

SUPPLEMENTAL DRAINAGE MEMORANDUM

For



PROPOSED

The Commons at River Road

***100 Old River Road
Andover, Massachusetts***

Prepared by:

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BOHLER //

March 3, 2026
#MAB250074.00

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the development of a proposed mixed use multi-family development located on the southwesterly side of Old River Road in the Town of Andover, Massachusetts. The site, which contains approximately 9.61 acres of land, contains an existing office building and associated parking lot. The remaining portion of the site is undeveloped consisting of wetland and wooded areas.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at two (2) “design points” where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	2.04	2.03	-0.01	4.12	3.70	-0.42	5.52	4.77	-0.75	7.73	7.55	-0.18
DP2	13.89	12.64	-1.25	24.30	23.64	-0.66	31.02	29.60	-1.42	41.48	39.00	-2.48

**Flows are represented in cubic feet per second (cfs)*

II. EXISTING SITE CONDITIONS

On-Site Soil Information

Onsite soil testing was performed by Bohler on November 5th, 2025. The test pits identified loamy sand on top of glacial till as well as areas of exposed or shallow bedrock. Estimated seasonal high groundwater (ESHGW) was not encountered in some of the test pits and therefore is assumed to be at the bottom of the exploration. ESHGW was observed in test pit 4 approximately 84” below existing grade. Additional sieve analysis was performed on soil samples and as such a Rawl’s Rate of 0.27 in/hour associated with Silty Loam has been used for the analysis. Refer to **Appendix C** for additional information.

Existing Watersheds and Design Point Information

Based on the peer review comments, portions of both DP1 and DP2 were revised to include woods as the ground cover to be consistent with the use of woods groundcover in the proposed model. The wooded areas are generally around the wetlands.

Additionally, EX2 was revised with an updated time of concentration (tc) for portions of the existing site that have overland flow across grass and wooded areas before discharge to the design point.

Refer to **Table 1.1** for the existing conditions peak rates of runoff. Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. **PROPOSED SITE CONDITIONS**

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided into eight (8) separate sub catchments for the proposed conditions as described below.

Under proposed conditions DP#1 receives stormwater flows from approximately 1.5 acres of land, designated as watershed "PR-1a" and "PR-1b".

Under proposed conditions DP#2 receives stormwater flows from approximately 6.3 acres of land, designated as watershed "PR-2a" through "PR-2f".

Refer to **Table 1.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix E** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. **STORMWATER MANAGEMENT STANDARDS**

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas (including the building roof and paved parking/driveway areas) shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The stormwater runoff from the project will be collected and diverted to the proposed infiltration systems. The project as proposed will involve the creation of 40,293 square feet of new impervious area and is required to infiltrate 853 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed infiltration systems will provide 11,916 cubic feet of volume below the lowest outlet for groundwater recharge. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes, including stage-storage tables for the infiltrating BMPs.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins or water quality inlets/units and the infiltration systems. This project is considered a LUHPPL per Standard 5 and is required to provide 44% pre-treatment as well as treat the 1.0 inch water quality volume. TSS removal calculations are included in **Appendix F** of this report. The project as proposed will result in a post-construction impervious area of 241,107 sf and is required to treat 20,092 cubic feet of water quality volume (or equivalent water quality flow rate) as defined in Stormwater Standard 4. The proposed water quality units have been sized to treat the water quality flow rate equivalent to meet the 1.0 inch water quality volume requirement. The removal rates from the manufacturer are included in this report. Per the Town of Andover Stormwater Management and Erosion Control Regulations Section IX.D, this project is required to remove 90% of total suspended solids (TSS) and 60% of total phosphorus (TP). This project is documenting compliance with the use of the EPA Region 1's BMP Accounting and Tracking Tool. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes, flow rate equivalents, and pollutant removals, including design point specific weighted removal rates.

Standard #5: Land Use with Higher Potential Pollutant Loads

The proposed project involves "Land Uses with Higher Potential Pollutant Loads". Accordingly, the stormwater management system includes an oil-grit separator (water quality units) prior to

discharge. In addition, the project will provide 44% TSS removal prior to infiltration and treat the 1.0 in water quality depth, as further illustrated in **Appendix E** of this report.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

The proposed project is a mix of new and re-development; however, the project as been designed to meet the requirements as if it were new development.

Standard #8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent. Refer to **Appendix H**.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties and an estimated budget for inspections and maintenance.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

V. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids and total phosphorus from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons is contained in **Table 1.1**.

As described in the report, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the project meets or exceeds the MADEP Stormwater Management Standards and the Town of Andover Stormwater Management and Erosion Control Regulations as described further herein.

The proposed stormwater management system will provide substantial groundwater recharge and infiltration compared to existing conditions will provide additional benefits to both stormwater runoff quality and quantity.

APPENDIX C: SOIL AND WETLAND INFORMATION

➤ **STORMWATER TEST PITS**



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

100 Old River Road LLC c/o DND Homes LLC

Owner Name

100 Old River Road

Street Address

Andover

City

MA

State

Map 143, Lot 8

Map/Lot #

01810

Zip Code

B. Site Information

1. (Check one) New Construction Upgrade

2. Soil Survey NRCS WebSoil Survey 711B; 73A; 6A; 256A Charlton-Rock outcrop-Hollis complex, 3-8%
Source Soil Map Unit Soil Series

Ridges, hills
Landform

Shallow depth to groundwater table; shallow depth to restrictive features.
Soil Limitations

Friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss.
Soil Parent material

3. Surficial Geological Report 1958 - Castle Qkt; Qal; Artificial fill
Year Published/Source Map Unit

Kame terrace deposits - Chiefly sand and pebble to boulder gravel; Local alluvial deposits - Largely muck and sand with lesser amounts of pebbles, cobbles, and boulders; Artificial fill.

4. Flood Rate Insurance Map Within a regulatory floodway? Yes No

5. Within a velocity zone? Yes No

6. Within a Mapped Wetland Area? Yes No If yes, MassGIS Wetland Data Layer: Shrub swamp (SS)
Wetland Type

7. Current Water Resource Conditions (USGS): MA-AJW 462 Andover: 11/4/25 Range: Above Normal Normal Below Normal
Month/Day/ Year

8. Other references reviewed: Site is not located in Zone I or II, Zone A, B, or C, IWPA, or NHESP Habitat area per MassMapper. There is an
(Zone II, IWPA, Zone A, EEA Data Portal, etc.) irrigation well on the 95 Old River Road property per the EEA Data Portal, but it is over 2,000' from the site.



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-18 11/05/2025 7:30 am Overcast 36F 42.6913561 -71.2107964
Hole # Date Time Weather Latitude Longitude

1. Land Use Parking lot landscaped island N/A N/A 3-8
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Parking lot area on southeastern portion of property

2. Soil Parent Material: Glacial till N/A N/A
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >50 feet Drainage Way >50 feet Wetlands 46 feet
 Property Line >10 feet Drinking Water Well >100 feet Other N/A feet

4. Unsuitable Materials Present: Yes No If Yes: Disturbed Soil/Fill Material Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: N/A Depth to Weeping in Hole** N/A Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	HTM (Mulch) +	N/A	N/A	-	Cnc :- Dpl: -	-	-	-	-	-	
6-65+	HTM*	Loamy Sand	10YR 4/4	-	Cnc :- Dpl: -	-	25	50	Massive	Friable	Roots to 21"; top of 12" RCP encountered at 54"
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

*Soil horizon appears to be glacial till material that has been reworked as parking lot fill material.



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-16 11/05/2025 8:30 am Overcast 37F 42.6913561 -71.2107964
Hole # Date Time Weather Latitude Longitude

1. Land Use Parking lot landscaped island N/A N/A 8-15
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Parking lot area on northern portion of property

2. Soil Parent Material: Glacial till N/A N/A
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >50 feet Drainage Way >50 feet Wetlands >100 feet
 Property Line 48 feet Drinking Water Well >100 feet Other N/A feet

4. Unsuitable Materials Present: Yes No If Yes: Disturbed Soil/Fill Material Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: N/A Depth to Weeping in Hole N/A Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8	HTM (Asphalt) +	N/A	N/A	-	Cnc :- Dpl: -	-	-	-	-	-	
8-62	HTM*	Loamy Sand	10YR 4/4	-	Cnc :- Dpl: -	-	25	50	SG	Loose	Exposed rock on side of test pit wall at 24"
62+	Cd	N/A	N/A	-	Cnc :- Dpl: -	-	-	-	-	-	Refusal (bedrock) at 62"
					Cnc :- Dpl: -	-	-	-	-	-	
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

*Soil horizon appears to be glacial till material that has been reworked as parking lot fill material.



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 11/05/2025 10:00 am Overcast 45F 42.6913561 -71.2107964
Hole # Date Time Weather Latitude Longitude

1. Land Use Parking lot N/A N/A 0-3
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Parking lot area on northern portion of property

2. Soil Parent Material: Glacial till N/A N/A
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >50 feet Drainage Way >50 feet Wetlands 54 feet
 Property Line 56 feet Drinking Water Well >100 feet Other N/A feet

4. Unsuitable Materials Present: Yes No If Yes: Disturbed Soil/Fill Material Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: 66" Depth to Weeping in Hole** N/A Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	HTM (Asphalt) +	N/A	N/A	-	Cnc :- Dpl: -	-	-	-	-	-	
4-23	HTM	Sand	10YR 5/6	-	Cnc :- Dpl: -	-	25	-	SG	Loose	
23-62	HTM*	Loamy Sand	10YR 4/4	-	Cnc :- Dpl: -	-	25	25	Massive	Friable	
62-86+	C	Sandy Loam	2.5Y 5/2	-	Cnc :- Dpl: -	-	10	25	Massive	Firm	Digging concluded due to boulders/wall collapse
					Cnc : Dpl:						
					Cnc : Dpl:						

Additional Notes:

*Soil horizon appears to be glacial till material that has been reworked as parking lot fill material.

**Weeping from pit wall face appears to be perched water.



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 11/05/2025 12:15 pm Overcast 54F 42.6913561 -71.2107964
Hole # Date Time Weather Latitude Longitude

1. Land Use Parking lot N/A N/A 0-3
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Parking lot area on northern portion of property

2. Soil Parent Material: Glacial till N/A N/A
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >50 feet Drainage Way >50 feet Wetlands 54 feet
Property Line 56 feet Drinking Water Well >100 feet Other N/A feet

4. Unsuitable Materials Present: Yes No If Yes: Disturbed Soil/Fill Material Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: 50" Depth to Weeping in Hole** N/A Depth to Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-4	HTM (Asphalt) +	N/A	N/A	-	Cnc :- Dpl: -	-	-	-	-	-	
4-16	HTM	Sand	10YR 5/6	-	Cnc :- Dpl: -	-	25	-	SG	Loose	
16-48	HTM*	Loamy Sand	10YR 4/4	-	Cnc :- Dpl: -	-	25	25	Massive	Friable	
66-96+	Ab	Loamy Sand	10YR 3/2	-	Cnc :- Dpl: -	-	15	-	Massive	Friable	
52-86+	C	Sandy Loam	2.5Y 5/1	-	Cnc :- Dpl: -	-	15	15	Massive	Firm	Digging concluded due to boulders/wall collapse +
					Cnc : Dpl:						

Additional Notes:

*Soil horizon appears to be glacial till material that has been reworked as parking lot fill material.

**Weeping from pit wall face appears to be perched water.



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

Depth to soil redoximorphic features

Obs. Hole # TP-4

Obs. Hole # _____

84" inches

_____ inches

Depth to observed standing water in observation hole

_____ inches

_____ inches

Depth to adjusted seasonal high groundwater (S_h)
(USGS methodology)

_____ inches

_____ inches

Index Well Number _____

Reading Date _____

$$S_h = S_c - [S_r \times (OW_c - OW_{max}) / OW_r]$$

Obs. Hole/Well# _____

S_c _____

S_r _____

OW_c _____

OW_{max} _____

OW_r _____

S_h _____

E. Depth of Pervious Material Not Applicable to Stormwater Testing Observations

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

Yes No

b. If yes, at what depth was it observed (exclude O, A, and E Horizons)?

Upper boundary: _____
inches

Lower boundary: _____
inches

c. If no, at what depth was impervious material observed?

