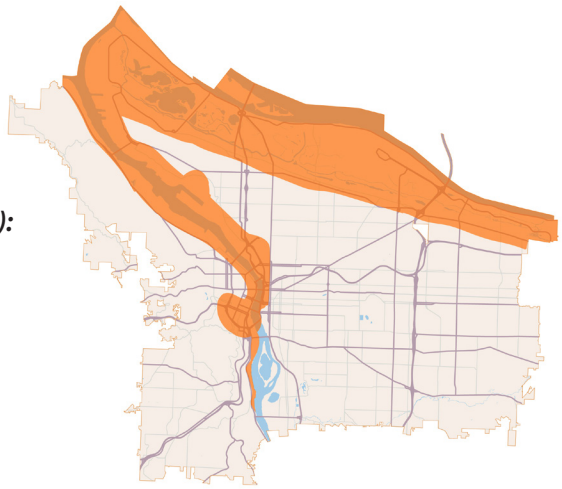
FACILITY DESIGN CHANGES:

Lined and unlined surface vegetated with offsite discharge (with underdrain):

- **Increase water quality storm—**the water-quality storm size will be 1.61 inches in 24 hours.
- Facilities will be sized based on an infiltration rate of 6 inches per hour for the imported growing media. This will balance the increase in the design storm size and result in a modest increase in facility size.
- Facility sizes will be less than 2% of the catchment area.
- Underdrain configuration requirements will change to reduce the amount of drain rock, improving plant health.

Rate-based facilities (manufactured stormwater treatment technologies):

- The intensity of the water-quality storm remains 0.19 inches per hour.
- Facilities on Environmental Services' approved list must be used.
- Allowed in limited circumstances if approved by Environmental Services.



Water Quality only

Along large water bodies, including the Willamette River and Columbia Slough, sites that cannot infiltrate must treat stormwater for water quality before discharging to surface waters (see map). These water bodies are large enough that flow control is not needed, however in some locations it is still required to preserve pipe capacity.

Water quality treatment and flow control to protect watershed heath

Environmental Services requires water-quality treatment and flow control at sites that discharge offsite to watersheds that flow into the Willamette River—such as Tryon, Fanno, and Johnson creeks.

REQUIREMENT (SOME CHANGES):

Provide treatment of water-quality storm (90% of average annual runoff)—and control post-development peak flows for a range of storm events.

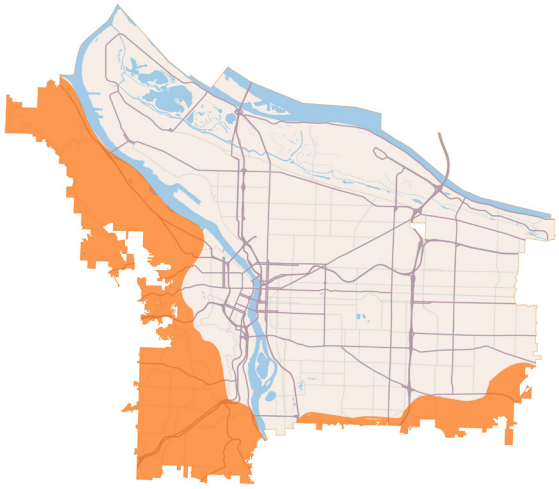
FACILITY DESIGN CHANGES:

Surface vegetated facilities with offsite discharge (with an underdrain):

- **Add orifice control to underdrained facilities—**Environmental Services will require orifices on more facilities, for reliable flow control.
- Facility sizes will increase to 8-9% of the catchment area.
- Facilities with small catchment areas that cannot meet flow control requirements will be required to filter the 25-year, 24-hour event.
- Underdrain configuration requirements will change to reduce the amount of drain rock, improving plant health.

Water quality treatment paired with detention:

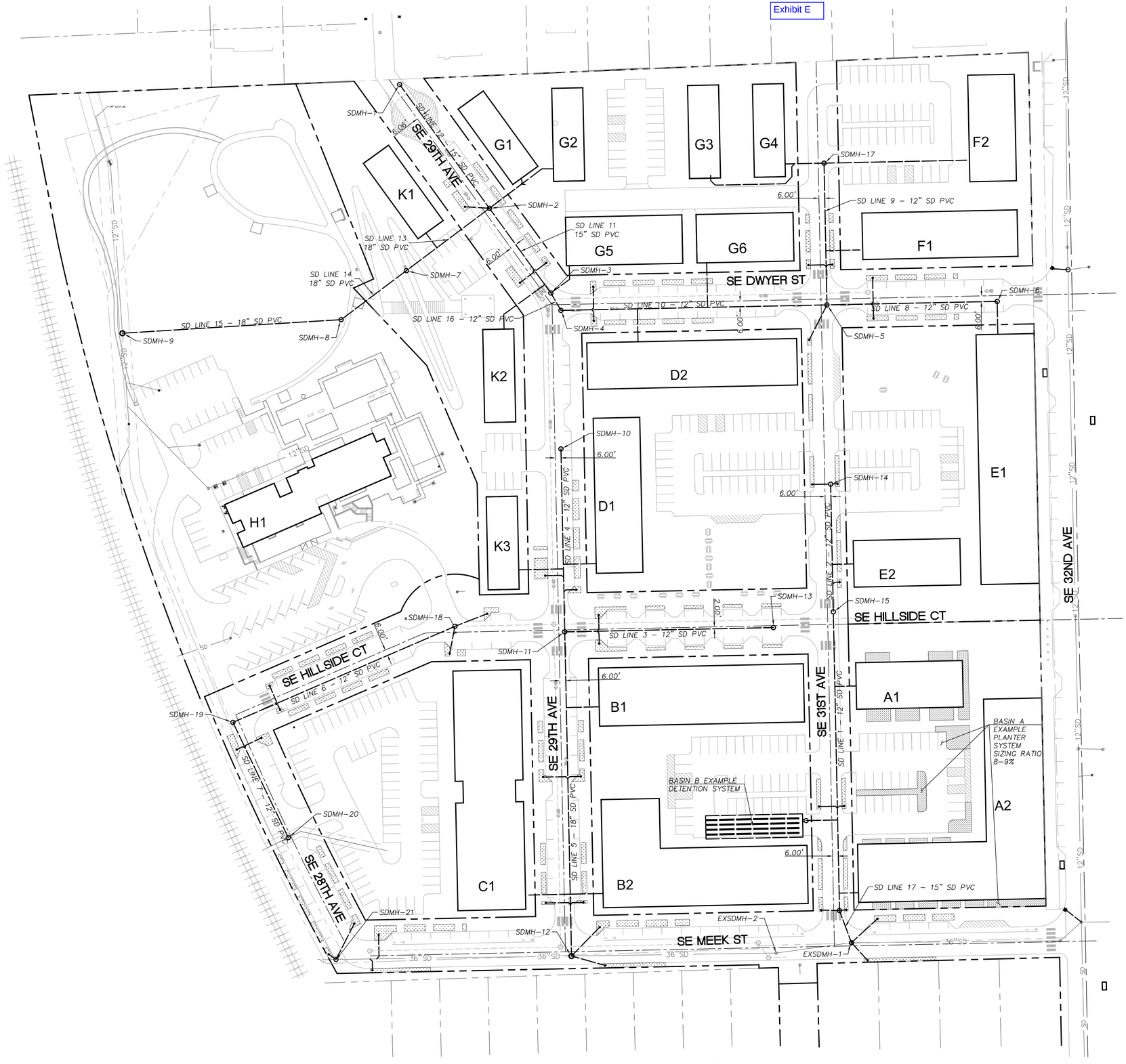
- Configurations with a water-quality facility paired with additional detention can meet water quality and flow control requirements.
- This combination can be used in limited circumstances when approved by Environmental Services.



Flow control + Water Quality

Where stormwater discharges to creeks, streams, and other smaller surface water bodies, both water quality treatment and flow control are required. Infiltration is often infeasible because of clay soils and landslide concerns. Treatment protects in-stream habitat from sediment and other pollutants. Flow control reduces channel erosion and flooding (see map).

Exhibit E



STORM SYSTEM PLAN
SCALE: 1"=50'

GENERAL SHEET NOTES

1. ALL CONSTRUCTION PER LATEST CITY OF MILWAUKIE PUBLIC WORKS STANDARDS.
2. STORM PIPE LESS THAN 24–INCH IN DIAMETER TO BE RIBBED PVC.
3. STORM PIPE LOCATED 5 FEET EAST OF STREET CENTERLINE WHERE POSSIBLE.
4. MINIMUM STORM PIPE COVER IS 36 INCHES.
5. EACH INDIVIDUAL LOT DEVELOPMENT SHALL MEET CURRENT CITY STORMWATER MANAGEMENT REQUIREMENTS FOR WATER QUALITY AND FLOW CONTROL.
6. ALL PUBLIC RIGHT OF WAY DEVELOPMENT IS PROPOSED TO HAVE STORMWATER MANAGEMENT MET BY SERIES OF GREEN STREET PLANTERS.

LEGEND

SYMBOL	DESCRIPTION
X" SD	EX. STORM DRAIN
X"SD – PVC	PROPOSED STORM DRAIN
	EX. STORM MANHOLE
	PROPOSED STORM MANHOLE
	OVERFLOW DRAIN
	PUBLIC STORM FACILITY SIZING FACTOR 8%

ABBREVIATIONS

EX.	EXISTING
FG	FINISHED GRADE
IE	INVERT ELEVATION
LF	LINEAL FEET
MH	MANHOLE
OD	OVERFLOW DRAIN
SD	STORM DRAIN

KEYNOTES

1. NONE THIS SHEET

GRAPHIC SCALE
0 50 100
1 inch = 50 ft.

KEY PLAN

S|E A
SCOTT|EDWARDS ARCHITECTURE LLP
2525 E. Burnside St., Portland, OR 97214
phone:(503) 226-3617 www.seallp.com

HILLSIDE MASTER PLAN

32ND AND MEEK ST.
MILWAUKIE, OR 97222

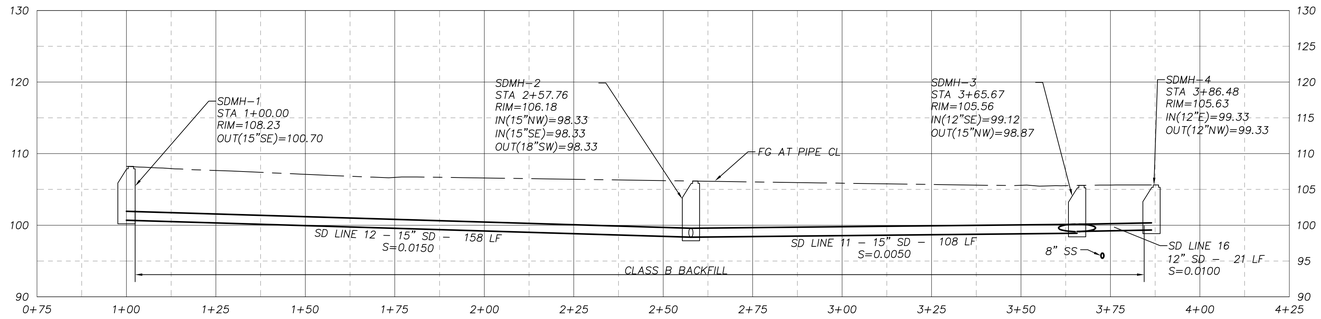
Humber Design Group, Inc.
Portland, OR • 503.946.6690 • hdgpdx.com

Drawing:

STORM SEWER PLAN

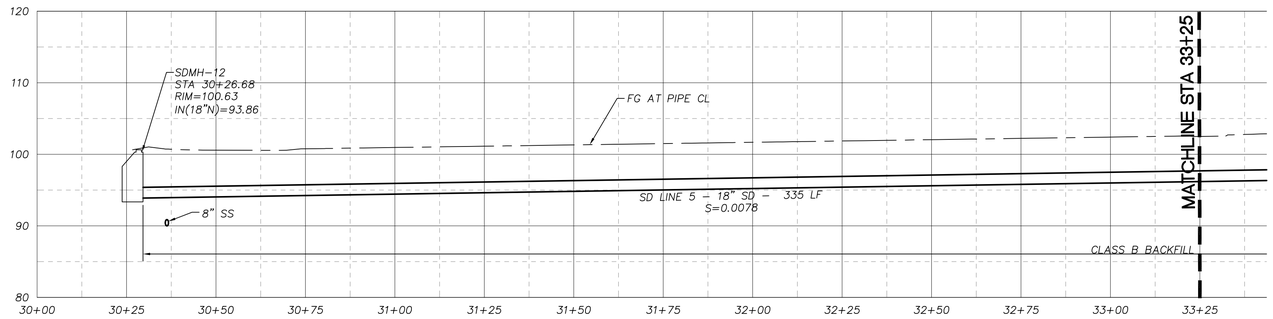
Job No:	20064
Date:	10/23/2020
Drawn By:	-
Checked By:	-
Sheet No:	

MP3.30



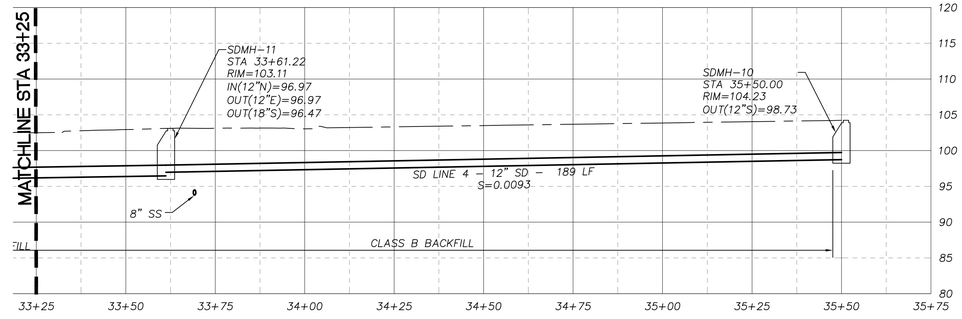
SE 29TH ST STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'



SE 29TH AVE STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'



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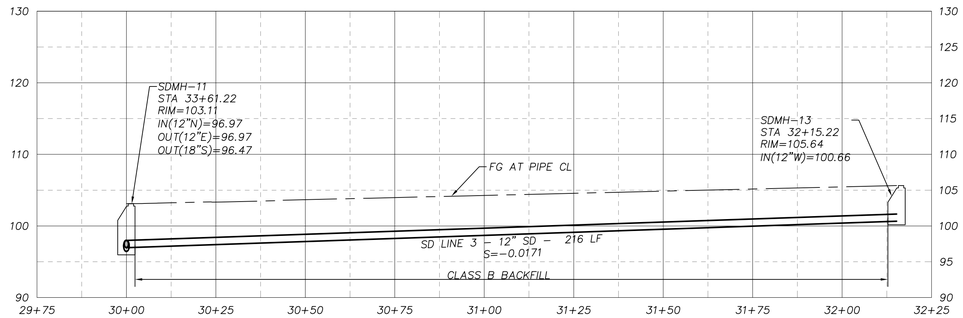
SCALE: H: 1"=20'
V: 1"=10'



SE HILLSIDE CT STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'

S|E A
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phone:(503) 226-3617 www.seallp.com

HILLSIDE MASTER PLAN

32ND AND MEEK ST.
MILWAUKIE, OR 97222

Humber Design Group, Inc.
Portland, OR • 503.946.6690 • hdgpdx.com

Drawing:

STORM SEWER PROFILE

Job No:	20064
Date:	10/23/2020
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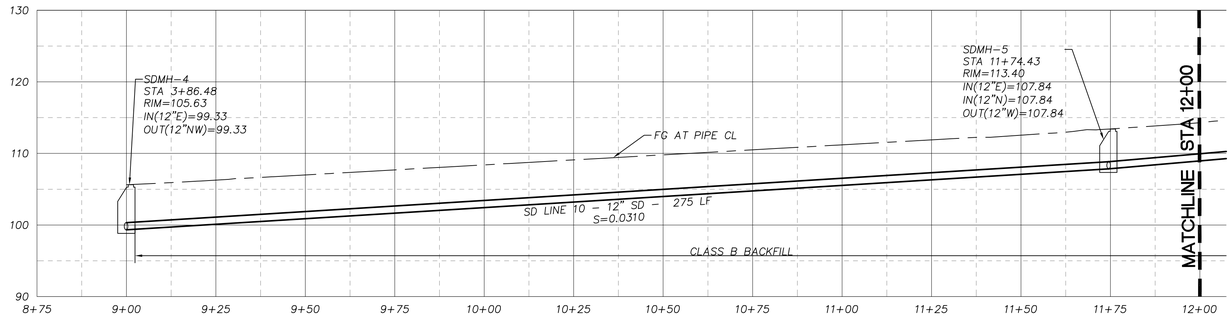
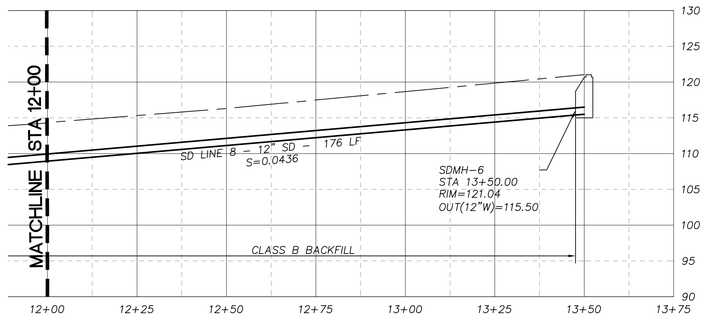
Checked By:	-
Sheet No:	

MP3.31



SE DWYER ST STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'



SE DWYER ST STORM SEWER PROFILE

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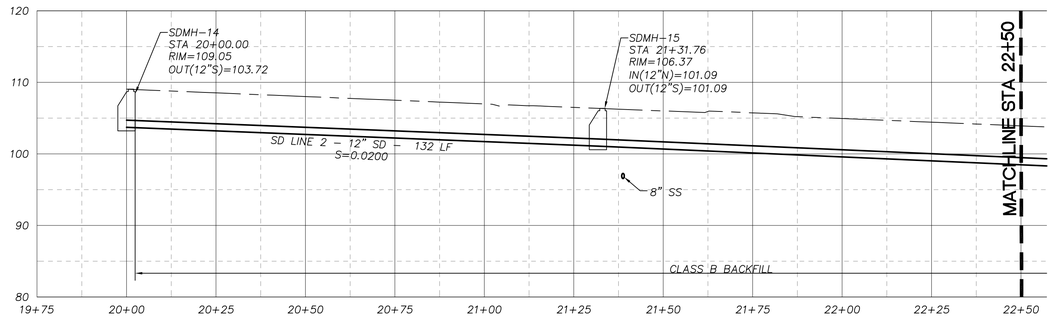

SE 31ST AVE STORM SEWER PROFILE

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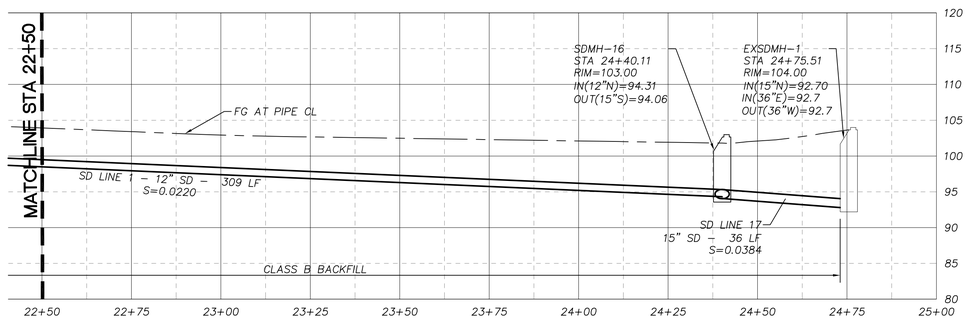


SE 31ST AVE STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'

S|E A
SCOTT|EDWARDS ARCHITECTURE LLP
2525 E. Burnside St., Portland, OR 97214
phone:(503) 226-3617 www.seallp.com

HILLSIDE MASTER PLAN

32ND AND MEEK ST.
MILWAUKIE, OR 97222

Humber Design Group, Inc.
Portland, OR • 503.946.6690 • hdgpdx.com

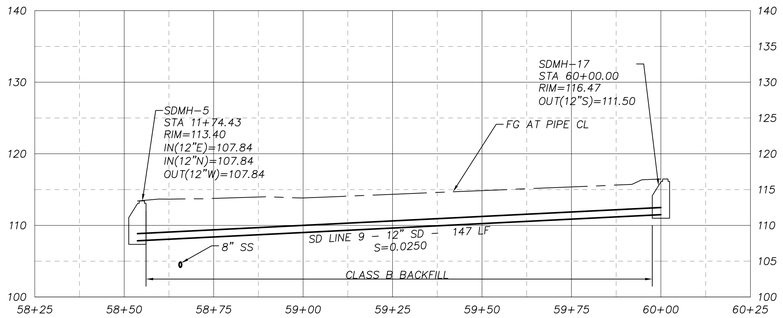
Drawing:

STORM SEWER PROFILE

Job No:	20064
Date:	10/23/2020
Drawn By:	-
Checked By:	-

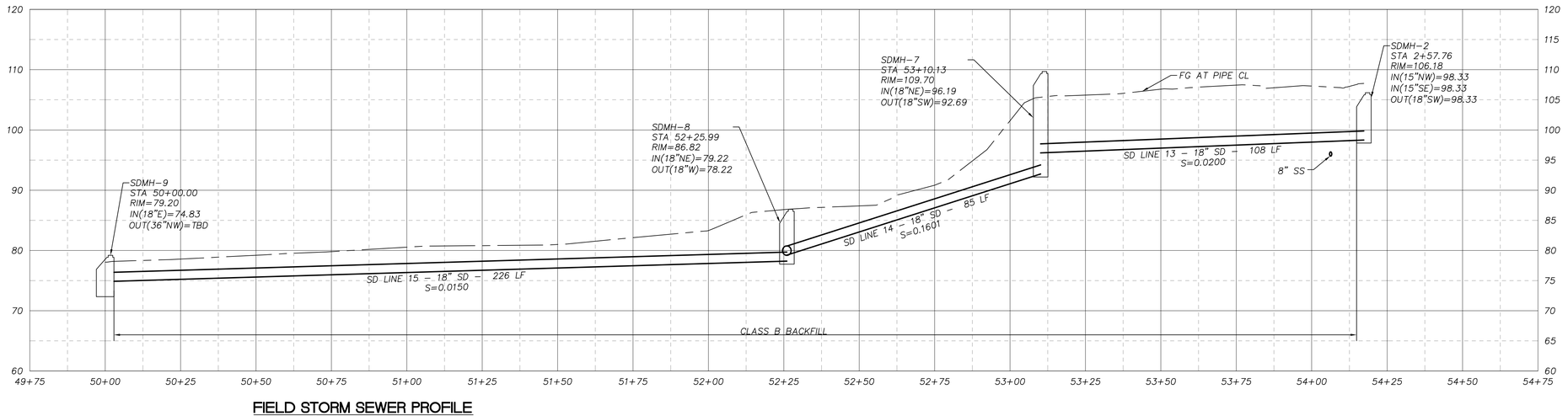
Sheet No:

MP3.32



SE 31ST AVE STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'



FIELD STORM SEWER PROFILE

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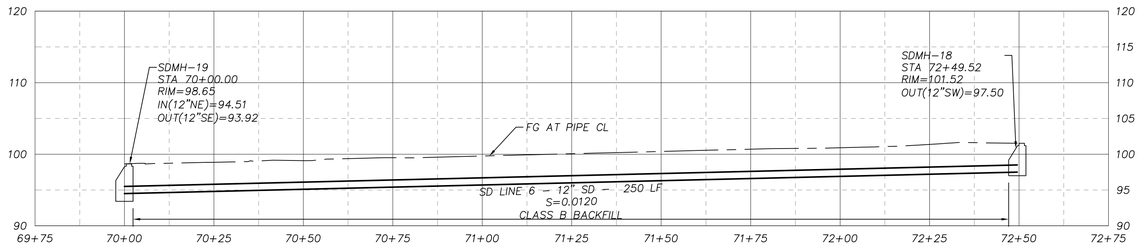
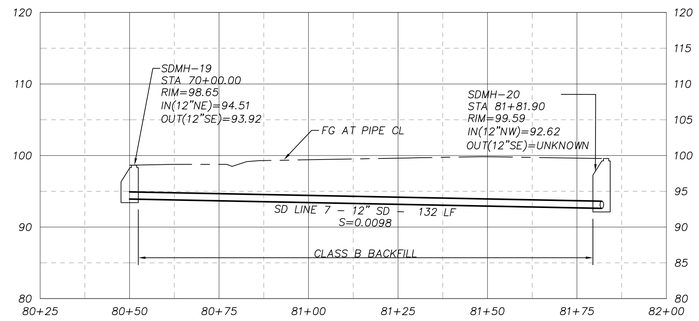


HILLSIDE CT STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'



28TH AVE STORM SEWER PROFILE

SCALE: H: 1"=20'
V: 1"=10'

S|E A
SCOTT|EDWARDS ARCHITECTURE LLP
2525 E. Burnside St., Portland, OR 97214
phone:(503) 226-3617 www.seallp.com

HILLSIDE MASTER PLAN

32ND AND MEEK ST.
MILWAUKIE, OR 97222

Humber Design Group, Inc.
Portland, OR • 503.946.6690 • hdgpdx.com

Drawing:

STORM SEWER PROFILE

Job No:	20064
Date:	10/23/2020
Drawn By:	-
Checked By:	-
Sheet No:	

MP3.33

EXHIBIT "F"

Public Planter HUD
Prepared by {enter your company name here}

Summary for Subcatchment 1: Typical Greenstreet Basin

Runoff = 0.10 cfs @ 7.90 hrs, Volume= 1,357 cf, Depth= 2.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2 year Rainfall=2.40"

	Area (sf)	CN	Description
*	7,500	98	
	7,500		100.00% Impervious Area

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

Subcatchment 1: Typical Greenstreet Basin

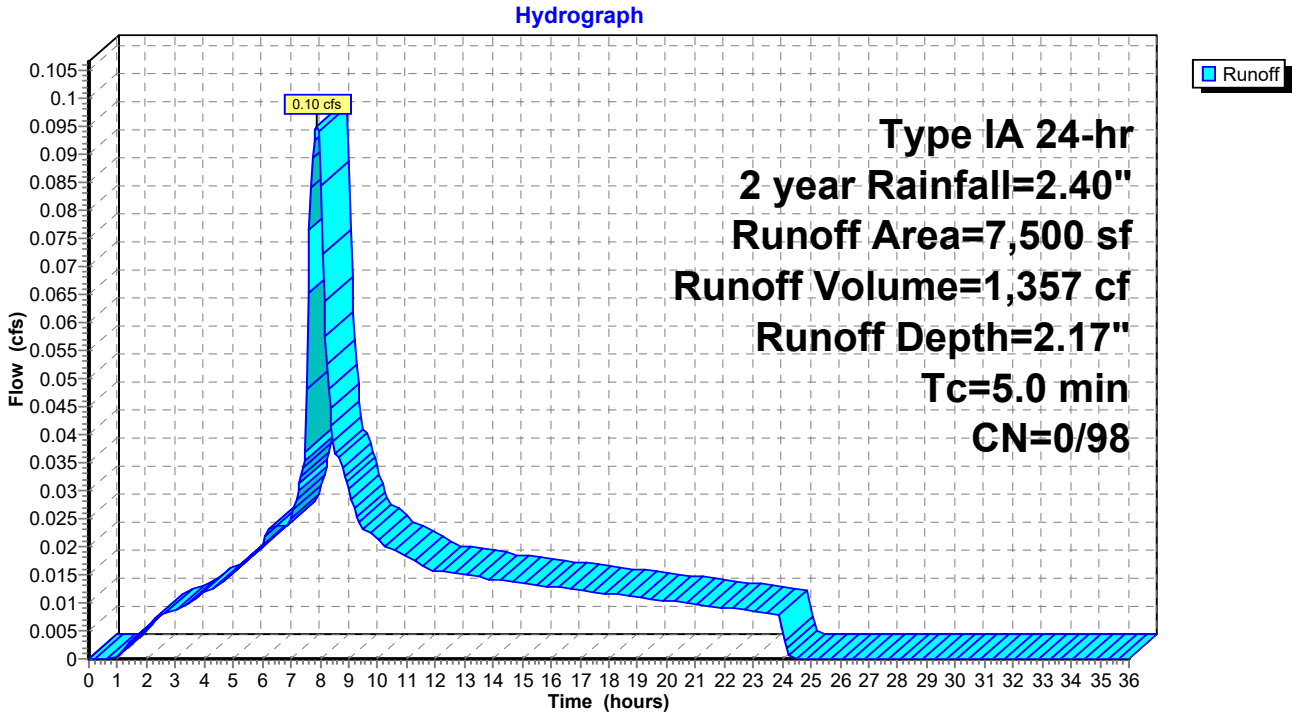


EXHIBIT "F"

Summary for Pond 2P: Typical Greenstreet Planter

Inflow Area = 7,500 sf,100.00% Impervious, Inflow Depth = 2.17" for 2 year event
Inflow = 0.10 cfs @ 7.90 hrs, Volume= 1,357 cf
Outflow = 0.03 cfs @ 7.20 hrs, Volume= 1,357 cf, Atten= 71%, Lag= 0.0 min
Discarded = 0.03 cfs @ 7.20 hrs, Volume= 1,357 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 100.28' @ 9.11 hrs Surf.Area= 600 sf Storage= 170 cf

Plug-Flow detention time= 31.9 min calculated for 1,357 cf (100% of inflow)
Center-of-Mass det. time= 31.9 min (707.0 - 675.2)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	600 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	600	0	0
101.00	600	600	600

7,500 sf basin with 600 sf planter. 600/7500= 8%

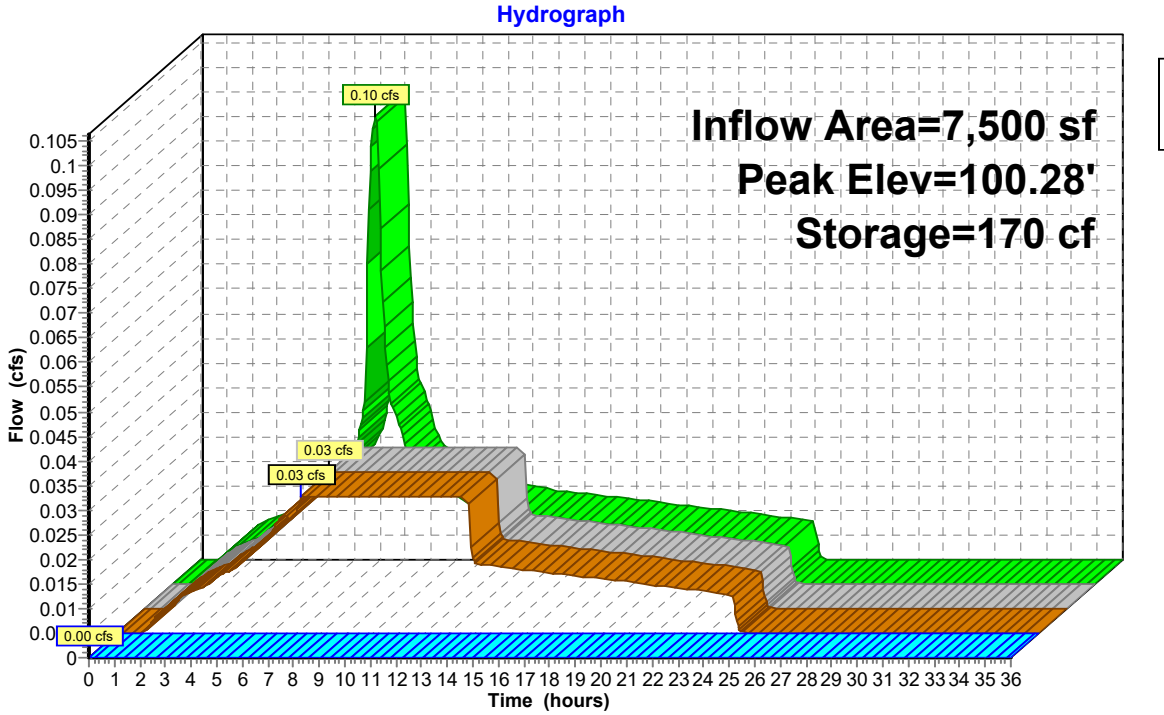
Device	Routing	Invert	Outlet Devices
#1	Discarded	100.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Primary	100.50'	**12.0" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 7.20 hrs HW=100.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

EXHIBIT "F"

Pond 2P: Typical Greenstreet Planter



Primary = overflow 6" above soil media

Per HUD funding requirements to meet NOAA/NEPA requirements, a storm water facility must treat 1/2 the volume of the 2 year storm. The PDX SWMM 2020 sizing of 8% was tested to confirm it would meet HUD criteria and passed. 100% of the water from the 2-year storm was filtered through the BES media.

These calculations verify use of public greenstreets and private planters to meet City of Milwaukie and HUD Criteria.

EXHIBIT "G"

Summary for Subcatchment 1 B Pre: B Predevleloped

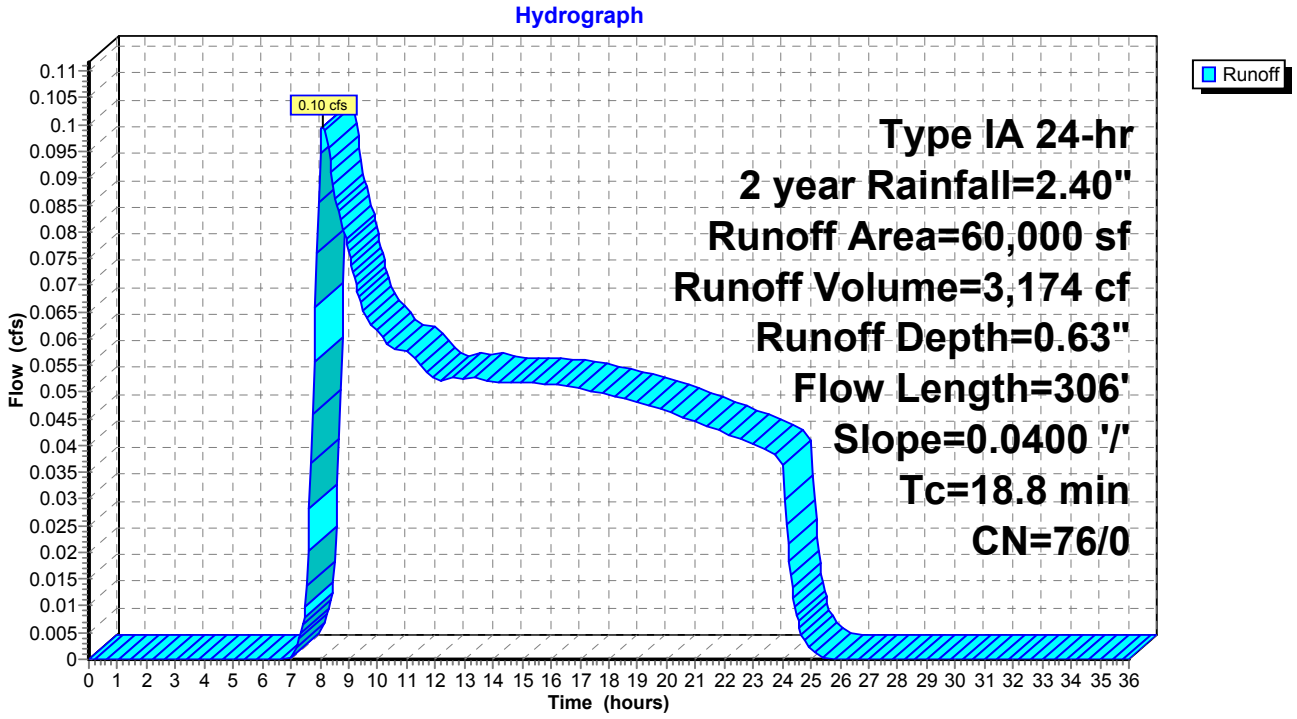
Runoff = 0.10 cfs @ 8.11 hrs, Volume= 3,174 cf, Depth= 0.63"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2 year Rainfall=2.40"