Upper boundary: _____
inches

Lower boundary: _____
inches



Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

<u>Jared Walsh</u>	<u>11/10/2025</u>
Signature of Soil Evaluator	Date
<u>Jared Walsh / License #14670</u>	<u>6/30/2028</u>
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
<u>N/A</u>	<u>N/A</u>
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with [Percolation Test Form 12](#).

Field Diagrams: Use this area for field diagrams:

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- EXISTING CONDITIONS DRAINAGE MAP
- EXISTING CONDITIONS HYDROCAD COMPUTATIONS

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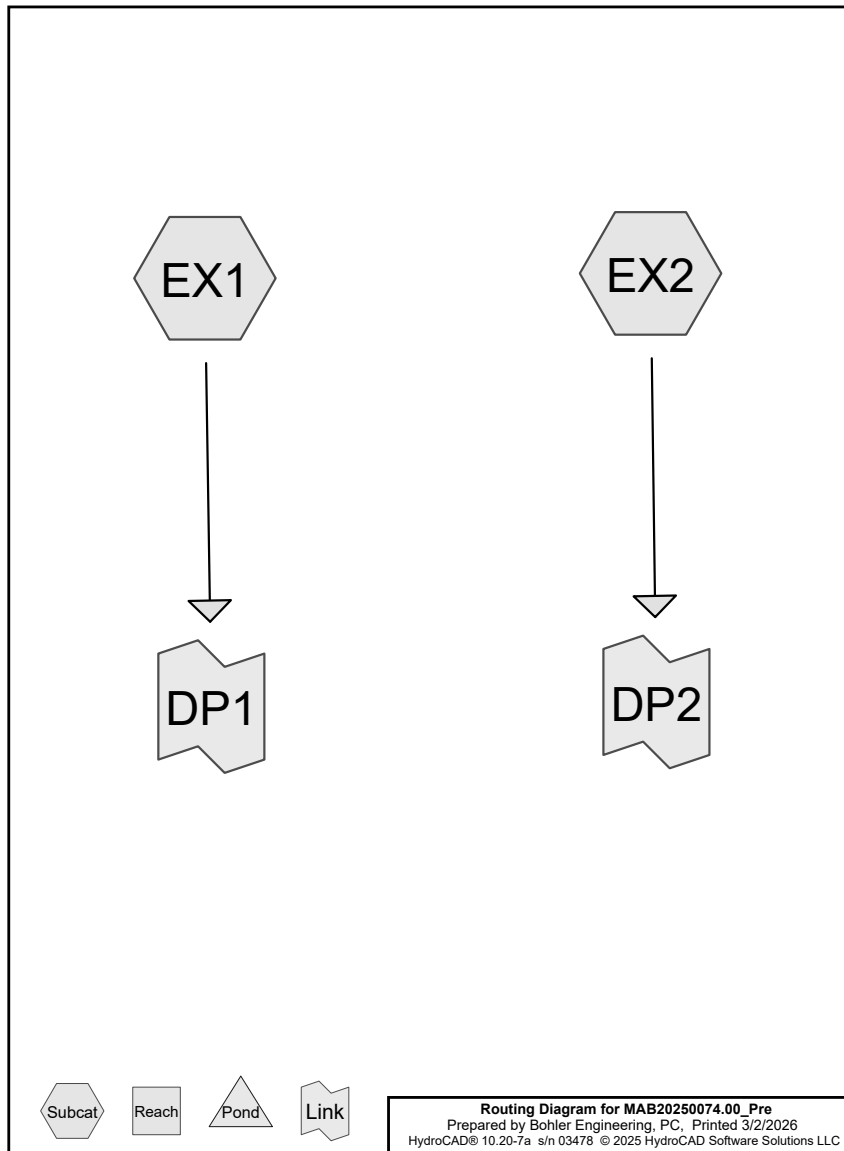
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.018	98	Building, HSG C (EX2)
3.592	98	Impervious Area, HSG C (EX1, EX2)
1.782	74	Open Space, HSG C (EX1, EX2)
0.497	70	Woods, HSC C (EX1)
0.964	70	Woods, HSG C (EX2)
7.853	87	TOTAL AREA



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Type III 24-hr 2-yr Rainfall=3.11"

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Page 3Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method**SubcatchmentEX1:** Runoff Area=57,467 sf 31.20% Impervious Runoff Depth=1.49"
Tc=6.0 min CN=WQ Runoff=2.04 cfs 0.164 af**SubcatchmentEX2:** Runoff Area=284,607 sf 64.26% Impervious Runoff Depth=2.17"
Flow Length=108' Tc=7.7 min CN=WQ Runoff=13.89 cfs 1.181 af**Link DP1:** Inflow=2.04 cfs 0.164 af
Primary=2.04 cfs 0.164 af**Link DP2:** Inflow=13.89 cfs 1.181 af
Primary=13.89 cfs 1.181 af**Total Runoff Area = 7.853 ac Runoff Volume = 1.345 af Average Runoff Depth = 2.06"**
41.30% Pervious = 3.243 ac 58.70% Impervious = 4.610 ac**MAB20250074.00_Pre**Prepared by Bohler Engineering, PC
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Type III 24-hr 2-yr Rainfall=3.11"

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Page 4**Summary for Subcatchment EX1:**Runoff = 2.04 cfs @ 12.09 hrs, Volume= 0.164 af, Depth= 1.49"
Routed to Link DP1 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

	Area (sf)	CN	Description
*	17,883	74	Open Space, HSG C
*	17,928	98	Impervious Area, HSG C
*	21,656	70	Woods, HSG C
	57,467		Weighted Average
	39,539		68.80% Pervious Area
	17,928		31.20% Impervious Area

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

Summary for Subcatchment EX2:Runoff = 13.89 cfs @ 12.11 hrs, Volume= 1.181 af, Depth= 2.17"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

	Area (sf)	CN	Description
*	44,341	98	Building, HSG C
*	59,744	74	Open Space, HSG C
*	138,535	98	Impervious Area, HSG C
*	41,987	70	Woods, HSG C
	284,607		Weighted Average
	101,731		35.74% Pervious Area
	182,876		64.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0120	0.12		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.11"
0.7	58	0.0860	1.47		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
7.7	108	Total			

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Type III 24-hr 2-yr Rainfall=3.11"

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Summary for Link DP1:

Inflow Area = 1.319 ac, 31.20% Impervious, Inflow Depth = 1.49" for 2-yr event
Inflow = 2.04 cfs @ 12.09 hrs, Volume= 0.164 af
Primary = 2.04 cfs @ 12.09 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.534 ac, 64.26% Impervious, Inflow Depth = 2.17" for 2-yr event
Inflow = 13.89 cfs @ 12.11 hrs, Volume= 1.181 af
Primary = 13.89 cfs @ 12.11 hrs, Volume= 1.181 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Type III 24-hr 10-yr Rainfall=4.92"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX1: Runoff Area=57,467 sf 31.20% Impervious Runoff Depth=2.92"
Tc=6.0 min CN=WQ Runoff=4.12 cfs 0.321 af

SubcatchmentEX2: Runoff Area=284,607 sf 64.26% Impervious Runoff Depth=3.78"
Flow Length=108' Tc=7.7 min CN=WQ Runoff=24.30 cfs 2.060 af

Link DP1: Inflow=4.12 cfs 0.321 af
Primary=4.12 cfs 0.321 af

Link DP2: Inflow=24.30 cfs 2.060 af
Primary=24.30 cfs 2.060 af

Total Runoff Area = 7.853 ac Runoff Volume = 2.381 af Average Runoff Depth = 3.64"
41.30% Pervious = 3.243 ac 58.70% Impervious = 4.610 ac

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Type III 24-hr 10-yr Rainfall=4.92"

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Summary for Subcatchment EX1:Runoff = 4.12 cfs @ 12.09 hrs, Volume= 0.321 af, Depth= 2.92"
Routed to Link DP1 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 17,883	74	Open Space, HSG C
* 17,928	98	Impervious Area, HSG C
* 21,656	70	Woods, HSG C
57,467		Weighted Average
39,539		68.80% Pervious Area
17,928		31.20% Impervious Area

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

Summary for Subcatchment EX2:Runoff = 24.30 cfs @ 12.11 hrs, Volume= 2.060 af, Depth= 3.78"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 44,341	98	Building, HSG C
* 59,744	74	Open Space, HSG C
* 138,535	98	Impervious Area, HSG C
* 41,987	70	Woods, HSG C
284,607		Weighted Average
101,731		35.74% Pervious Area
182,876		64.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0120	0.12		Sheet Flow, A-B
					Grass: Short n= 0.150 P2= 3.11"
0.7	58	0.0860	1.47		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
7.7	108	Total			

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Type III 24-hr 10-yr Rainfall=4.92"

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Summary for Link DP1:Inflow Area = 1.319 ac, 31.20% Impervious, Inflow Depth = 2.92" for 10-yr event
Inflow = 4.12 cfs @ 12.09 hrs, Volume= 0.321 af
Primary = 4.12 cfs @ 12.09 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:Inflow Area = 6.534 ac, 64.26% Impervious, Inflow Depth = 3.78" for 10-yr event
Inflow = 24.30 cfs @ 12.11 hrs, Volume= 2.060 af
Primary = 24.30 cfs @ 12.11 hrs, Volume= 2.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Type III 24-hr 25-yr Rainfall=6.05"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX1: Runoff Area=57,467 sf 31.20% Impervious Runoff Depth=3.89"
 Tc=6.0 min CN=WQ Runoff=5.52 cfs 0.428 af

SubcatchmentEX2: Runoff Area=284,607 sf 64.26% Impervious Runoff Depth=4.83"
 Flow Length=108' Tc=7.7 min CN=WQ Runoff=31.02 cfs 2.631 af

Link DP1: Inflow=5.52 cfs 0.428 af
 Primary=5.52 cfs 0.428 af

Link DP2: Inflow=31.02 cfs 2.631 af
 Primary=31.02 cfs 2.631 af

Total Runoff Area = 7.853 ac Runoff Volume = 3.058 af Average Runoff Depth = 4.67"
41.30% Pervious = 3.243 ac 58.70% Impervious = 4.610 ac

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Type III 24-hr 25-yr Rainfall=6.05"

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Summary for Subcatchment EX1:

Runoff = 5.52 cfs @ 12.09 hrs, Volume= 0.428 af, Depth= 3.89"
 Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-yr Rainfall=6.05"

	Area (sf)	CN	Description
*	17,883	74	Open Space, HSG C
*	17,928	98	Impervious Area, HSG C
*	21,656	70	Woods, HSG C
	57,467		Weighted Average
	39,539		68.80% Pervious Area
	17,928		31.20% Impervious Area

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

Summary for Subcatchment EX2:

Runoff = 31.02 cfs @ 12.11 hrs, Volume= 2.631 af, Depth= 4.83"
 Routed to Link DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-yr Rainfall=6.05"

	Area (sf)	CN	Description
*	44,341	98	Building, HSG C
*	59,744	74	Open Space, HSG C
*	138,535	98	Impervious Area, HSG C
*	41,987	70	Woods, HSG C
	284,607		Weighted Average
	101,731		35.74% Pervious Area
	182,876		64.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0120	0.12		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.11"
0.7	58	0.0860	1.47		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
7.7	108	Total			

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Type III 24-hr 25-yr Rainfall=6.05"

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Summary for Link DP1:

Inflow Area = 1.319 ac, 31.20% Impervious, Inflow Depth = 3.89" for 25-yr event
 Inflow = 5.52 cfs @ 12.09 hrs, Volume= 0.428 af
 Primary = 5.52 cfs @ 12.09 hrs, Volume= 0.428 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.534 ac, 64.26% Impervious, Inflow Depth = 4.83" for 25-yr event
 Inflow = 31.02 cfs @ 12.11 hrs, Volume= 2.631 af
 Primary = 31.02 cfs @ 12.11 hrs, Volume= 2.631 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Type III 24-hr 100-yr Rainfall=7.78"

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX1:

Runoff Area=57,467 sf 31.20% Impervious Runoff Depth=5.44"
 Tc=6.0 min CN=WQ Runoff=7.73 cfs 0.598 af

SubcatchmentEX2:

Runoff Area=284,607 sf 64.26% Impervious Runoff Depth=6.47"
 Flow Length=108' Tc=7.7 min CN=WQ Runoff=41.48 cfs 3.522 af

Link DP1:

Inflow=7.73 cfs 0.598 af
 Primary=7.73 cfs 0.598 af

Link DP2:

Inflow=41.48 cfs 3.522 af
 Primary=41.48 cfs 3.522 af

Total Runoff Area = 7.853 ac Runoff Volume = 4.120 af Average Runoff Depth = 6.30"
41.30% Pervious = 3.243 ac 58.70% Impervious = 4.610 ac

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Type III 24-hr 100-yr Rainfall=7.78"

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Page 13**Summary for Subcatchment EX1:**Runoff = 7.73 cfs @ 12.09 hrs, Volume= 0.598 af, Depth= 5.44"
Routed to Link DP1 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 17,883	74	Open Space, HSG C
* 17,928	98	Impervious Area, HSG C
* 21,656	70	Woods, HSG C
57,467		Weighted Average
39,539		68.80% Pervious Area
17,928		31.20% Impervious Area

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

Summary for Subcatchment EX2:Runoff = 41.48 cfs @ 12.11 hrs, Volume= 3.522 af, Depth= 6.47"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 44,341	98	Building, HSG C
* 59,744	74	Open Space, HSG C
* 138,535	98	Impervious Area, HSG C
* 41,987	70	Woods, HSG C
284,607		Weighted Average
101,731		35.74% Pervious Area
182,876		64.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0120	0.12		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.11"
0.7	58	0.0860	1.47		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
7.7	108	Total			

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Type III 24-hr 100-yr Rainfall=7.78"

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Page 14**Summary for Link DP1:**Inflow Area = 1.319 ac, 31.20% Impervious, Inflow Depth = 5.44" for 100-yr event
Inflow = 7.73 cfs @ 12.09 hrs, Volume= 0.598 af
Primary = 7.73 cfs @ 12.09 hrs, Volume= 0.598 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:Inflow Area = 6.534 ac, 64.26% Impervious, Inflow Depth = 6.47" for 100-yr event
Inflow = 41.48 cfs @ 12.11 hrs, Volume= 3.522 af
Primary = 41.48 cfs @ 12.11 hrs, Volume= 3.522 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- PROPOSED CONDITIONS DRAINAGE MAP
- PROPOSED CONDITIONS HYDROCAD CALCULATIONS

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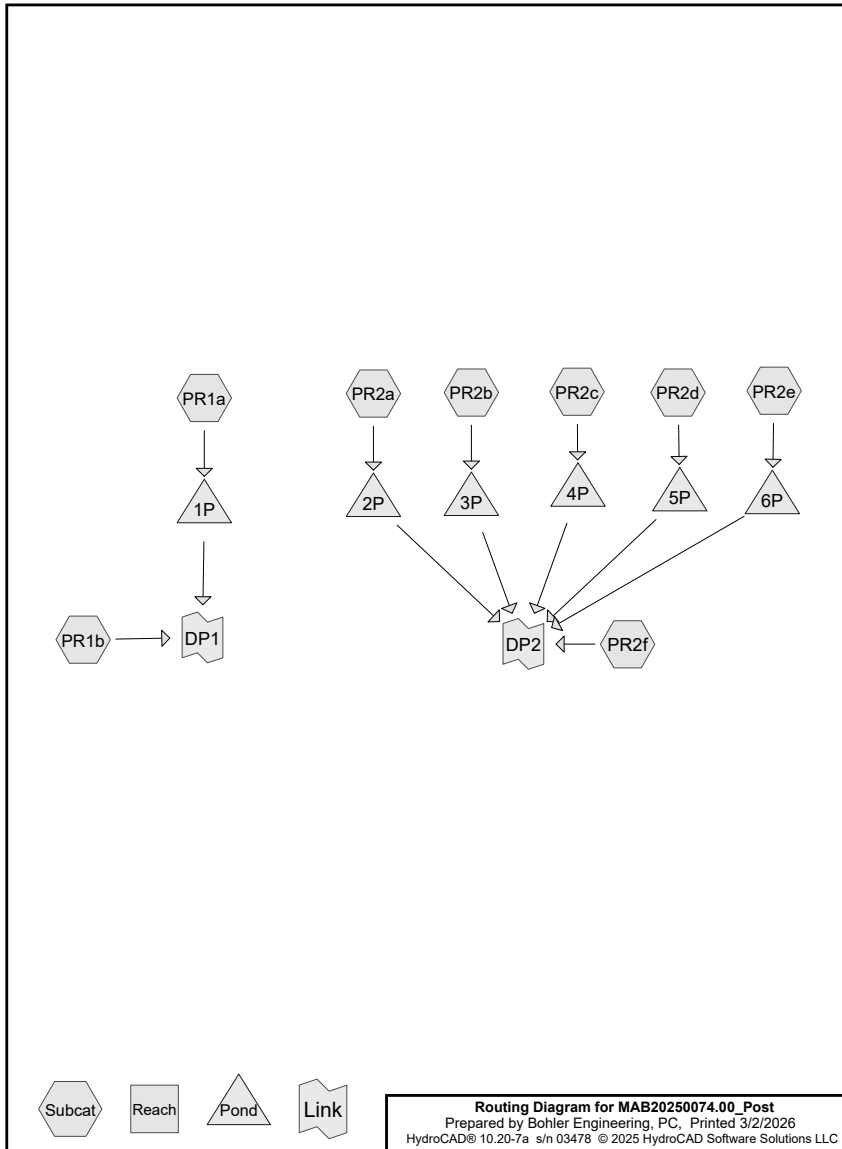
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.006	98	Impervious Area, HSG C (PR1a, PR2b, PR2c, PR2d, PR2e)
1.343	98	Impervious Area, HSG C (south bldg and courtyard) (PR2a)
0.088	98	Impervious, HSG C (PR1b)
1.114	86	Open Space, HSG C (PR1a, PR2a, PR2b, PR2c, PR2e)
0.053	86	OpenSpace, HSG C (PR2d)
1.248	70	Woods, HSG C (PR1b, PR2f)
7.853	92	TOTAL AREA



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Type III 24-hr 2-yr Rainfall=3.11"

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Page 3Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1a: Runoff Area=35,497 sf 64.37% Impervious Runoff Depth=2.48"
Tc=6.0 min CN=WQ Runoff=2.13 cfs 0.168 af

SubcatchmentPR1b: Runoff Area=28,436 sf 13.53% Impervious Runoff Depth=1.06"
Tc=6.0 min CN=WQ Runoff=0.71 cfs 0.058 af

SubcatchmentPR2a: Runoff Area=63,506 sf 92.10% Impervious Runoff Depth=2.79"
Tc=6.0 min CN=WQ Runoff=4.19 cfs 0.339 af

SubcatchmentPR2b: Runoff Area=125,323 sf 94.22% Impervious Runoff Depth=2.81"
Tc=6.0 min CN=WQ Runoff=8.32 cfs 0.674 af

SubcatchmentPR2c: Runoff Area=11,522 sf 93.48% Impervious Runoff Depth=2.80"
Tc=6.0 min CN=WQ Runoff=0.76 cfs 0.062 af

SubcatchmentPR2d: Runoff Area=12,917 sf 82.10% Impervious Runoff Depth=2.68"
Tc=6.0 min CN=WQ Runoff=0.82 cfs 0.066 af

SubcatchmentPR2e: Runoff Area=35,069 sf 34.71% Impervious Runoff Depth=2.15"
Tc=6.0 min CN=WQ Runoff=1.88 cfs 0.144 af

SubcatchmentPR2f: Runoff Area=29,792 sf 0.00% Impervious Runoff Depth=0.78"
Tc=6.0 min CN=70 Runoff=0.54 cfs 0.044 af

Pond 1P: Peak Elev=74.72' Storage=2,078 cf Inflow=2.13 cfs 0.168 af
Discarded=0.02 cfs 0.041 af Primary=1.44 cfs 0.111 af Outflow=1.46 cfs 0.152 af

Pond 2P: Peak Elev=76.80' Storage=2,549 cf Inflow=4.19 cfs 0.339 af
Discarded=0.00 cfs 0.000 af Primary=3.36 cfs 0.324 af Outflow=3.36 cfs 0.324 af

Pond 3P: Peak Elev=69.08' Storage=4,059 cf Inflow=8.32 cfs 0.674 af
Discarded=0.01 cfs 0.028 af Primary=8.13 cfs 0.583 af Outflow=8.14 cfs 0.610 af

Pond 4P: Peak Elev=69.43' Storage=1,200 cf Inflow=0.76 cfs 0.062 af
Discarded=0.01 cfs 0.015 af Primary=0.53 cfs 0.024 af Outflow=0.54 cfs 0.039 af

Pond 5P: Peak Elev=68.72' Storage=842 cf Inflow=0.82 cfs 0.066 af
Discarded=0.01 cfs 0.013 af Primary=0.80 cfs 0.039 af Outflow=0.80 cfs 0.052 af

Pond 6P: Peak Elev=73.25' Storage=3,414 cf Inflow=1.88 cfs 0.144 af
Discarded=0.02 cfs 0.039 af Primary=0.23 cfs 0.041 af Outflow=0.25 cfs 0.080 af

Link DP1: Inflow=2.03 cfs 0.169 af
Primary=2.03 cfs 0.169 af

Link DP2: Inflow=12.64 cfs 1.054 af
Primary=12.64 cfs 1.054 af

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Type III 24-hr 2-yr Rainfall=3.11"

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Page 4**Total Runoff Area = 7.853 ac Runoff Volume = 1.556 af Average Runoff Depth = 2.38"**
30.77% Pervious = 2.416 ac 69.23% Impervious = 5.437 ac

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Type III 24-hr 2-yr Rainfall=3.11"

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Summary for Subcatchment PR1a:Runoff = 2.13 cfs @ 12.09 hrs, Volume= 0.168 af, Depth= 2.48"
Routed to Pond 1P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 12,647	86	Open Space, HSG C
* 22,850	98	Impervious Area, HSG C
35,497		Weighted Average
12,647		35.63% Pervious Area
22,850		64.37% Impervious Area

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

Summary for Subcatchment PR1b:Runoff = 0.71 cfs @ 12.10 hrs, Volume= 0.058 af, Depth= 1.06"
Routed to Link DP1 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 24,588	70	Woods, HSG C
* 3,848	98	Impervious, HSG C
28,436		Weighted Average
24,588		86.47% Pervious Area
3,848		13.53% Impervious Area

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

Summary for Subcatchment PR2a:Runoff = 4.19 cfs @ 12.09 hrs, Volume= 0.339 af, Depth= 2.79"
Routed to Pond 2P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Type III 24-hr 2-yr Rainfall=3.11"

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Area (sf)	CN	Description
* 58,491	98	Impervious Area, HSG C (south bldg and courtyard)
* 5,015	86	Open Space, HSG C
63,506		Weighted Average
5,015		7.90% Pervious Area
58,491		92.10% Impervious Area

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

Summary for Subcatchment PR2b:Runoff = 8.32 cfs @ 12.09 hrs, Volume= 0.674 af, Depth= 2.81"
Routed to Pond 3P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 118,084	98	Impervious Area, HSG C
* 7,239	86	Open Space, HSG C
125,323		Weighted Average
7,239		5.78% Pervious Area
118,084		94.22% Impervious Area

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

Summary for Subcatchment PR2c:Runoff = 0.76 cfs @ 12.09 hrs, Volume= 0.062 af, Depth= 2.80"
Routed to Pond 4P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 10,771	98	Impervious Area, HSG C
* 751	86	Open Space, HSG C
11,522		Weighted Average
751		6.52% Pervious Area
10,771		93.48% Impervious Area

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

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Type III 24-hr 2-yr Rainfall=3.11"

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Summary for Subcatchment PR2d:Runoff = 0.82 cfs @ 12.09 hrs, Volume= 0.066 af, Depth= 2.68"
Routed to Pond 5P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 10,605	98	Impervious Area, HSG C
* 2,312	86	OpenSpace, HSG C
12,917		Weighted Average
2,312		17.90% Pervious Area
10,605		82.10% Impervious Area

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

Summary for Subcatchment PR2e:Runoff = 1.88 cfs @ 12.09 hrs, Volume= 0.144 af, Depth= 2.15"
Routed to Pond 6P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"

Area (sf)	CN	Description
* 22,895	86	Open Space, HSG C
* 12,174	98	Impervious Area, HSG C
35,069		Weighted Average
22,895		65.29% Pervious Area
12,174		34.71% Impervious Area

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

Summary for Subcatchment PR2f:Runoff = 0.54 cfs @ 12.11 hrs, Volume= 0.044 af, Depth= 0.78"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.11"**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Type III 24-hr 2-yr Rainfall=3.11"

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Area (sf)	CN	Description
* 29,792	70	Woods, HSG C
29,792		100.00% Pervious Area

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

Summary for Pond 1P:Inflow Area = 0.815 ac, 64.37% Impervious, Inflow Depth = 2.48" for 2-yr event
Inflow = 2.13 cfs @ 12.09 hrs, Volume= 0.168 af
Outflow = 1.46 cfs @ 12.18 hrs, Volume= 0.152 af, Atten= 32%, Lag= 5.4 min
Discarded = 0.02 cfs @ 6.40 hrs, Volume= 0.041 af
Primary = 1.44 cfs @ 12.18 hrs, Volume= 0.111 af
Routed to Link DP1 :Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 74.72' @ 12.18 hrs Surf.Area= 3,035 sf Storage= 2,078 cfPlug-Flow detention time= 139.7 min calculated for 0.152 af (90% of inflow)
Center-of-Mass det. time= 92.3 min (866.2 - 773.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	73.60'	2,090 cf	29.50'W x 102.88'L x 2.33'H Field A 7,082 cf Overall - 1,857 cf Embedded = 5,224 cf x 40.0% Voids
#2A	74.10'	1,857 cf	ADS_StormTech SC-310 +Cap x 126 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 126 Chambers in 9 Rows
		3,947 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	73.60'	0.270 in/hr Exfiltration over Surface area
#2	Primary	71.00'	12.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 71.00' / 70.20' S= 0.0267 ' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#3	Device 2	75.45'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 2	74.30'	22.0" W x 4.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

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Page 9**Discarded OutFlow** Max=0.02 cfs @ 6.40 hrs HW=73.62' (Free Discharge)
↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)**Primary OutFlow** Max=1.43 cfs @ 12.18 hrs HW=74.71' (Free Discharge)
↳ **2=Culvert** (Passes 1.43 cfs of 6.78 cfs potential flow)↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
↳ **4=Orifice/Grate** (Orifice Controls 1.43 cfs @ 2.34 fps)**Summary for Pond 2P:**Inflow Area = 1.458 ac, 92.10% Impervious, Inflow Depth = 2.79" for 2-yr event
Inflow = 4.19 cfs @ 12.09 hrs, Volume= 0.339 af
Outflow = 3.36 cfs @ 12.15 hrs, Volume= 0.324 af, Atten= 20%, Lag= 4.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 3.36 cfs @ 12.15 hrs, Volume= 0.324 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 76.80' @ 12.15 hrs Surf.Area= 3,120 sf Storage= 2,549 cfPlug-Flow detention time= 75.4 min calculated for 0.324 af (95% of inflow)
Center-of-Mass det. time= 49.0 min (809.3 - 760.3)

Volume	Invert	Avail.Storage	Storage Description
#1B	75.50'	2,146 cf	32.58'W x 95.76'L x 2.33'H Field B 7,280 cf Overall - 1,916 cf Embedded = 5,364 cf x 40.0% Voids
#2B	76.00'	1,916 cf	ADS_StormTech SC-310 +Cap x 130 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 10 Rows
		4,062 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	76.00'	24.0" Round Culvert L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.00' / 75.50' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	76.85'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.50' (Free Discharge)
↳ **1=Exfiltration** (Passes 0.00 cfs of 0.02 cfs potential flow)↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)**Primary OutFlow** Max=3.34 cfs @ 12.15 hrs HW=76.80' (Free Discharge)
↳ **2=Culvert** (Barrel Controls 3.34 cfs @ 4.22 fps)**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Page 10**Summary for Pond 3P:**Inflow Area = 2.877 ac, 94.22% Impervious, Inflow Depth = 2.81" for 2-yr event
Inflow = 8.32 cfs @ 12.09 hrs, Volume= 0.674 af
Outflow = 8.14 cfs @ 12.11 hrs, Volume= 0.610 af, Atten= 2%, Lag= 1.2 min
Discarded = 0.01 cfs @ 2.65 hrs, Volume= 0.028 af
Primary = 8.13 cfs @ 12.11 hrs, Volume= 0.583 af
Routed to Link DP2 :Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 69.08' @ 12.11 hrs Surf.Area= 1,928 sf Storage= 4,059 cfPlug-Flow detention time= 96.0 min calculated for 0.610 af (91% of inflow)
Center-of-Mass det. time= 48.2 min (807.7 - 759.4)

Volume	Invert	Avail.Storage	Storage Description
#1B	66.00'	1,384 cf	22.75'W x 41.55'L x 5.50'H Field B 5,199 cf Overall - 1,739 cf Embedded = 3,460 cf x 40.0% Voids
#2B	66.75'	1,739 cf	ADS_StormTech MC-3500 d +Cap x 15 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 15 Chambers in 3 Rows Cap Storage= 14.9 cf x 2 x 3 rows = 89.4 cf
#3D	66.00'	1,434 cf	15.58'W x 63.06'L x 5.50'H Field D 5,405 cf Overall - 1,819 cf Embedded = 3,586 cf x 40.0% Voids
#4D	66.75'	1,819 cf	ADS_StormTech MC-3500 d +Cap x 16 Inside #3 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 16 Chambers in 2 Rows Cap Storage= 14.9 cf x 2 x 2 rows = 59.6 cf
		6,376 cf	Total Available Storage

Storage Group B created with Chamber Wizard
Storage Group D created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.60'	24.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.60' / 67.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	68.35'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.65 hrs HW=66.06' (Free Discharge)
↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=7.98 cfs @ 12.11 hrs HW=69.08' (Free Discharge)
↳ **2=Culvert** (Passes 7.98 cfs of 8.12 cfs potential flow)
↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 7.98 cfs @ 2.74 fps)

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Summary for Pond 4P:

Inflow Area = 0.265 ac, 93.48% Impervious, Inflow Depth = 2.80" for 2-yr event
 Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.062 af
 Outflow = 0.54 cfs @ 12.21 hrs, Volume= 0.039 af, Atten= 29%, Lag= 7.6 min
 Discarded = 0.01 cfs @ 5.25 hrs, Volume= 0.015 af
 Primary = 0.53 cfs @ 12.21 hrs, Volume= 0.024 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 69.43' @ 12.21 hrs Surf.Area= 1,071 sf Storage= 1,200 cf

Plug-Flow detention time= 241.6 min calculated for 0.039 af (63% of inflow)
 Center-of-Mass det. time= 137.6 min (897.3 - 759.7)

Volume	Invert	Avail.Storage	Storage Description
#1C	67.50'	752 cf	23.33'W x 45.92'L x 2.33'H Field C 2,500 cf Overall - 619 cf Embedded = 1,881 cf x 40.0% Voids
#2C	68.00'	619 cf	ADS_StormTech SC-310 +Cap x 42 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 42 Chambers in 7 Rows
		1,372 cf	Total Available Storage

Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	68.00'	12.0" Round Culvert L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 68.00' / 66.70' S= 0.0144 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	69.30'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 5.25 hrs HW=67.52' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.48 cfs @ 12.21 hrs HW=69.42' (Free Discharge)
 ↳ **2=Culvert** (Passes 0.48 cfs of 2.87 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 0.48 cfs @ 0.98 fps)

Summary for Pond 5P:

Inflow Area = 0.297 ac, 82.10% Impervious, Inflow Depth = 2.68" for 2-yr event
 Inflow = 0.82 cfs @ 12.09 hrs, Volume= 0.066 af
 Outflow = 0.80 cfs @ 12.11 hrs, Volume= 0.052 af, Atten= 2%, Lag= 1.3 min
 Discarded = 0.01 cfs @ 4.75 hrs, Volume= 0.013 af
 Primary = 0.80 cfs @ 12.11 hrs, Volume= 0.039 af

Routed to Link DP2 :

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Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 68.72' @ 12.11 hrs Surf.Area= 905 sf Storage= 842 cf

Plug-Flow detention time= 172.8 min calculated for 0.052 af (78% of inflow)
 Center-of-Mass det. time= 93.5 min (858.3 - 764.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	67.20'	639 cf	23.33'W x 38.80'L x 2.33'H Field A 2,112 cf Overall - 516 cf Embedded = 1,596 cf x 40.0% Voids
#2A	67.70'	516 cf	ADS_StormTech SC-310 +Cap x 35 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 35 Chambers in 7 Rows
		1,155 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.20'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.70'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.70' / 67.20' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	68.55'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 4.75 hrs HW=67.22' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.78 cfs @ 12.11 hrs HW=68.72' (Free Discharge)
 ↳ **2=Culvert** (Passes 0.78 cfs of 2.15 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 0.78 cfs @ 1.15 fps)

Summary for Pond 6P:

Inflow Area = 0.805 ac, 34.71% Impervious, Inflow Depth = 2.15" for 2-yr event
 Inflow = 1.88 cfs @ 12.09 hrs, Volume= 0.144 af
 Outflow = 0.25 cfs @ 12.67 hrs, Volume= 0.080 af, Atten= 87%, Lag= 34.6 min
 Discarded = 0.02 cfs @ 12.67 hrs, Volume= 0.039 af
 Primary = 0.23 cfs @ 12.67 hrs, Volume= 0.041 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 73.25' @ 12.67 hrs Surf.Area= 3,443 sf Storage= 3,414 cf

Plug-Flow detention time= 314.0 min calculated for 0.079 af (55% of inflow)
 Center-of-Mass det. time= 201.3 min (994.0 - 792.7)

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Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	2,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
#2	72.00'	3,547 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,357 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	931	0	0
73.00	1,395	1,163	1,163
74.00	1,900	1,648	2,811

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	1,133	0	0
73.00	1,730	1,432	1,432
74.00	2,500	2,115	3,547

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	12.0" Round Culvert L= 340.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 70.00' / 67.40' S= 0.0076 ' S= 0.0076 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	73.20'	6.0" Horiz. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#3	Discarded	72.00'	0.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 12.67 hrs HW=73.25' (Free Discharge)

↑**3=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.22 cfs @ 12.67 hrs HW=73.25' (Free Discharge)

↑**1=Culvert** (Passes 0.22 cfs of 3.91 cfs potential flow)

↑**2=Orifice/Grate** (Weir Controls 0.22 cfs @ 0.73 fps)

Summary for Link DP1:

Inflow Area = 1.468 ac, 41.76% Impervious, Inflow Depth = 1.38" for 2-yr event
Inflow = 2.03 cfs @ 12.14 hrs, Volume= 0.169 af
Primary = 2.03 cfs @ 12.14 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.385 ac, 75.55% Impervious, Inflow Depth > 1.98" for 2-yr event
Inflow = 12.64 cfs @ 12.12 hrs, Volume= 1.054 af
Primary = 12.64 cfs @ 12.12 hrs, Volume= 1.054 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1a:	Runoff Area=35,497 sf 64.37% Impervious Runoff Depth=4.22" Tc=6.0 min CN=WQ Runoff=3.58 cfs 0.287 af
SubcatchmentPR1b:	Runoff Area=28,436 sf 13.53% Impervious Runoff Depth=2.34" Tc=6.0 min CN=WQ Runoff=1.67 cfs 0.127 af
SubcatchmentPR2a:	Runoff Area=63,506 sf 92.10% Impervious Runoff Depth=4.58" Tc=6.0 min CN=WQ Runoff=6.75 cfs 0.557 af
SubcatchmentPR2b:	Runoff Area=125,323 sf 94.22% Impervious Runoff Depth=4.61" Tc=6.0 min CN=WQ Runoff=13.38 cfs 1.105 af
SubcatchmentPR2c:	Runoff Area=11,522 sf 93.48% Impervious Runoff Depth=4.60" Tc=6.0 min CN=WQ Runoff=1.23 cfs 0.101 af
SubcatchmentPR2d:	Runoff Area=12,917 sf 82.10% Impervious Runoff Depth=4.45" Tc=6.0 min CN=WQ Runoff=1.35 cfs 0.110 af
SubcatchmentPR2e:	Runoff Area=35,069 sf 34.71% Impervious Runoff Depth=3.84" Tc=6.0 min CN=WQ Runoff=3.33 cfs 0.258 af
SubcatchmentPR2f:	Runoff Area=29,792 sf 0.00% Impervious Runoff Depth=1.98" Tc=6.0 min CN=70 Runoff=1.53 cfs 0.113 af
Pond 1P:	Peak Elev=75.05' Storage=2,765 cf Inflow=3.58 cfs 0.287 af Discarded=0.02 cfs 0.043 af Primary=2.24 cfs 0.227 af Outflow=2.26 cfs 0.270 af
Pond 2P:	Peak Elev=77.10' Storage=3,119 cf Inflow=6.75 cfs 0.557 af Discarded=0.02 cfs 0.000 af Primary=5.81 cfs 0.541 af Outflow=5.82 cfs 0.541 af
Pond 3P:	Peak Elev=69.61' Storage=4,724 cf Inflow=13.38 cfs 1.105 af Discarded=0.01 cfs 0.029 af Primary=12.06 cfs 1.012 af Outflow=12.07 cfs 1.041 af
Pond 4P:	Peak Elev=69.53' Storage=1,240 cf Inflow=1.23 cfs 0.101 af Discarded=0.01 cfs 0.015 af Primary=1.21 cfs 0.063 af Outflow=1.22 cfs 0.078 af
Pond 5P:	Peak Elev=68.79' Storage=875 cf Inflow=1.35 cfs 0.110 af Discarded=0.01 cfs 0.013 af Primary=1.33 cfs 0.082 af Outflow=1.34 cfs 0.096 af
Pond 6P:	Peak Elev=73.47' Storage=4,216 cf Inflow=3.33 cfs 0.258 af Discarded=0.02 cfs 0.042 af Primary=1.98 cfs 0.151 af Outflow=2.00 cfs 0.193 af
Link DP1:	Inflow=3.70 cfs 0.354 af Primary=3.70 cfs 0.354 af
Link DP2:	Inflow=23.64 cfs 1.962 af Primary=23.64 cfs 1.962 af

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Total Runoff Area = 7.853 ac Runoff Volume = 2.658 af Average Runoff Depth = 4.06"
30.77% Pervious = 2.416 ac 69.23% Impervious = 5.437 ac

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Summary for Subcatchment PR1a:

Runoff = 3.58 cfs @ 12.09 hrs, Volume= 0.287 af, Depth= 4.22"
 Routed to Pond 1P :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 12,647	86	Open Space, HSG C
* 22,850	98	Impervious Area, HSG C
35,497		Weighted Average
12,647		35.63% Pervious Area
22,850		64.37% Impervious Area

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

Summary for Subcatchment PR1b:

Runoff = 1.67 cfs @ 12.09 hrs, Volume= 0.127 af, Depth= 2.34"
 Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 24,588	70	Woods, HSG C
* 3,848	98	Impervious, HSG C
28,436		Weighted Average
24,588		86.47% Pervious Area
3,848		13.53% Impervious Area

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

Summary for Subcatchment PR2a:

Runoff = 6.75 cfs @ 12.09 hrs, Volume= 0.557 af, Depth= 4.58"
 Routed to Pond 2P :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-yr Rainfall=4.92"

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Type III 24-hr 10-yr Rainfall=4.92"

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Area (sf)	CN	Description
* 58,491	98	Impervious Area, HSG C (south bldg and courtyard)
* 5,015	86	Open Space, HSG C
63,506		Weighted Average
5,015		7.90% Pervious Area
58,491		92.10% Impervious Area

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

Summary for Subcatchment PR2b:Runoff = 13.38 cfs @ 12.09 hrs, Volume= 1.105 af, Depth= 4.61"
Routed to Pond 3P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 118,084	98	Impervious Area, HSG C
* 7,239	86	Open Space, HSG C
125,323		Weighted Average
7,239		5.78% Pervious Area
118,084		94.22% Impervious Area

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

Summary for Subcatchment PR2c:Runoff = 1.23 cfs @ 12.09 hrs, Volume= 0.101 af, Depth= 4.60"
Routed to Pond 4P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 10,771	98	Impervious Area, HSG C
* 751	86	Open Space, HSG C
11,522		Weighted Average
751		6.52% Pervious Area
10,771		93.48% Impervious Area

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

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Type III 24-hr 10-yr Rainfall=4.92"

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Summary for Subcatchment PR2d:Runoff = 1.35 cfs @ 12.09 hrs, Volume= 0.110 af, Depth= 4.45"
Routed to Pond 5P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 10,605	98	Impervious Area, HSG C
* 2,312	86	OpenSpace, HSG C
12,917		Weighted Average
2,312		17.90% Pervious Area
10,605		82.10% Impervious Area

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

Summary for Subcatchment PR2e:Runoff = 3.33 cfs @ 12.09 hrs, Volume= 0.258 af, Depth= 3.84"
Routed to Pond 6P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

Area (sf)	CN	Description
* 22,895	86	Open Space, HSG C
* 12,174	98	Impervious Area, HSG C
35,069		Weighted Average
22,895		65.29% Pervious Area
12,174		34.71% Impervious Area

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

Summary for Subcatchment PR2f:Runoff = 1.53 cfs @ 12.10 hrs, Volume= 0.113 af, Depth= 1.98"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.92"

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Type III 24-hr 10-yr Rainfall=4.92"

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Area (sf)	CN	Description
* 29,792	70	Woods, HSG C
29,792		100.00% Pervious Area

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

Summary for Pond 1P:

Inflow Area = 0.815 ac, 64.37% Impervious, Inflow Depth = 4.22" for 10-yr event
 Inflow = 3.58 cfs @ 12.09 hrs, Volume= 0.287 af
 Outflow = 2.26 cfs @ 12.19 hrs, Volume= 0.270 af, Atten= 37%, Lag= 6.4 min
 Discarded = 0.02 cfs @ 3.80 hrs, Volume= 0.043 af
 Primary = 2.24 cfs @ 12.19 hrs, Volume= 0.227 af
 Routed to Link DP1 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 75.05' @ 12.19 hrs Surf.Area= 3,035 sf Storage= 2,765 cf

Plug-Flow detention time= 99.2 min calculated for 0.270 af (94% of inflow)
 Center-of-Mass det. time= 67.0 min (831.5 - 764.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	73.60'	2,090 cf	29.50'W x 102.88'L x 2.33'H Field A 7,082 cf Overall - 1,857 cf Embedded = 5,224 cf x 40.0% Voids
#2A	74.10'	1,857 cf	ADS_StormTech SC-310 +Cap x 126 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 126 Chambers in 9 Rows
		3,947 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	73.60'	0.270 in/hr Exfiltration over Surface area
#2	Primary	71.00'	12.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 71.00' / 70.20' S= 0.0267 ' /' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#3	Device 2	75.45'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 2	74.30'	22.0" W x 4.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

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Type III 24-hr 10-yr Rainfall=4.92"

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Discarded OutFlow Max=0.02 cfs @ 3.80 hrs HW=73.62' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.23 cfs @ 12.19 hrs HW=75.05' (Free Discharge)
 ↳ **2=Culvert** (Passes 2.23 cfs of 7.12 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
 ↳ **4=Orifice/Grate** (Orifice Controls 2.23 cfs @ 3.65 fps)

Summary for Pond 2P:

Inflow Area = 1.458 ac, 92.10% Impervious, Inflow Depth = 4.58" for 10-yr event
 Inflow = 6.75 cfs @ 12.09 hrs, Volume= 0.557 af
 Outflow = 5.82 cfs @ 12.14 hrs, Volume= 0.541 af, Atten= 14%, Lag= 3.2 min
 Discarded = 0.02 cfs @ 12.05 hrs, Volume= 0.000 af
 Primary = 5.81 cfs @ 12.14 hrs, Volume= 0.541 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 77.10' @ 12.14 hrs Surf.Area= 3,120 sf Storage= 3,119 cf

Plug-Flow detention time= 55.3 min calculated for 0.541 af (97% of inflow)
 Center-of-Mass det. time= 38.0 min (789.6 - 751.6)

Volume	Invert	Avail.Storage	Storage Description
#1B	75.50'	2,146 cf	32.58'W x 95.76'L x 2.33'H Field B 7,280 cf Overall - 1,916 cf Embedded = 5,364 cf x 40.0% Voids
#2B	76.00'	1,916 cf	ADS_StormTech SC-310 +Cap x 130 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 10 Rows
		4,062 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	76.00'	24.0" Round Culvert L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.00' / 75.50' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	76.85'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.02 cfs @ 12.05 hrs HW=76.90' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)
 ↳ **3=Broad-Crested Rectangular Weir** (Passes 0.02 cfs of 0.14 cfs potential flow)

Primary OutFlow Max=5.72 cfs @ 12.14 hrs HW=77.09' (Free Discharge)
 ↳ **2=Culvert** (Barrel Controls 5.72 cfs @ 4.71 fps)

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Summary for Pond 3P:

Inflow Area = 2.877 ac, 94.22% Impervious, Inflow Depth = 4.61" for 10-yr event
 Inflow = 13.38 cfs @ 12.09 hrs, Volume= 1.105 af
 Outflow = 12.07 cfs @ 12.12 hrs, Volume= 1.041 af, Atten= 10%, Lag= 2.3 min
 Discarded = 0.01 cfs @ 1.70 hrs, Volume= 0.029 af
 Primary = 12.06 cfs @ 12.12 hrs, Volume= 1.012 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 69.61' @ 12.12 hrs Surf.Area= 1,928 sf Storage= 4,724 cf

Plug-Flow detention time= 70.0 min calculated for 1.041 af (94% of inflow)
 Center-of-Mass det. time= 36.9 min (787.6 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1B	66.00'	1,384 cf	22.75'W x 41.55'L x 5.50'H Field B 5,199 cf Overall - 1,739 cf Embedded = 3,460 cf x 40.0% Voids
#2B	66.75'	1,739 cf	ADS_StormTech MC-3500 d +Capx 15 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 15 Chambers in 3 Rows Cap Storage= 14.9 cf x 2 x 3 rows = 89.4 cf
#3D	66.00'	1,434 cf	15.58'W x 63.06'L x 5.50'H Field D 5,405 cf Overall - 1,819 cf Embedded = 3,586 cf x 40.0% Voids
#4D	66.75'	1,819 cf	ADS_StormTech MC-3500 d +Capx 16 Inside #3 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 16 Chambers in 2 Rows Cap Storage= 14.9 cf x 2 x 2 rows = 59.6 cf
		6,376 cf	Total Available Storage

Storage Group B created with Chamber Wizard
 Storage Group D created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.60'	24.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.60' / 67.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	68.35'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 1.70 hrs HW=66.06' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=11.83 cfs @ 12.12 hrs HW=69.57' (Free Discharge)
 ↳2=Culvert (Inlet Controls 11.83 cfs @ 3.78 fps)
 ↳3=Broad-Crested Rectangular Weir(Passes 11.83 cfs of 17.96 cfs potential flow)

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Summary for Pond 4P:

Inflow Area = 0.265 ac, 93.48% Impervious, Inflow Depth = 4.60" for 10-yr event
 Inflow = 1.23 cfs @ 12.09 hrs, Volume= 0.101 af
 Outflow = 1.22 cfs @ 12.10 hrs, Volume= 0.078 af, Atten= 1%, Lag= 0.9 min
 Discarded = 0.01 cfs @ 3.10 hrs, Volume= 0.015 af
 Primary = 1.21 cfs @ 12.10 hrs, Volume= 0.063 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 69.53' @ 12.10 hrs Surf.Area= 1,071 sf Storage= 1,240 cf

Plug-Flow detention time= 173.6 min calculated for 0.078 af (77% of inflow)
 Center-of-Mass det. time= 91.0 min (842.0 - 751.0)