Area (sf)	CN	Description
60,000	76	Woods/grass comb., Fair, HSG C
60,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	75	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.40"
3.8	231	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.8	306	Total			

Subcatchment 1 B Pre: B Predevleloped



Summary for Subcatchment 2 B Post: Post Developed

[49] Hint: Tc<2dt may require smaller dt

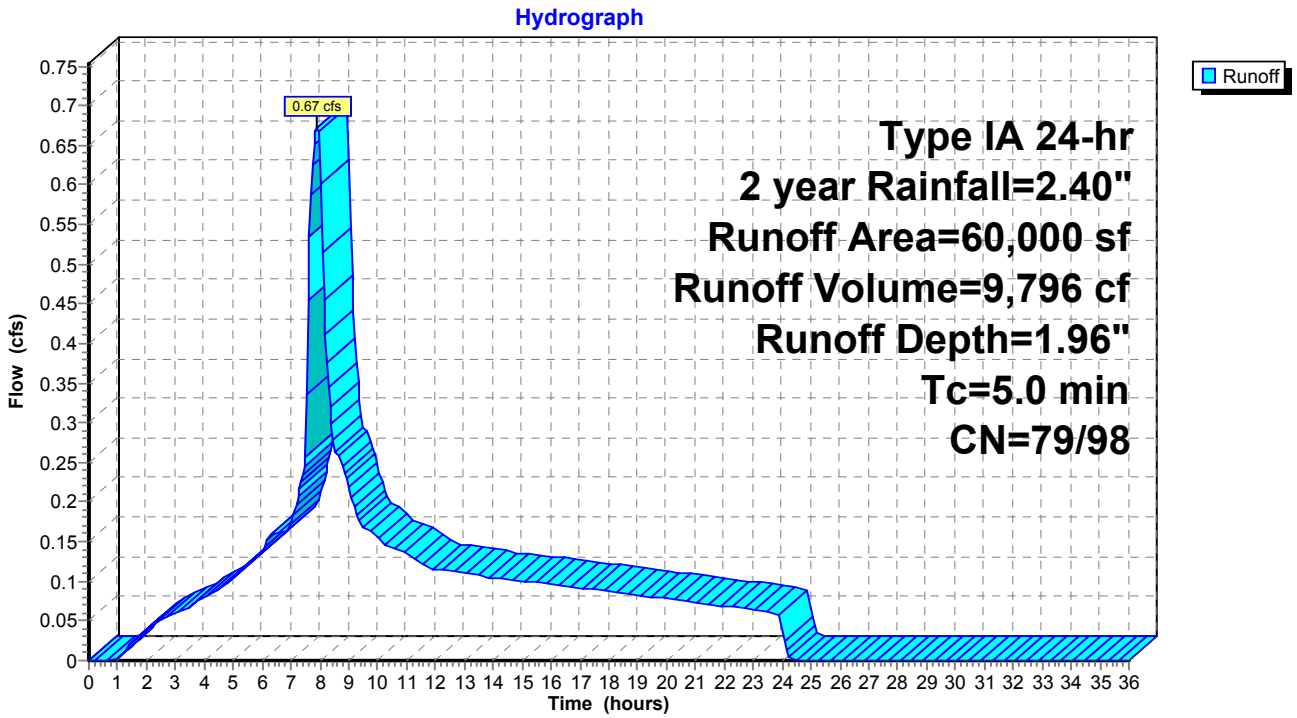
Runoff = 0.67 cfs @ 7.91 hrs, Volume= 9,796 cf, Depth= 1.96"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2 year Rainfall=2.40"

	Area (sf)	CN	Description
*	50,912	98	Paved parking & roofs
	9,088	79	50-75% Grass cover, Fair, HSG C
	60,000	95	Weighted Average
	9,088		15.15% Pervious Area
	50,912		84.85% Impervious Area

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

Subcatchment 2 B Post: Post Developed



Summary for Pond 3 B1: B Det Pipe

Inflow Area = 60,000 sf, 84.85% Impervious, Inflow Depth = 1.96" for 2 year event
Inflow = 0.67 cfs @ 7.91 hrs, Volume= 9,796 cf
Outflow = 0.09 cfs @ 16.38 hrs, Volume= 9,277 cf, Atten= 86%, Lag= 508.4 min
Primary = 0.09 cfs @ 16.38 hrs, Volume= 9,277 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 102.39' @ 16.38 hrs Surf.Area= 1,961 sf Storage= 3,919 cf

Plug-Flow detention time= 505.7 min calculated for 9,277 cf (95% of inflow)
Center-of-Mass det. time= 467.0 min (1,153.5 - 686.5)

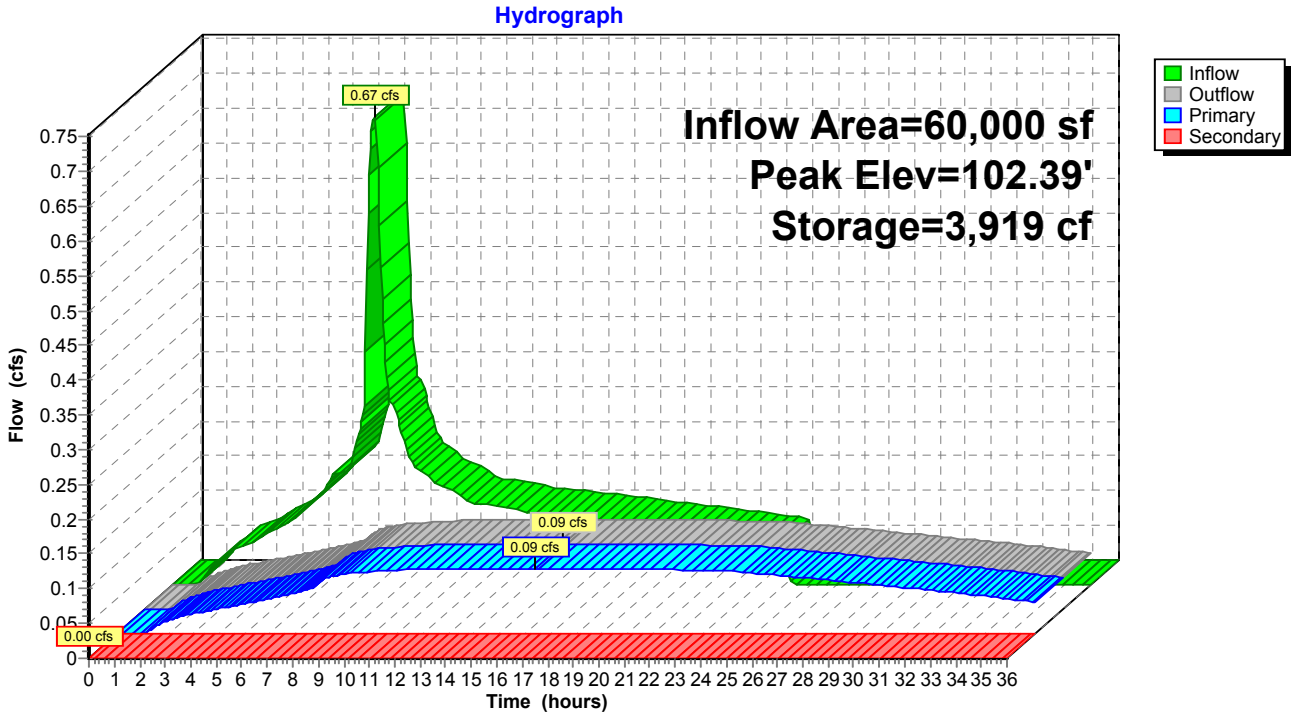
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	6,283 cf	**48.0" Round CMP_Round 48"** x 5 L= 100.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**1.5" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads
#2	Primary	102.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	103.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.09 cfs @ 16.38 hrs HW=102.39' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.09 cfs @ 7.69 fps)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' (Free Discharge)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3 B1: B Det Pipe



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1 B Pre: B Predevleloped Runoff Area=60,000 sf 0.00% Impervious Runoff Depth=0.95"
Flow Length=306' Slope=0.0400 '/' Tc=18.8 min CN=76/0 Runoff=0.19 cfs 4,741 cf

Subcatchment2 B Post: Post Developed Runoff Area=60,000 sf 84.85% Impervious Runoff Depth=2.43"
Tc=5.0 min CN=79/98 Runoff=0.83 cfs 12,167 cf

Pond 3 B1: B Det Pipe Peak Elev=102.91' Storage=4,904 cf Inflow=0.83 cfs 12,167 cf
Primary=0.13 cfs 11,124 cf Secondary=0.00 cfs 0 cf Outflow=0.13 cfs 11,124 cf

Total Runoff Area = 120,000 sf Runoff Volume = 16,909 cf Average Runoff Depth = 1.69"
57.57% Pervious = 69,088 sf 42.43% Impervious = 50,912 sf

Summary for Subcatchment 1 B Pre: B Predevleloped

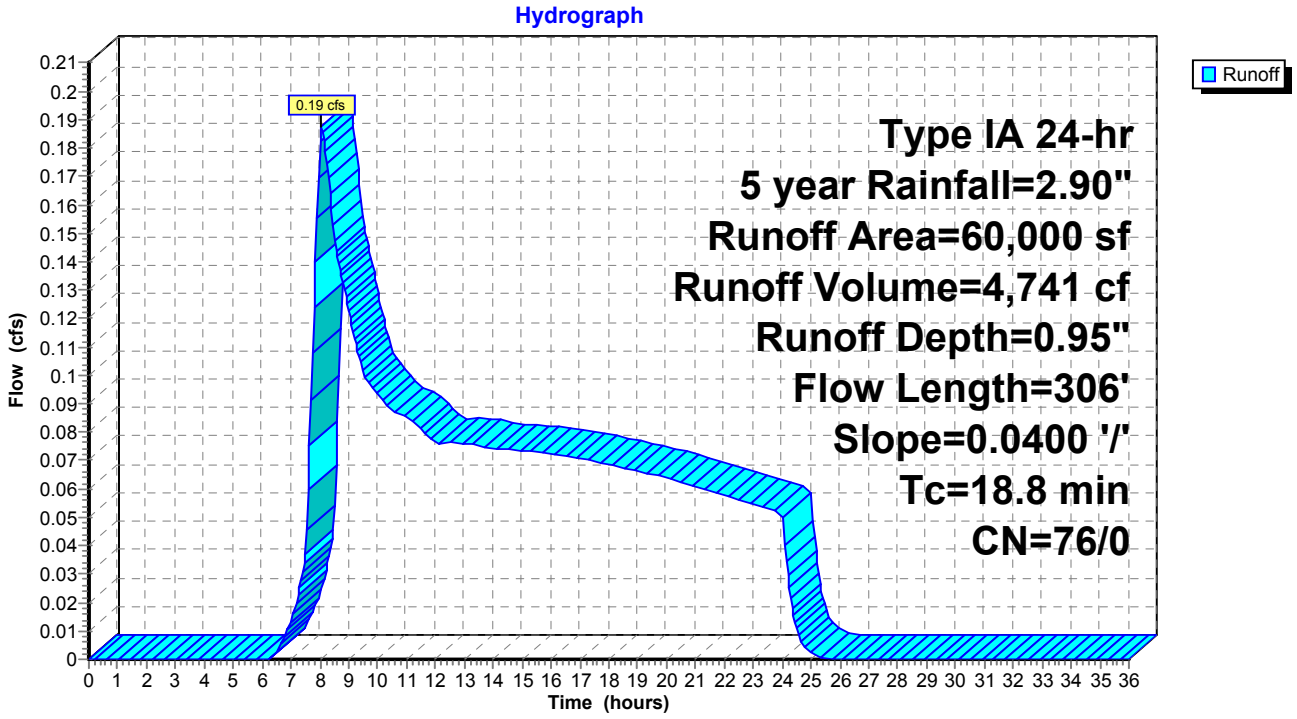
Runoff = 0.19 cfs @ 8.06 hrs, Volume= 4,741 cf, Depth= 0.95"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5 year Rainfall=2.90"