Volume	Invert	Avail.Storage	Storage Description
#1C	67.50'	752 cf	23.33'W x 45.92'L x 2.33'H Field C 2,500 cf Overall - 619 cf Embedded = 1,881 cf x 40.0% Voids
#2C	68.00'	619 cf	ADS_StormTech SC-310 +Capx 42 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 42 Chambers in 7 Rows
		1,372 cf	Total Available Storage

Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	68.00'	12.0" Round Culvert L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 68.00' / 66.70' S= 0.0144 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	69.30'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 3.10 hrs HW=67.52' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.20 cfs @ 12.10 hrs HW=69.52' (Free Discharge)
 ↳2=Culvert (Passes 1.20 cfs of 3.02 cfs potential flow)
 ↳3=Broad-Crested Rectangular Weir(Weir Controls 1.20 cfs @ 1.34 fps)

Summary for Pond 5P:

Inflow Area = 0.297 ac, 82.10% Impervious, Inflow Depth = 4.45" for 10-yr event
 Inflow = 1.35 cfs @ 12.09 hrs, Volume= 0.110 af
 Outflow = 1.34 cfs @ 12.10 hrs, Volume= 0.096 af, Atten= 1%, Lag= 1.0 min
 Discarded = 0.01 cfs @ 2.80 hrs, Volume= 0.013 af
 Primary = 1.33 cfs @ 12.10 hrs, Volume= 0.082 af
 Routed to Link DP2 :

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Type III 24-hr 10-yr Rainfall=4.92"

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Page 23Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 68.79' @ 12.10 hrs Surf.Area= 905 sf Storage= 875 cfPlug-Flow detention time= 128.5 min calculated for 0.096 af (87% of inflow)
Center-of-Mass det. time= 68.5 min (824.5 - 756.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	67.20'	639 cf	23.33'W x 38.80'L x 2.33'H Field A 2,112 cf Overall - 516 cf Embedded = 1,596 cf x 40.0% Voids
#2A	67.70'	516 cf	ADS_StormTech SC-310 +Cap x 35 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 35 Chambers in 7 Rows
		1,155 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.20'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.70'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.70' / 67.20' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	68.55'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.80 hrs HW=67.22' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=1.31 cfs @ 12.10 hrs HW=68.79' (Free Discharge)
↑**2=Culvert** (Passes 1.31 cfs of 2.29 cfs potential flow)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 1.31 cfs @ 1.38 fps)**Summary for Pond 6P:**

Inflow Area = 0.805 ac, 34.71% Impervious, Inflow Depth = 3.84" for 10-yr event
 Inflow = 3.33 cfs @ 12.09 hrs, Volume= 0.258 af
 Outflow = 2.00 cfs @ 12.21 hrs, Volume= 0.193 af, Atten= 40%, Lag= 7.0 min
 Discarded = 0.02 cfs @ 12.21 hrs, Volume= 0.042 af
 Primary = 1.98 cfs @ 12.21 hrs, Volume= 0.151 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 73.47' @ 12.21 hrs Surf.Area= 3,728 sf Storage= 4,216 cfPlug-Flow detention time= 188.2 min calculated for 0.193 af (75% of inflow)
Center-of-Mass det. time= 102.7 min (883.7 - 781.0)**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	2,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
#2	72.00'	3,547 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,357 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	931	0	0
73.00	1,395	1,163	1,163
74.00	1,900	1,648	2,811

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	1,133	0	0
73.00	1,730	1,432	1,432
74.00	2,500	2,115	3,547

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	12.0" Round Culvert L= 340.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 70.00' / 67.40' S= 0.0076 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	73.20'	6.0" Horiz. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#3	Discarded	72.00'	0.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 12.21 hrs HW=73.47' (Free Discharge)
↑**3=Exfiltration** (Exfiltration Controls 0.02 cfs)**Primary OutFlow** Max=1.97 cfs @ 12.21 hrs HW=73.47' (Free Discharge)
↑**1=Culvert** (Passes 1.97 cfs of 4.00 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 1.97 cfs @ 2.51 fps)**Summary for Link DP1:**

Inflow Area = 1.468 ac, 41.76% Impervious, Inflow Depth = 2.90" for 10-yr event
 Inflow = 3.70 cfs @ 12.12 hrs, Volume= 0.354 af
 Primary = 3.70 cfs @ 12.12 hrs, Volume= 0.354 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.385 ac, 75.55% Impervious, Inflow Depth = 3.69" for 10-yr event
 Inflow = 23.64 cfs @ 12.12 hrs, Volume= 1.962 af
 Primary = 23.64 cfs @ 12.12 hrs, Volume= 1.962 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1a: Runoff Area=35,497 sf 64.37% Impervious Runoff Depth=5.33"
 Tc=6.0 min CN=WQ Runoff=4.48 cfs 0.362 af

SubcatchmentPR1b: Runoff Area=28,436 sf 13.53% Impervious Runoff Depth=3.25"
 Tc=6.0 min CN=WQ Runoff=2.35 cfs 0.177 af

SubcatchmentPR2a: Runoff Area=63,506 sf 92.10% Impervious Runoff Depth=5.70"
 Tc=6.0 min CN=WQ Runoff=8.35 cfs 0.693 af

SubcatchmentPR2b: Runoff Area=125,323 sf 94.22% Impervious Runoff Depth=5.73"
 Tc=6.0 min CN=WQ Runoff=16.52 cfs 1.375 af

SubcatchmentPR2c: Runoff Area=11,522 sf 93.48% Impervious Runoff Depth=5.72"
 Tc=6.0 min CN=WQ Runoff=1.52 cfs 0.126 af

SubcatchmentPR2d: Runoff Area=12,917 sf 82.10% Impervious Runoff Depth=5.57"
 Tc=6.0 min CN=WQ Runoff=1.67 cfs 0.138 af

SubcatchmentPR2e: Runoff Area=35,069 sf 34.71% Impervious Runoff Depth=4.93"
 Tc=6.0 min CN=WQ Runoff=4.24 cfs 0.331 af

SubcatchmentPR2f: Runoff Area=29,792 sf 0.00% Impervious Runoff Depth=2.84"
 Tc=6.0 min CN=70 Runoff=2.23 cfs 0.162 af

Pond 1P: Peak Elev=75.34' Storage=3,222 cf Inflow=4.48 cfs 0.362 af
 Discarded=0.02 cfs 0.044 af Primary=2.75 cfs 0.301 af Outflow=2.76 cfs 0.345 af

Pond 2P: Peak Elev=77.29' Storage=3,377 cf Inflow=8.35 cfs 0.693 af
 Discarded=0.02 cfs 0.001 af Primary=7.44 cfs 0.677 af Outflow=7.46 cfs 0.678 af

Pond 3P: Peak Elev=70.09' Storage=5,261 cf Inflow=16.52 cfs 1.375 af
 Discarded=0.01 cfs 0.029 af Primary=14.61 cfs 1.282 af Outflow=14.63 cfs 1.310 af

Pond 4P: Peak Elev=69.56' Storage=1,254 cf Inflow=1.52 cfs 0.126 af
 Discarded=0.01 cfs 0.016 af Primary=1.50 cfs 0.087 af Outflow=1.51 cfs 0.103 af

Pond 5P: Peak Elev=68.83' Storage=892 cf Inflow=1.67 cfs 0.138 af
 Discarded=0.01 cfs 0.013 af Primary=1.66 cfs 0.110 af Outflow=1.67 cfs 0.123 af

Pond 6P: Peak Elev=73.64' Storage=4,846 cf Inflow=4.24 cfs 0.331 af
 Discarded=0.02 cfs 0.043 af Primary=2.50 cfs 0.223 af Outflow=2.53 cfs 0.266 af

Link DP1: Inflow=4.77 cfs 0.477 af
 Primary=4.77 cfs 0.477 af

Link DP2: Inflow=29.60 cfs 2.541 af
 Primary=29.60 cfs 2.541 af

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Total Runoff Area = 7.853 ac Runoff Volume = 3.363 af Average Runoff Depth = 5.14"
30.77% Pervious = 2.416 ac 69.23% Impervious = 5.437 ac

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Type III 24-hr 25-yr Rainfall=6.05"

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Summary for Subcatchment PR1a:Runoff = 4.48 cfs @ 12.09 hrs, Volume= 0.362 af, Depth= 5.33"
Routed to Pond 1P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 12,647	86	Open Space, HSG C
* 22,850	98	Impervious Area, HSG C
35,497		Weighted Average
12,647		35.63% Pervious Area
22,850		64.37% Impervious Area

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

Summary for Subcatchment PR1b:Runoff = 2.35 cfs @ 12.09 hrs, Volume= 0.177 af, Depth= 3.25"
Routed to Link DP1 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 24,588	70	Woods, HSG C
* 3,848	98	Impervious, HSG C
28,436		Weighted Average
24,588		86.47% Pervious Area
3,848		13.53% Impervious Area

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

Summary for Subcatchment PR2a:Runoff = 8.35 cfs @ 12.09 hrs, Volume= 0.693 af, Depth= 5.70"
Routed to Pond 2P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Type III 24-hr 25-yr Rainfall=6.05"

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Area (sf)	CN	Description
* 58,491	98	Impervious Area, HSG C (south bldg and courtyard)
* 5,015	86	Open Space, HSG C
63,506		Weighted Average
5,015		7.90% Pervious Area
58,491		92.10% Impervious Area

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

Summary for Subcatchment PR2b:Runoff = 16.52 cfs @ 12.09 hrs, Volume= 1.375 af, Depth= 5.73"
Routed to Pond 3P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 118,084	98	Impervious Area, HSG C
* 7,239	86	Open Space, HSG C
125,323		Weighted Average
7,239		5.78% Pervious Area
118,084		94.22% Impervious Area

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

Summary for Subcatchment PR2c:Runoff = 1.52 cfs @ 12.09 hrs, Volume= 0.126 af, Depth= 5.72"
Routed to Pond 4P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 10,771	98	Impervious Area, HSG C
* 751	86	Open Space, HSG C
11,522		Weighted Average
751		6.52% Pervious Area
10,771		93.48% Impervious Area

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

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Summary for Subcatchment PR2d:Runoff = 1.67 cfs @ 12.09 hrs, Volume= 0.138 af, Depth= 5.57"
Routed to Pond 5P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 10,605	98	Impervious Area, HSG C
* 2,312	86	OpenSpace, HSG C
12,917		Weighted Average
2,312		17.90% Pervious Area
10,605		82.10% Impervious Area

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

Summary for Subcatchment PR2e:Runoff = 4.24 cfs @ 12.09 hrs, Volume= 0.331 af, Depth= 4.93"
Routed to Pond 6P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.05"

Area (sf)	CN	Description
* 22,895	86	Open Space, HSG C
* 12,174	98	Impervious Area, HSG C
35,069		Weighted Average
22,895		65.29% Pervious Area
12,174		34.71% Impervious Area

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

Summary for Subcatchment PR2f:Runoff = 2.23 cfs @ 12.09 hrs, Volume= 0.162 af, Depth= 2.84"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
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Area (sf)	CN	Description
* 29,792	70	Woods, HSG C
29,792		100.00% Pervious Area

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

Summary for Pond 1P:Inflow Area = 0.815 ac, 64.37% Impervious, Inflow Depth = 5.33" for 25-yr event
Inflow = 4.48 cfs @ 12.09 hrs, Volume= 0.362 af
Outflow = 2.76 cfs @ 12.20 hrs, Volume= 0.345 af, Atten= 38%, Lag= 6.7 min
Discarded = 0.02 cfs @ 2.90 hrs, Volume= 0.044 af
Primary = 2.75 cfs @ 12.20 hrs, Volume= 0.301 af
Routed to Link DP1 :Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 75.34' @ 12.20 hrs Surf.Area= 3,035 sf Storage= 3,222 cfPlug-Flow detention time= 86.2 min calculated for 0.344 af (95% of inflow)
Center-of-Mass det. time= 59.4 min (820.1 - 760.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	73.60'	2,090 cf	29.50'W x 102.88'L x 2.33'H Field A 7,082 cf Overall - 1,857 cf Embedded = 5,224 cf x 40.0% Voids
#2A	74.10'	1,857 cf	ADS_StormTech SC-310 +Cap x 126 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 126 Chambers in 9 Rows
		3,947 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	73.60'	0.270 in/hr Exfiltration over Surface area
#2	Primary	71.00'	12.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 71.00' / 70.20' S= 0.0267 ' S= 0.0267 ' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#3	Device 2	75.45'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 2	74.30'	22.0" W x 4.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