Area (sf)	CN	Description
60,000	76	Woods/grass comb., Fair, HSG C
60,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	75	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.40"
3.8	231	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.8	306	Total			

Subcatchment 1 B Pre: B Predevleloped



Summary for Subcatchment 2 B Post: Post Developed

[49] Hint: Tc<2dt may require smaller dt

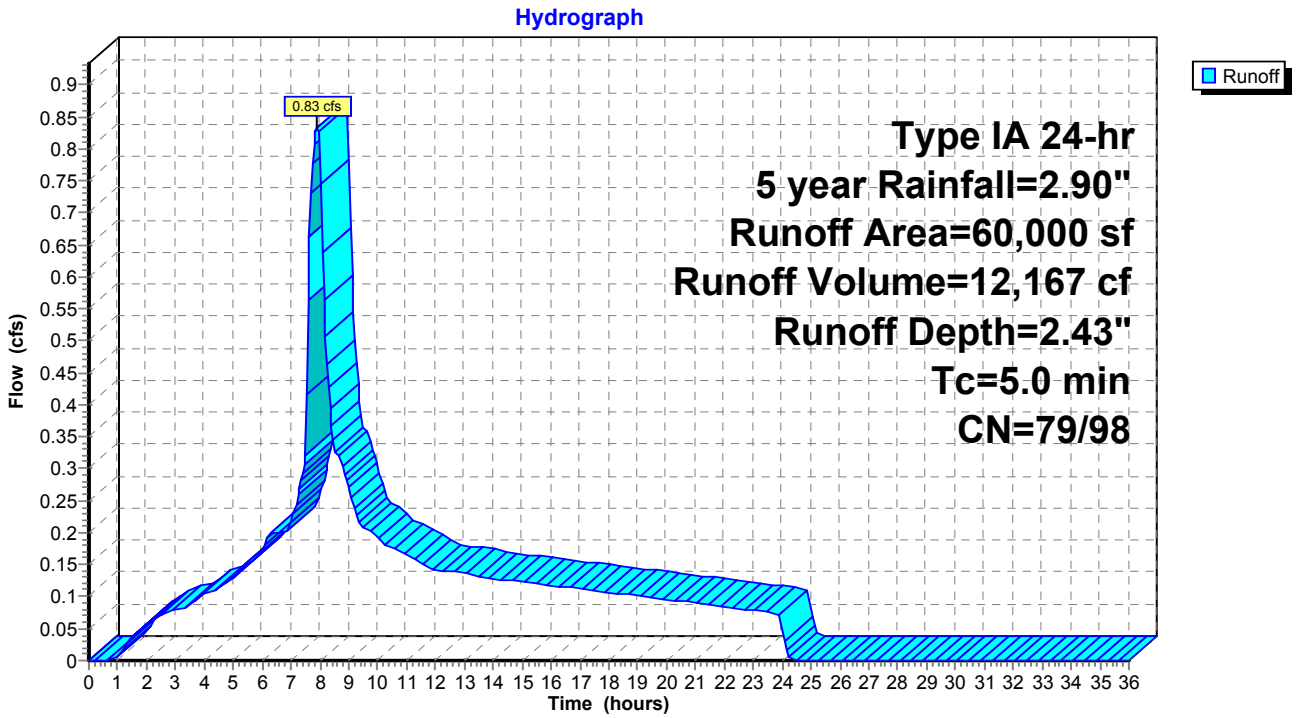
Runoff = 0.83 cfs @ 7.91 hrs, Volume= 12,167 cf, Depth= 2.43"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5 year Rainfall=2.90"

	Area (sf)	CN	Description
*	50,912	98	Paved parking & roofs
	9,088	79	50-75% Grass cover, Fair, HSG C
	60,000	95	Weighted Average
	9,088		15.15% Pervious Area
	50,912		84.85% Impervious Area

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

Subcatchment 2 B Post: Post Developed



Summary for Pond 3 B1: B Det Pipe

Inflow Area = 60,000 sf, 84.85% Impervious, Inflow Depth = 2.43" for 5 year event
Inflow = 0.83 cfs @ 7.91 hrs, Volume= 12,167 cf
Outflow = 0.13 cfs @ 13.40 hrs, Volume= 11,124 cf, Atten= 84%, Lag= 329.7 min
Primary = 0.13 cfs @ 13.40 hrs, Volume= 11,124 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 102.91' @ 13.40 hrs Surf.Area= 1,779 sf Storage= 4,904 cf

Plug-Flow detention time= 521.4 min calculated for 11,124 cf (91% of inflow)
Center-of-Mass det. time= 459.9 min (1,141.0 - 681.1)

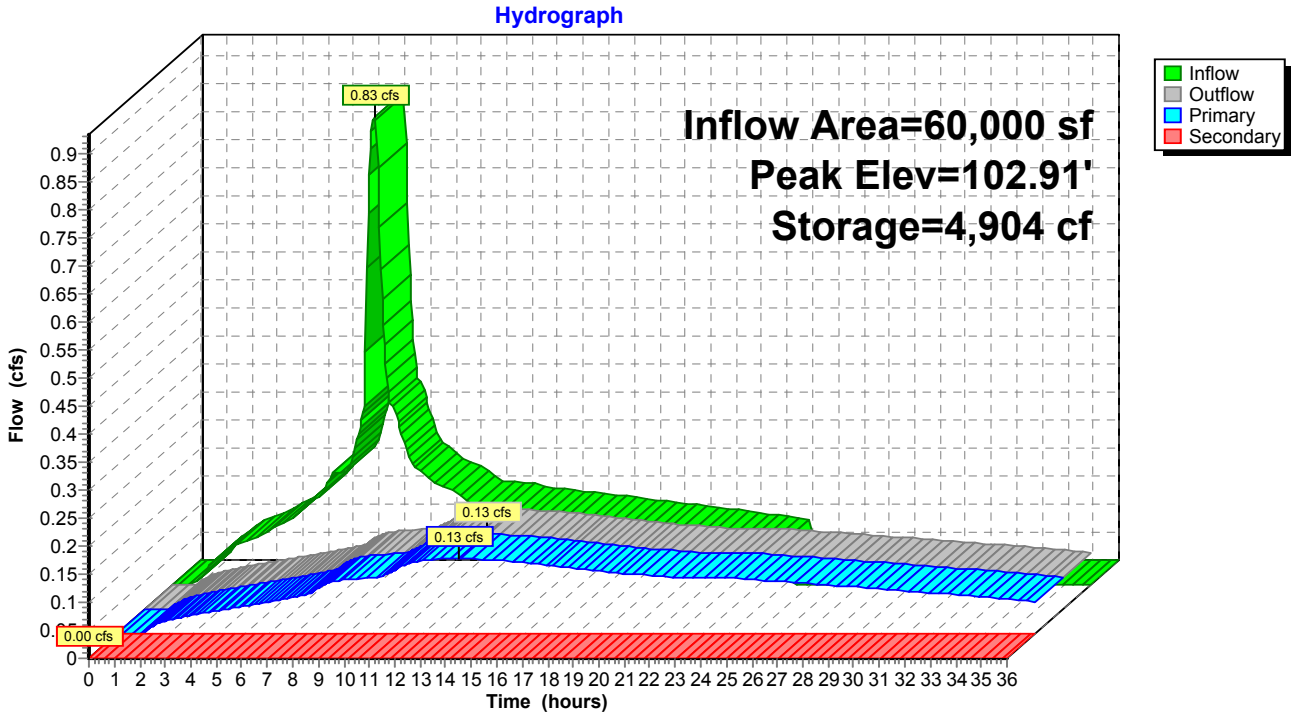
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	6,283 cf	**48.0" Round CMP_Round 48"** x 5 L= 100.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**1.5" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads
#2	Primary	102.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	103.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 13.40 hrs HW=102.91' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.10 cfs @ 8.49 fps)
└**2=Orifice/Grate** (Orifice Controls 0.03 cfs @ 1.38 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' (Free Discharge)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3 B1: B Det Pipe



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1 B Pre: B Predevleloped Runoff Area=60,000 sf 0.00% Impervious Runoff Depth=1.29"
Flow Length=306' Slope=0.0400 '/' Tc=18.8 min CN=76/0 Runoff=0.29 cfs 6,466 cf

Subcatchment2 B Post: Post Developed Runoff Area=60,000 sf 84.85% Impervious Runoff Depth=2.91"
Tc=5.0 min CN=79/98 Runoff=1.00 cfs 14,563 cf

Pond 3 B1: B Det Pipe Peak Elev=103.29' Storage=5,529 cf Inflow=1.00 cfs 14,563 cf
Primary=0.18 cfs 13,394 cf Secondary=0.00 cfs 0 cf Outflow=0.18 cfs 13,394 cf

Total Runoff Area = 120,000 sf Runoff Volume = 21,029 cf Average Runoff Depth = 2.10"
57.57% Pervious = 69,088 sf 42.43% Impervious = 50,912 sf

Summary for Subcatchment 1 B Pre: B Predevleloped

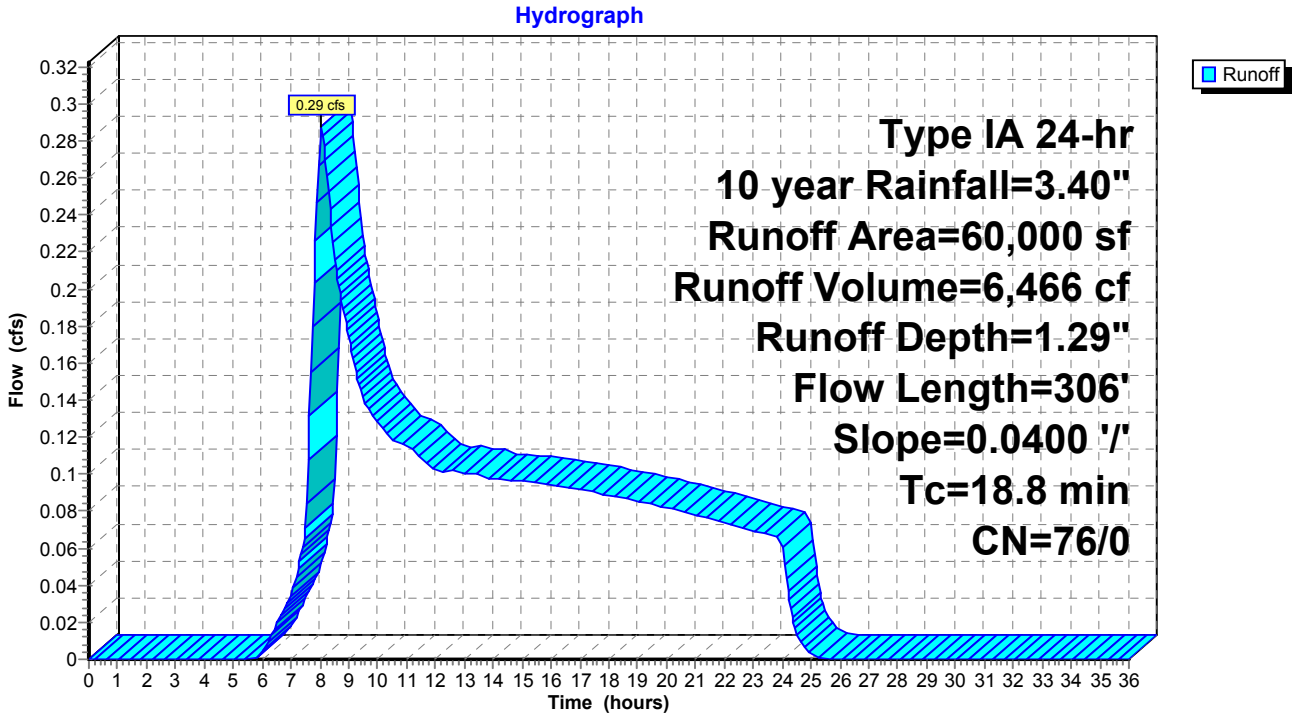
Runoff = 0.29 cfs @ 8.05 hrs, Volume= 6,466 cf, Depth= 1.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.40"

Area (sf)	CN	Description
60,000	76	Woods/grass comb., Fair, HSG C
60,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	75	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.40"
3.8	231	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.8	306	Total			

Subcatchment 1 B Pre: B Predevleloped



Summary for Subcatchment 2 B Post: Post Developed

[49] Hint: Tc<2dt may require smaller dt

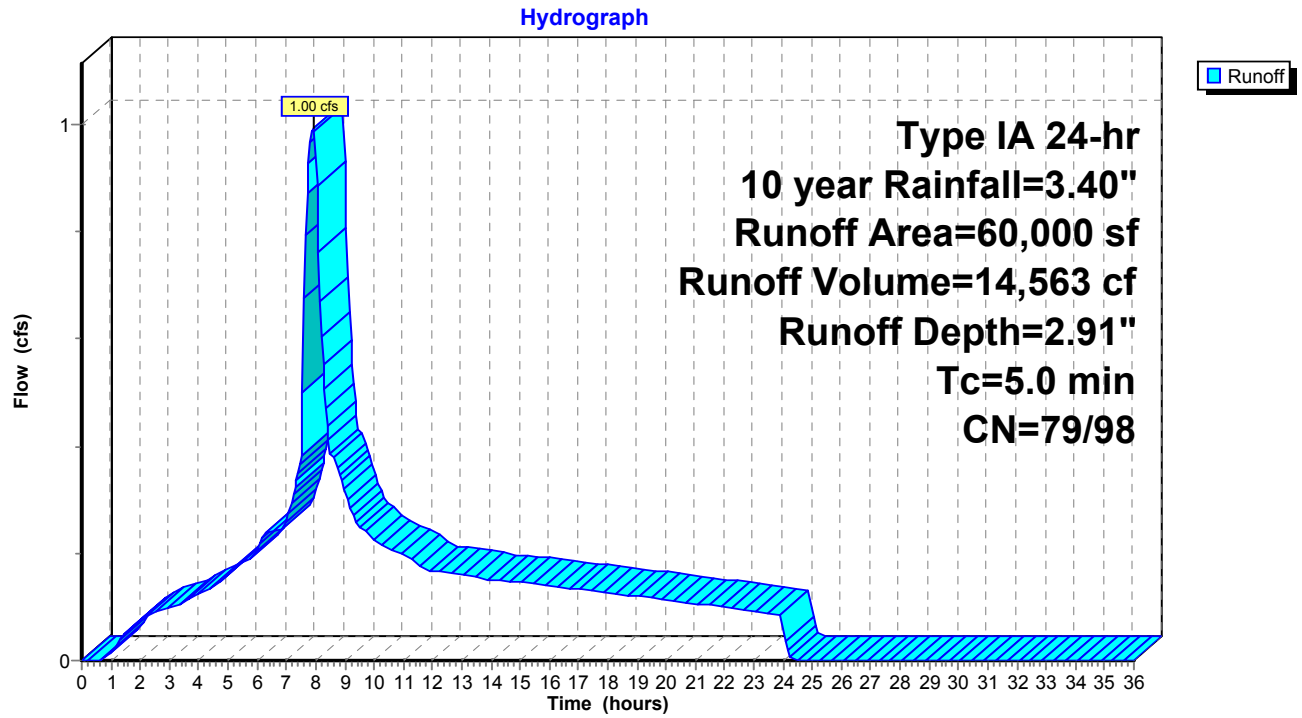
Runoff = 1.00 cfs @ 7.91 hrs, Volume= 14,563 cf, Depth= 2.91"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.40"

	Area (sf)	CN	Description
*	50,912	98	Paved parking & roofs
	9,088	79	50-75% Grass cover, Fair, HSG C
	60,000	95	Weighted Average
	9,088		15.15% Pervious Area
	50,912		84.85% Impervious Area

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

Subcatchment 2 B Post: Post Developed



Summary for Pond 3 B1: B Det Pipe

Inflow Area = 60,000 sf, 84.85% Impervious, Inflow Depth = 2.91" for 10 year event
Inflow = 1.00 cfs @ 7.91 hrs, Volume= 14,563 cf
Outflow = 0.18 cfs @ 11.47 hrs, Volume= 13,394 cf, Atten= 82%, Lag= 213.7 min
Primary = 0.18 cfs @ 11.47 hrs, Volume= 13,394 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 103.29' @ 11.47 hrs Surf.Area= 1,529 sf Storage= 5,529 cf

Plug-Flow detention time= 474.5 min calculated for 13,394 cf (92% of inflow)
Center-of-Mass det. time= 416.4 min (1,093.4 - 677.0)

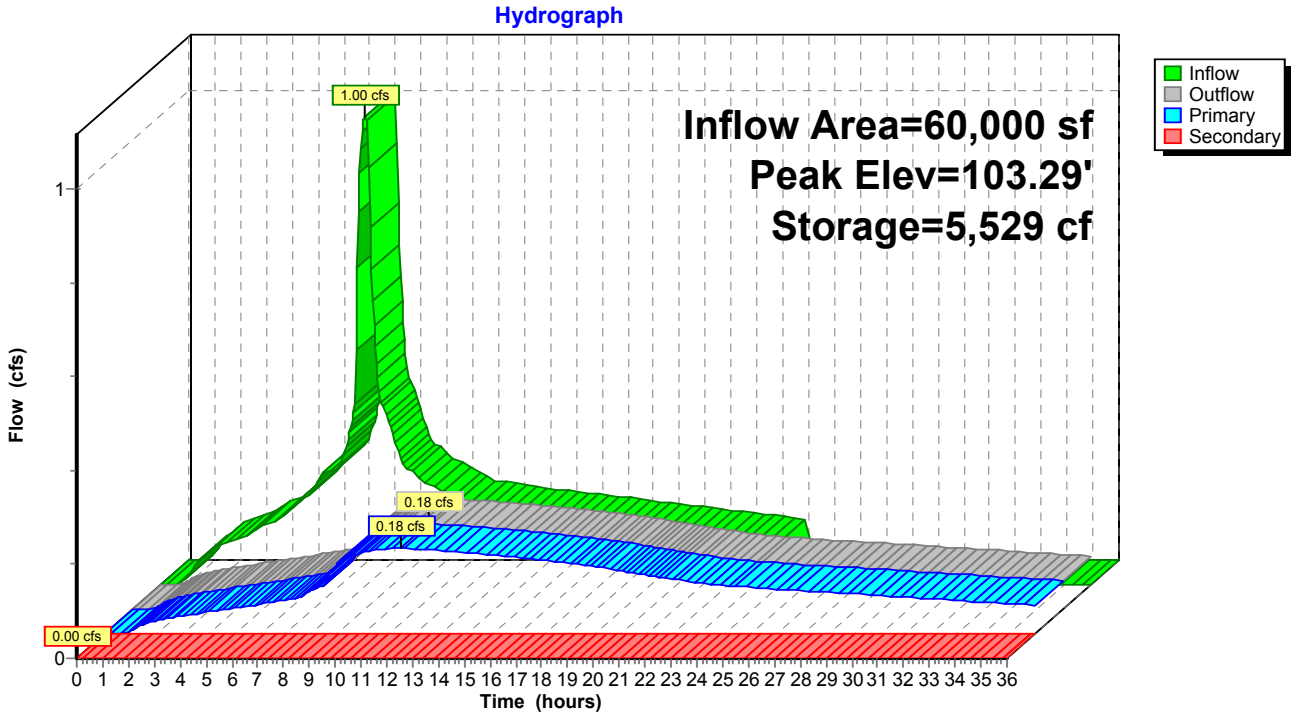
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	6,283 cf	**48.0" Round CMP_Round 48"** x 5 L= 100.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**1.5" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads
#2	Primary	102.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	103.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.18 cfs @ 11.47 hrs HW=103.29' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.11 cfs @ 9.02 fps)
└**2=Orifice/Grate** (Orifice Controls 0.07 cfs @ 3.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=100.00' (Free Discharge)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 3 B1: B Det Pipe



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1 B Pre: B Predevleloped Runoff Area=60,000 sf 0.00% Impervious Runoff Depth=1.66"
Flow Length=306' Slope=0.0400 '/' Tc=18.8 min CN=76/0 Runoff=0.40 cfs 8,312 cf

Subcatchment2 B Post: Post Developed Runoff Area=60,000 sf 84.85% Impervious Runoff Depth=3.40"
Tc=5.0 min CN=79/98 Runoff=1.16 cfs 16,977 cf

Pond 3 B1: B Det Pipe Peak Elev=103.78' Storage=6,145 cf Inflow=1.16 cfs 16,977 cf
Primary=0.22 cfs 15,544 cf Secondary=0.05 cfs 175 cf Outflow=0.27 cfs 15,719 cf

Total Runoff Area = 120,000 sf Runoff Volume = 25,288 cf Average Runoff Depth = 2.53"
57.57% Pervious = 69,088 sf 42.43% Impervious = 50,912 sf

Summary for Subcatchment 1 B Pre: B Predevleloped

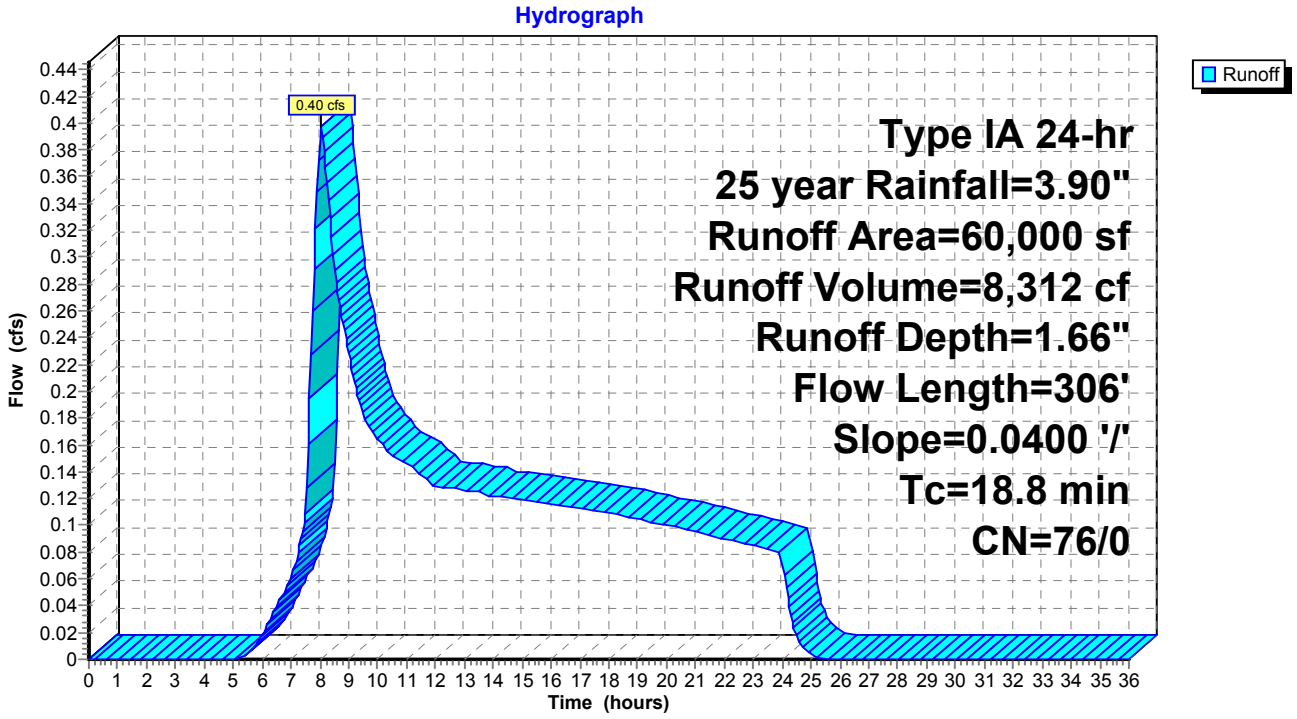
Runoff = 0.40 cfs @ 8.04 hrs, Volume= 8,312 cf, Depth= 1.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