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Discarded OutFlow Max=0.02 cfs @ 2.90 hrs HW=73.62' (Free Discharge)↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)**Primary OutFlow** Max=2.74 cfs @ 12.20 hrs HW=75.34' (Free Discharge)↳ **2=Culvert** (Passes 2.74 cfs of 7.41 cfs potential flow)↳ **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)↳ **4=Orifice/Grate** (Orifice Controls 2.74 cfs @ 4.49 fps)**Summary for Pond 2P:**

Inflow Area = 1.458 ac, 92.10% Impervious, Inflow Depth = 5.70" for 25-yr event
 Inflow = 8.35 cfs @ 12.09 hrs, Volume= 0.693 af
 Outflow = 7.46 cfs @ 12.13 hrs, Volume= 0.678 af, Atten= 11%, Lag= 2.6 min
 Discarded = 0.02 cfs @ 12.05 hrs, Volume= 0.001 af
 Primary = 7.44 cfs @ 12.13 hrs, Volume= 0.677 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Peak Elev= 77.29' @ 12.13 hrs Surf.Area= 3,120 sf Storage= 3,377 cf

Plug-Flow detention time= 47.9 min calculated for 0.678 af (98% of inflow)

Center-of-Mass det. time= 33.7 min (782.0 - 748.3)

Volume	Invert	Avail.Storage	Storage Description
#1B	75.50'	2,146 cf	32.58'W x 95.76'L x 2.33'H Field B 7,280 cf Overall - 1,916 cf Embedded = 5,364 cf x 40.0% Voids
#2B	76.00'	1,916 cf	ADS_StormTech SC-310 +Cap x 130 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 10 Rows
		4,062 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	76.00'	24.0" Round Culvert L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.00' / 75.50' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	76.85'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.02 cfs @ 12.05 hrs HW=77.05' (Free Discharge)↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)↳ **3=Broad-Crested Rectangular Weir** (Passes 0.02 cfs of 1.03 cfs potential flow)**Primary OutFlow** Max=7.28 cfs @ 12.13 hrs HW=77.27' (Free Discharge)↳ **2=Culvert** (Barrel Controls 7.28 cfs @ 4.94 fps)**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Summary for Pond 3P:

Inflow Area = 2.877 ac, 94.22% Impervious, Inflow Depth = 5.73" for 25-yr event
 Inflow = 16.52 cfs @ 12.09 hrs, Volume= 1.375 af
 Outflow = 14.63 cfs @ 12.13 hrs, Volume= 1.310 af, Atten= 11%, Lag= 2.7 min
 Discarded = 0.01 cfs @ 1.40 hrs, Volume= 0.029 af
 Primary = 14.61 cfs @ 12.13 hrs, Volume= 1.282 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Peak Elev= 70.09' @ 12.13 hrs Surf.Area= 1,928 sf Storage= 5,261 cf

Plug-Flow detention time= 60.1 min calculated for 1.310 af (95% of inflow)

Center-of-Mass det. time= 32.4 min (779.8 - 747.4)

Volume	Invert	Avail.Storage	Storage Description
#1B	66.00'	1,384 cf	22.75'W x 41.55'L x 5.50'H Field B 5,199 cf Overall - 1,739 cf Embedded = 3,460 cf x 40.0% Voids
#2B	66.75'	1,739 cf	ADS_StormTech MC-3500 d +Cap x 15 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 15 Chambers in 3 Rows Cap Storage= 14.9 cf x 2 x 3 rows = 89.4 cf
#3D	66.00'	1,434 cf	15.58'W x 63.06'L x 5.50'H Field D 5,405 cf Overall - 1,819 cf Embedded = 3,586 cf x 40.0% Voids
#4D	66.75'	1,819 cf	ADS_StormTech MC-3500 d +Cap x 16 Inside #3 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 16 Chambers in 2 Rows Cap Storage= 14.9 cf x 2 x 2 rows = 59.6 cf
		6,376 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Storage Group D created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.60'	24.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.60' / 67.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	68.35'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 1.40 hrs HW=66.06' (Free Discharge)↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=14.35 cfs @ 12.13 hrs HW=70.04' (Free Discharge)↳ **2=Culvert** (Inlet Controls 14.35 cfs @ 4.57 fps)↳ **3=Broad-Crested Rectangular Weir** (Passes 14.35 cfs of 29.27 cfs potential flow)

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Summary for Pond 4P:

Inflow Area = 0.265 ac, 93.48% Impervious, Inflow Depth = 5.72" for 25-yr event
 Inflow = 1.52 cfs @ 12.09 hrs, Volume= 0.126 af
 Outflow = 1.51 cfs @ 12.10 hrs, Volume= 0.103 af, Atten= 1%, Lag= 0.9 min
 Discarded = 0.01 cfs @ 2.40 hrs, Volume= 0.016 af
 Primary = 1.50 cfs @ 12.10 hrs, Volume= 0.087 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 69.56' @ 12.10 hrs Surf.Area= 1,071 sf Storage= 1,254 cf

Plug-Flow detention time= 154.2 min calculated for 0.103 af (82% of inflow)
 Center-of-Mass det. time= 80.7 min (828.4 - 747.7)

Volume	Invert	Avail.Storage	Storage Description
#1C	67.50'	752 cf	23.33'W x 45.92'L x 2.33'H Field C 2,500 cf Overall - 619 cf Embedded = 1,881 cf x 40.0% Voids
#2C	68.00'	619 cf	ADS_StormTech SC-310 +Cap x 42 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 42 Chambers in 7 Rows
		1,372 cf	Total Available Storage

Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	68.00'	12.0" Round Culvert L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 68.00' / 66.70' S= 0.0144 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	69.30'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.40 hrs HW=67.52' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.50 cfs @ 12.10 hrs HW=69.56' (Free Discharge)
 ↳ **2=Culvert** (Passes 1.50 cfs of 3.07 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 1.50 cfs @ 1.44 fps)

Summary for Pond 5P:

Inflow Area = 0.297 ac, 82.10% Impervious, Inflow Depth = 5.57" for 25-yr event
 Inflow = 1.67 cfs @ 12.09 hrs, Volume= 0.138 af
 Outflow = 1.67 cfs @ 12.10 hrs, Volume= 0.123 af, Atten= 1%, Lag= 0.9 min
 Discarded = 0.01 cfs @ 2.15 hrs, Volume= 0.013 af
 Primary = 1.66 cfs @ 12.10 hrs, Volume= 0.110 af

Routed to Link DP2 :

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Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 68.83' @ 12.10 hrs Surf.Area= 905 sf Storage= 892 cf

Plug-Flow detention time= 112.5 min calculated for 0.123 af (89% of inflow)
 Center-of-Mass det. time= 60.7 min (813.2 - 752.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	67.20'	639 cf	23.33'W x 38.80'L x 2.33'H Field A 2,112 cf Overall - 516 cf Embedded = 1,596 cf x 40.0% Voids
#2A	67.70'	516 cf	ADS_StormTech SC-310 +Cap x 35 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 35 Chambers in 7 Rows
		1,155 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.20'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.70'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.70' / 67.20' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	68.55'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.15 hrs HW=67.22' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.65 cfs @ 12.10 hrs HW=68.83' (Free Discharge)
 ↳ **2=Culvert** (Passes 1.65 cfs of 2.36 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 1.65 cfs @ 1.49 fps)

Summary for Pond 6P:

Inflow Area = 0.805 ac, 34.71% Impervious, Inflow Depth = 4.93" for 25-yr event
 Inflow = 4.24 cfs @ 12.09 hrs, Volume= 0.331 af
 Outflow = 2.53 cfs @ 12.21 hrs, Volume= 0.266 af, Atten= 40%, Lag= 7.0 min
 Discarded = 0.02 cfs @ 12.21 hrs, Volume= 0.043 af
 Primary = 2.50 cfs @ 12.21 hrs, Volume= 0.223 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 73.64' @ 12.21 hrs Surf.Area= 3,938 sf Storage= 4,846 cf

Plug-Flow detention time= 161.6 min calculated for 0.266 af (80% of inflow)
 Center-of-Mass det. time= 85.7 min (861.7 - 776.0)

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Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	2,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
#2	72.00'	3,547 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,357 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	931	0	0
73.00	1,395	1,163	1,163
74.00	1,900	1,648	2,811

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	1,133	0	0
73.00	1,730	1,432	1,432
74.00	2,500	2,115	3,547

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	12.0" Round Culvert L= 340.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 70.00' / 67.40' S= 0.0076 ' S= 0.0076 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	73.20'	6.0" Horiz. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#3	Discarded	72.00'	0.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 12.21 hrs HW=73.64' (Free Discharge)

↑**3=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.50 cfs @ 12.21 hrs HW=73.64' (Free Discharge)

↑**1=Culvert** (Passes 2.50 cfs of 4.07 cfs potential flow)

↑**2=Orifice/Grate** (Orifice Controls 2.50 cfs @ 3.18 fps)

Summary for Link DP1:

Inflow Area = 1.468 ac, 41.76% Impervious, Inflow Depth = 3.90" for 25-yr event
Inflow = 4.77 cfs @ 12.12 hrs, Volume= 0.477 af
Primary = 4.77 cfs @ 12.12 hrs, Volume= 0.477 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.385 ac, 75.55% Impervious, Inflow Depth = 4.78" for 25-yr event
Inflow = 29.60 cfs @ 12.12 hrs, Volume= 2.541 af
Primary = 29.60 cfs @ 12.12 hrs, Volume= 2.541 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

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Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR1a:	Runoff Area=35,497 sf 64.37% Impervious Runoff Depth=7.03" Tc=6.0 min CN=WQ Runoff=5.87 cfs 0.478 af
SubcatchmentPR1b:	Runoff Area=28,436 sf 13.53% Impervious Runoff Depth=4.72" Tc=6.0 min CN=WQ Runoff=3.43 cfs 0.257 af
SubcatchmentPR2a:	Runoff Area=63,506 sf 92.10% Impervious Runoff Depth=7.43" Tc=6.0 min CN=WQ Runoff=10.79 cfs 0.902 af
SubcatchmentPR2b:	Runoff Area=125,323 sf 94.22% Impervious Runoff Depth=7.46" Tc=6.0 min CN=WQ Runoff=21.34 cfs 1.788 af
SubcatchmentPR2c:	Runoff Area=11,522 sf 93.48% Impervious Runoff Depth=7.45" Tc=6.0 min CN=WQ Runoff=1.96 cfs 0.164 af
SubcatchmentPR2d:	Runoff Area=12,917 sf 82.10% Impervious Runoff Depth=7.29" Tc=6.0 min CN=WQ Runoff=2.17 cfs 0.180 af
SubcatchmentPR2e:	Runoff Area=35,069 sf 34.71% Impervious Runoff Depth=6.61" Tc=6.0 min CN=WQ Runoff=5.62 cfs 0.444 af
SubcatchmentPR2f:	Runoff Area=29,792 sf 0.00% Impervious Runoff Depth=4.28" Tc=6.0 min CN=70 Runoff=3.36 cfs 0.244 af
Pond 1P:	Peak Elev=75.71' Storage=3,680 cf Inflow=5.87 cfs 0.478 af Discarded=0.02 cfs 0.045 af Primary=4.80 cfs 0.416 af Outflow=4.82 cfs 0.460 af
Pond 2P:	Peak Elev=77.55' Storage=3,712 cf Inflow=10.79 cfs 0.902 af Discarded=0.02 cfs 0.001 af Primary=10.02 cfs 0.886 af Outflow=10.04 cfs 0.887 af
Pond 3P:	Peak Elev=71.11' Storage=6,072 cf Inflow=21.34 cfs 1.788 af Discarded=0.01 cfs 0.029 af Primary=18.93 cfs 1.695 af Outflow=18.94 cfs 1.724 af
Pond 4P:	Peak Elev=69.61' Storage=1,274 cf Inflow=1.96 cfs 0.164 af Discarded=0.01 cfs 0.016 af Primary=1.95 cfs 0.125 af Outflow=1.95 cfs 0.141 af
Pond 5P:	Peak Elev=68.88' Storage=913 cf Inflow=2.17 cfs 0.180 af Discarded=0.01 cfs 0.014 af Primary=2.16 cfs 0.152 af Outflow=2.17 cfs 0.166 af
Pond 6P:	Peak Elev=73.85' Storage=5,706 cf Inflow=5.62 cfs 0.444 af Discarded=0.03 cfs 0.044 af Primary=3.05 cfs 0.334 af Outflow=3.07 cfs 0.379 af
Link DP1:	Inflow=7.55 cfs 0.672 af Primary=7.55 cfs 0.672 af
Link DP2:	Inflow=39.00 cfs 3.436 af Primary=39.00 cfs 3.436 af