Area (sf)	CN	Description
60,000	76	Woods/grass comb., Fair, HSG C
60,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	75	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.40"
3.8	231	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.8	306	Total			

Subcatchment 1 B Pre: B Predevleloped



Summary for Subcatchment 2 B Post: Post Developed

[49] Hint: Tc<2dt may require smaller dt

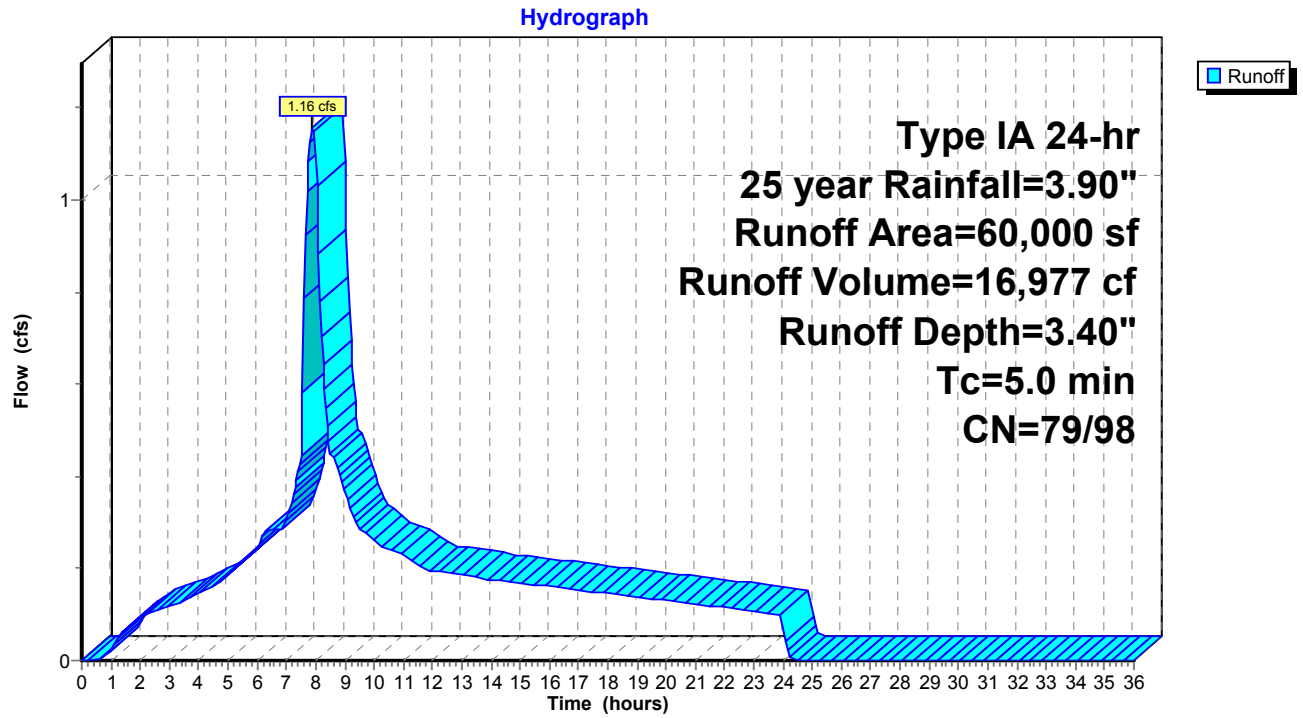
Runoff = 1.16 cfs @ 7.90 hrs, Volume= 16,977 cf, Depth= 3.40"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.90"

	Area (sf)	CN	Description
*	50,912	98	Paved parking & roofs
	9,088	79	50-75% Grass cover, Fair, HSG C
	60,000	95	Weighted Average
	9,088		15.15% Pervious Area
	50,912		84.85% Impervious Area

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

Subcatchment 2 B Post: Post Developed



Summary for Pond 3 B1: B Det Pipe

Inflow Area = 60,000 sf, 84.85% Impervious, Inflow Depth = 3.40" for 25 year event
Inflow = 1.16 cfs @ 7.90 hrs, Volume= 16,977 cf
Outflow = 0.27 cfs @ 9.85 hrs, Volume= 15,719 cf, Atten= 76%, Lag= 116.6 min
Primary = 0.22 cfs @ 9.85 hrs, Volume= 15,544 cf
Secondary = 0.05 cfs @ 9.85 hrs, Volume= 175 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 103.78' @ 9.85 hrs Surf.Area= 918 sf Storage= 6,145 cf

Plug-Flow detention time= 441.0 min calculated for 15,719 cf (93% of inflow)
Center-of-Mass det. time= 387.0 min (1,060.6 - 673.6)

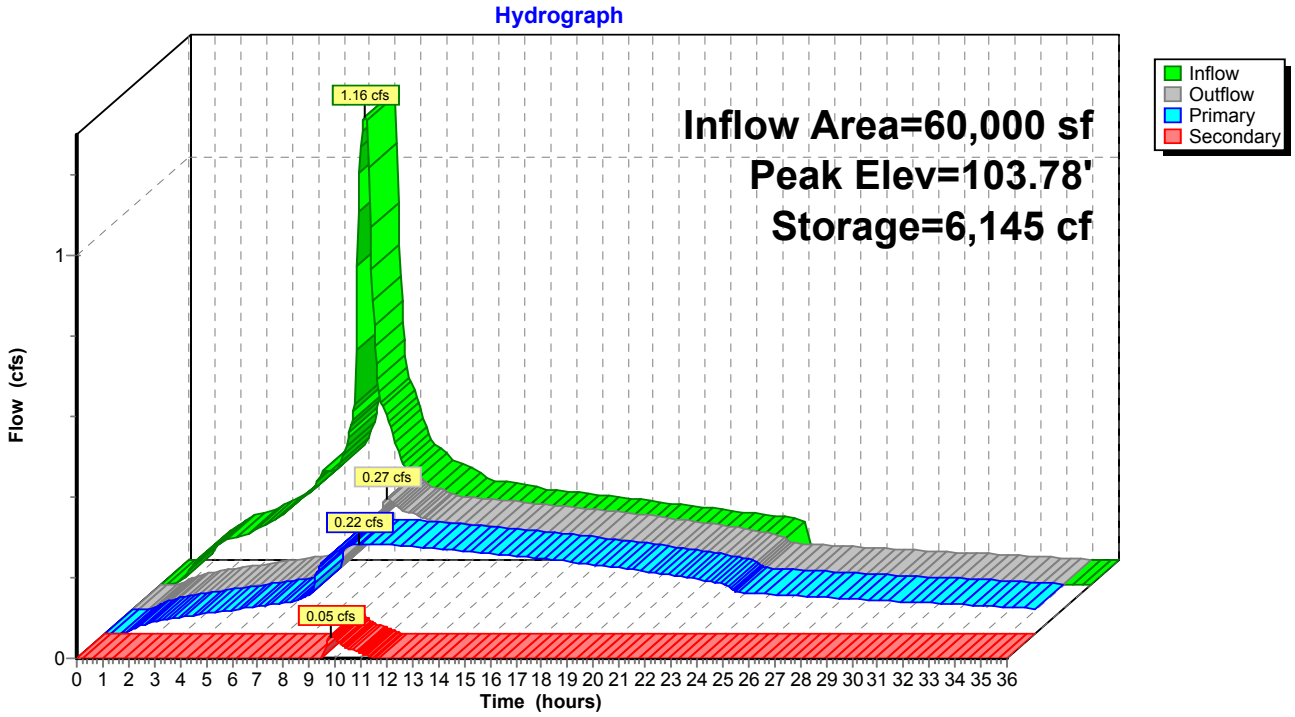
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	6,283 cf	**48.0" Round CMP_Round 48"** x 5 L= 100.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**1.5" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads
#2	Primary	102.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	103.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.22 cfs @ 9.85 hrs HW=103.78' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.12 cfs @ 9.67 fps)
└**2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 4.68 fps)

Secondary OutFlow Max=0.04 cfs @ 9.85 hrs HW=103.78' (Free Discharge)
└**3=Orifice/Grate** (Weir Controls 0.04 cfs @ 0.53 fps)

Pond 3 B1: B Det Pipe



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1 B Pre: B Predevleloped Runoff Area=60,000 sf 0.00% Impervious Runoff Depth=2.05"
Flow Length=306' Slope=0.0400 '/' Tc=18.8 min CN=76/0 Runoff=0.52 cfs 10,251 cf

Subcatchment2 B Post: Post Developed Runoff Area=60,000 sf 84.85% Impervious Runoff Depth=3.88"
Tc=5.0 min CN=79/98 Runoff=1.32 cfs 19,404 cf

Pond 3 B1: B Det Pipe Peak Elev=103.85' Storage=6,206 cf Inflow=1.32 cfs 19,404 cf
Primary=0.23 cfs 16,662 cf Secondary=0.33 cfs 1,389 cf Outflow=0.55 cfs 18,051 cf

Total Runoff Area = 120,000 sf Runoff Volume = 29,655 cf Average Runoff Depth = 2.97"
57.57% Pervious = 69,088 sf 42.43% Impervious = 50,912 sf

Summary for Subcatchment 1 B Pre: B Predevleloped

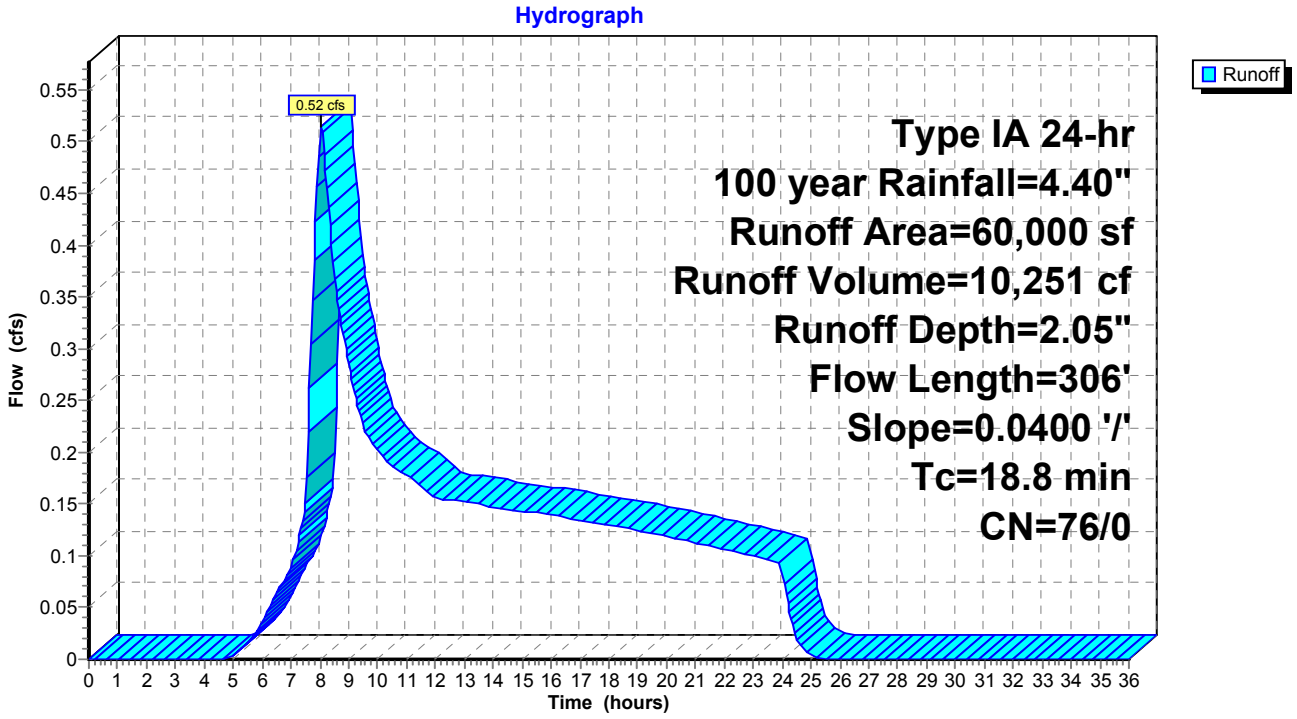
Runoff = 0.52 cfs @ 8.04 hrs, Volume= 10,251 cf, Depth= 2.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

Area (sf)	CN	Description
60,000	76	Woods/grass comb., Fair, HSG C
60,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	75	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.40"
3.8	231	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.8	306	Total			

Subcatchment 1 B Pre: B Predevleloped



Summary for Subcatchment 2 B Post: Post Developed

[49] Hint: Tc<2dt may require smaller dt

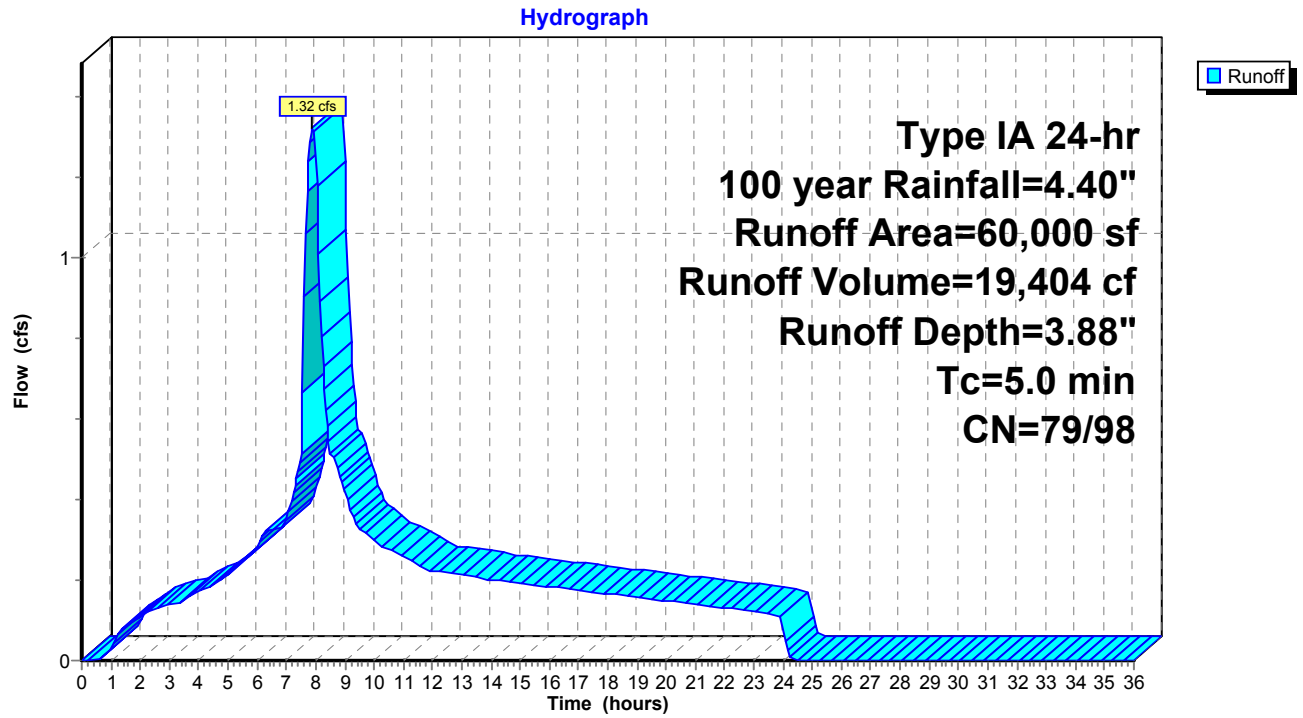
Runoff = 1.32 cfs @ 7.90 hrs, Volume= 19,404 cf, Depth= 3.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

	Area (sf)	CN	Description
*	50,912	98	Paved parking & roofs
	9,088	79	50-75% Grass cover, Fair, HSG C
	60,000	95	Weighted Average
	9,088		15.15% Pervious Area
	50,912		84.85% Impervious Area

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

Subcatchment 2 B Post: Post Developed



Summary for Pond 3 B1: B Det Pipe

Inflow Area = 60,000 sf, 84.85% Impervious, Inflow Depth = 3.88" for 100 year event
Inflow = 1.32 cfs @ 7.90 hrs, Volume= 19,404 cf
Outflow = 0.55 cfs @ 8.46 hrs, Volume= 18,051 cf, Atten= 58%, Lag= 33.4 min
Primary = 0.23 cfs @ 8.46 hrs, Volume= 16,662 cf
Secondary = 0.33 cfs @ 8.46 hrs, Volume= 1,389 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 103.85' @ 8.46 hrs Surf.Area= 761 sf Storage= 6,206 cf

Plug-Flow detention time= 402.0 min calculated for 18,026 cf (93% of inflow)
Center-of-Mass det. time= 351.6 min (1,022.4 - 670.8)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	6,283 cf	**48.0" Round CMP_Round 48"** x 5 L= 100.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**1.5" Horiz. Orifice/Grate** C= 0.620 Limited to weir flow at low heads
#2	Primary	102.75'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	103.75'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.23 cfs @ 8.46 hrs HW=103.85' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.12 cfs @ 9.76 fps)
└**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 4.85 fps)

Secondary OutFlow Max=0.32 cfs @ 8.46 hrs HW=103.85' (Free Discharge)
└**3=Orifice/Grate** (Weir Controls 0.32 cfs @ 1.03 fps)

Pond 3 B1: B Det Pipe

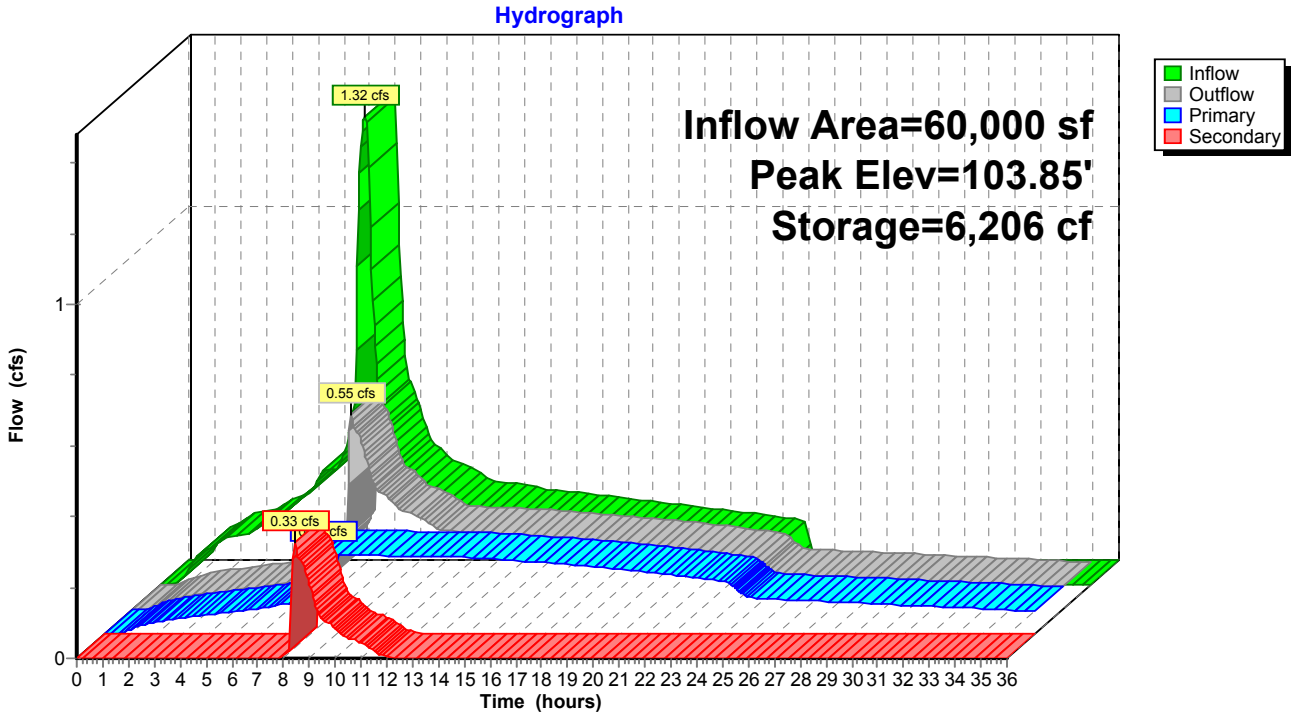


Exhibit H

NOAA Stormwater Requirements

Treat 50% of the 2-year 24 hours storm runoff.

		System Used
2 Year - 24 hour Storm	2.4 in	
18" Contech Treatment Capacity = 0.033 cfs		X
"Low Drop" Contech Treatment Capacity = 0.022 cfs		
12" Kristar Perkfilter Treatment Capacity = .0267 cfs		
18" Kristar Perkfilter Treatment Capacity = 0.040		

Number of Cartridges Used	2

Export from HydroCAD 2 year Storm Event

Time (hours)	*Precip. (inches)*	*Imp.Excess (inches)*	*Runoff (cfs)*	*Treatment Capacity of Filter System (cfs)*	*Volume Treated (cf)*	*Volume Exceeding*
0	0	0	0	0.04	0	0
1	0.05	0	0	0.04	0	0
2	0.13	0.02	0.01	0.04	36	0
3	0.2	0.07	0.01	0.04	36	0
4	0.29	0.14	0.01	0.04	36	0
5	0.39	0.22	0.02	0.04	72	0
6	0.51	0.33	0.02	0.04	72	0
7	0.67	0.48	0.03	0.04	108	0
8	1.06	0.85	0.11	0.04	396	252
9	1.3	1.08	0.04	0.04	144	0
10	1.44	1.22	0.03	0.04	108	0
11	1.56	1.34	0.02	0.04	72	0
12	1.66	1.44	0.02	0.04	72	0
13	1.75	1.53	0.02	0.04	72	0
14	1.84	1.62	0.02	0.04	72	0
15	1.92	1.7	0.02	0.04	72	0
16	2	1.78	0.02	0.04	72	0
17	2.08	1.85	0.01	0.04	36	0
18	2.15	1.92	0.01	0.04	36	0
19	2.22	1.99	0.01	0.04	36	0
20	2.28	2.05	0.01	0.04	36	0
21	2.34	2.11	0.01	0.04	36	0
22	2.4	2.17	0.01	0.04	36	0
23	2.45	2.22	0.01	0.04	36	0
24	2.5	2.27	0.01	0.04	72	0

Total 2 year Volume treated (CF)	**Total 2-year Volume Bypass (CF)**
1764	252

87.50%	**of 2-year 24 hours storm is treated.**

City of Portland Water Quality Calculations

Basin	**A**	
WQ Storm (I)	0.19	in
Acres	1.4	AC
Acres/SF Conversion	60984	SF
Coefficient ©	0.9	HR
WQ storm	**0.298018519**	**cfs**

Contech StormFilter® Water Quality

Basin	**A**	
Max WQ Runoff	0.298018519	cfs
Q cartridge	7.5	gpm
gpm/cfs conversion	449	gpm/cfs
Number of Cartridges Required	**18**	**Cartridges**

EXHIBIT "I"

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Clackamas County Area, Oregon

February 13, 2019

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,490 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
53B	Latourell loam, 3 to 8 percent slopes	0.1	0.6%
84	Wapato silty clay loam	0.4	1.8%
91B	Woodburn silt loam, 3 to 8 percent slopes	20.7	97.6%
Totals for Area of Interest		**21.2**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Clackamas County Area, Oregon

53B—Latourell loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 225k
Elevation: 50 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Latourell and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Latourell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 48 inches: loam
H3 - 48 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

84—Wapato silty clay loam

Map Unit Setting

National map unit symbol: 227j

Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Wapato and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wapato

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 18 inches: silty clay loam
H2 - 18 to 45 inches: silty clay loam
H3 - 45 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Cove

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Humaquepts

Percent of map unit: 4 percent
Landform: Flood plains

Hydric soil rating: Yes

91B—Woodburn silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227z
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

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