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Total Runoff Area = 7.853 ac Runoff Volume = 4.456 af Average Runoff Depth = 6.81"
30.77% Pervious = 2.416 ac 69.23% Impervious = 5.437 ac

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Summary for Subcatchment PR1a:

Runoff = 5.87 cfs @ 12.09 hrs, Volume= 0.478 af, Depth= 7.03"
 Routed to Pond 1P :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 12,647	86	Open Space, HSG C
* 22,850	98	Impervious Area, HSG C
35,497		Weighted Average
12,647		35.63% Pervious Area
22,850		64.37% Impervious Area

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

Summary for Subcatchment PR1b:

Runoff = 3.43 cfs @ 12.09 hrs, Volume= 0.257 af, Depth= 4.72"
 Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 24,588	70	Woods, HSG C
* 3,848	98	Impervious, HSG C
28,436		Weighted Average
24,588		86.47% Pervious Area
3,848		13.53% Impervious Area

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

Summary for Subcatchment PR2a:

Runoff = 10.79 cfs @ 12.09 hrs, Volume= 0.902 af, Depth= 7.43"
 Routed to Pond 2P :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-yr Rainfall=7.78"

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Area (sf)	CN	Description
* 58,491	98	Impervious Area, HSG C (south bldg and courtyard)
* 5,015	86	Open Space, HSG C
63,506		Weighted Average
5,015		7.90% Pervious Area
58,491		92.10% Impervious Area

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

Summary for Subcatchment PR2b:Runoff = 21.34 cfs @ 12.09 hrs, Volume= 1.788 af, Depth= 7.46"
Routed to Pond 3P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 118,084	98	Impervious Area, HSG C
* 7,239	86	Open Space, HSG C
125,323		Weighted Average
7,239		5.78% Pervious Area
118,084		94.22% Impervious Area

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

Summary for Subcatchment PR2c:Runoff = 1.96 cfs @ 12.09 hrs, Volume= 0.164 af, Depth= 7.45"
Routed to Pond 4P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 10,771	98	Impervious Area, HSG C
* 751	86	Open Space, HSG C
11,522		Weighted Average
751		6.52% Pervious Area
10,771		93.48% Impervious Area

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

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Summary for Subcatchment PR2d:Runoff = 2.17 cfs @ 12.09 hrs, Volume= 0.180 af, Depth= 7.29"
Routed to Pond 5P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 10,605	98	Impervious Area, HSG C
* 2,312	86	OpenSpace, HSG C
12,917		Weighted Average
2,312		17.90% Pervious Area
10,605		82.10% Impervious Area

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

Summary for Subcatchment PR2e:Runoff = 5.62 cfs @ 12.09 hrs, Volume= 0.444 af, Depth= 6.61"
Routed to Pond 6P :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=7.78"

Area (sf)	CN	Description
* 22,895	86	Open Space, HSG C
* 12,174	98	Impervious Area, HSG C
35,069		Weighted Average
22,895		65.29% Pervious Area
12,174		34.71% Impervious Area

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

Summary for Subcatchment PR2f:Runoff = 3.36 cfs @ 12.09 hrs, Volume= 0.244 af, Depth= 4.28"
Routed to Link DP2 :Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
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Area (sf)	CN	Description
* 29,792	70	Woods, HSG C
29,792		100.00% Pervious Area

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

Summary for Pond 1P:

Inflow Area = 0.815 ac, 64.37% Impervious, Inflow Depth = 7.03" for 100-yr event
 Inflow = 5.87 cfs @ 12.09 hrs, Volume= 0.478 af
 Outflow = 4.82 cfs @ 12.16 hrs, Volume= 0.460 af, Atten= 18%, Lag= 4.3 min
 Discarded = 0.02 cfs @ 2.05 hrs, Volume= 0.045 af
 Primary = 4.80 cfs @ 12.16 hrs, Volume= 0.416 af
 Routed to Link DP1 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 75.71' @ 12.16 hrs Surf.Area= 3,035 sf Storage= 3,680 cf

Plug-Flow detention time= 73.3 min calculated for 0.460 af (96% of inflow)
 Center-of-Mass det. time= 51.4 min (807.6 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	73.60'	2,090 cf	29.50'W x 102.88'L x 2.33'H Field A 7,082 cf Overall - 1,857 cf Embedded = 5,224 cf x 40.0% Voids
#2A	74.10'	1,857 cf	ADS_StormTech SC-310 +Cap x 126 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 126 Chambers in 9 Rows
		3,947 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	73.60'	0.270 in/hr Exfiltration over Surface area
#2	Primary	71.00'	12.0" Round Culvert L= 30.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 71.00' / 70.20' S= 0.0267 ' /' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#3	Device 2	75.45'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 2	74.30'	22.0" W x 4.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

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Discarded OutFlow Max=0.02 cfs @ 2.05 hrs HW=73.62' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=4.64 cfs @ 12.16 hrs HW=75.70' (Free Discharge)
 ↳ **2=Culvert** (Passes 4.64 cfs of 7.75 cfs potential flow)
 ↳ **3=Broad-Crested Rectangular Weir** (Weir Controls 1.38 cfs @ 1.40 fps)
 ↳ **4=Orifice/Grate** (Orifice Controls 2.26 cfs @ 5.33 fps)

Summary for Pond 2P:

Inflow Area = 1.458 ac, 92.10% Impervious, Inflow Depth = 7.43" for 100-yr event
 Inflow = 10.79 cfs @ 12.09 hrs, Volume= 0.902 af
 Outflow = 10.04 cfs @ 12.12 hrs, Volume= 0.887 af, Atten= 7%, Lag= 2.0 min
 Discarded = 0.02 cfs @ 11.95 hrs, Volume= 0.001 af
 Primary = 10.02 cfs @ 12.12 hrs, Volume= 0.886 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 77.55' @ 12.12 hrs Surf.Area= 3,120 sf Storage= 3,712 cf

Plug-Flow detention time= 39.8 min calculated for 0.886 af (98% of inflow)
 Center-of-Mass det. time= 29.1 min (773.7 - 744.6)

Volume	Invert	Avail.Storage	Storage Description
#1B	75.50'	2,146 cf	32.58'W x 95.76'L x 2.33'H Field B 7,280 cf Overall - 1,916 cf Embedded = 5,364 cf x 40.0% Voids
#2B	76.00'	1,916 cf	ADS_StormTech SC-310 +Cap x 130 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 10 Rows
		4,062 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	76.00'	24.0" Round Culvert L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.00' / 75.50' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	76.85'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.02 cfs @ 11.95 hrs HW=76.90' (Free Discharge)
 ↳ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)
 ↳ **3=Broad-Crested Rectangular Weir** (Passes 0.02 cfs of 0.14 cfs potential flow)

Primary OutFlow Max=9.71 cfs @ 12.12 hrs HW=77.52' (Free Discharge)
 ↳ **2=Culvert** (Barrel Controls 9.71 cfs @ 5.24 fps)

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Summary for Pond 3P:

Inflow Area = 2.877 ac, 94.22% Impervious, Inflow Depth = 7.46" for 100-yr event
 Inflow = 21.34 cfs @ 12.09 hrs, Volume= 1.788 af
 Outflow = 18.94 cfs @ 12.13 hrs, Volume= 1.724 af, Atten= 11%, Lag= 2.6 min
 Discarded = 0.01 cfs @ 1.10 hrs, Volume= 0.029 af
 Primary = 18.93 cfs @ 12.13 hrs, Volume= 1.695 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 71.11' @ 12.13 hrs Surf.Area= 1,928 sf Storage= 6,072 cf

Plug-Flow detention time= 48.9 min calculated for 1.721 af (96% of inflow)
 Center-of-Mass det. time= 27.4 min (771.2 - 743.8)

Volume	Invert	Avail.Storage	Storage Description
#1B	66.00'	1,384 cf	22.75'W x 41.55'L x 5.50'H Field B 5,199 cf Overall - 1,739 cf Embedded = 3,460 cf x 40.0% Voids
#2B	66.75'	1,739 cf	ADS_StormTech MC-3500 d +Capx 15 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 15 Chambers in 3 Rows Cap Storage= 14.9 cf x 2 x 3 rows = 89.4 cf
#3D	66.00'	1,434 cf	15.58'W x 63.06'L x 5.50'H Field D 5,405 cf Overall - 1,819 cf Embedded = 3,586 cf x 40.0% Voids
#4D	66.75'	1,819 cf	ADS_StormTech MC-3500 d +Capx 16 Inside #3 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 16 Chambers in 2 Rows Cap Storage= 14.9 cf x 2 x 2 rows = 59.6 cf
		6,376 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Storage Group D created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	66.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.60'	24.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.60' / 67.10' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 2	68.35'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 1.10 hrs HW=66.06' (Free Discharge)↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=18.56 cfs @ 12.13 hrs HW=71.02' (Free Discharge)↳ **2=Culvert** (Inlet Controls 18.56 cfs @ 5.91 fps)↳ **3=Broad-Crested Rectangular Weir**(Passes 18.56 cfs of 57.79 cfs potential flow)**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Summary for Pond 4P:

Inflow Area = 0.265 ac, 93.48% Impervious, Inflow Depth = 7.45" for 100-yr event
 Inflow = 1.96 cfs @ 12.09 hrs, Volume= 0.164 af
 Outflow = 1.95 cfs @ 12.10 hrs, Volume= 0.141 af, Atten= 0%, Lag= 0.8 min
 Discarded = 0.01 cfs @ 1.70 hrs, Volume= 0.016 af
 Primary = 1.95 cfs @ 12.10 hrs, Volume= 0.125 af

Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 69.61' @ 12.10 hrs Surf.Area= 1,071 sf Storage= 1,274 cf

Plug-Flow detention time= 132.4 min calculated for 0.141 af (86% of inflow)
 Center-of-Mass det. time= 70.7 min (814.8 - 744.1)

Volume	Invert	Avail.Storage	Storage Description
#1C	67.50'	752 cf	23.33'W x 45.92'L x 2.33'H Field C 2,500 cf Overall - 619 cf Embedded = 1,881 cf x 40.0% Voids
#2C	68.00'	619 cf	ADS_StormTech SC-310 +Capx 42 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 42 Chambers in 7 Rows
		1,372 cf	Total Available Storage

Storage Group C created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	68.00'	12.0" Round Culvert L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 68.00' / 66.70' S= 0.0144 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	69.30'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 1.70 hrs HW=67.52' (Free Discharge)↳ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=1.94 cfs @ 12.10 hrs HW=69.61' (Free Discharge)↳ **2=Culvert** (Passes 1.94 cfs of 3.14 cfs potential flow)↳ **3=Broad-Crested Rectangular Weir**(Weir Controls 1.94 cfs @ 1.59 fps)**Summary for Pond 5P:**

Inflow Area = 0.297 ac, 82.10% Impervious, Inflow Depth = 7.29" for 100-yr event
 Inflow = 2.17 cfs @ 12.09 hrs, Volume= 0.180 af
 Outflow = 2.17 cfs @ 12.10 hrs, Volume= 0.166 af, Atten= 0%, Lag= 0.8 min
 Discarded = 0.01 cfs @ 1.55 hrs, Volume= 0.014 af
 Primary = 2.16 cfs @ 12.10 hrs, Volume= 0.152 af

Routed to Link DP2 :

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Page 45Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 68.88' @ 12.10 hrs Surf.Area= 905 sf Storage= 913 cfPlug-Flow detention time= 95.2 min calculated for 0.166 af (92% of inflow)
Center-of-Mass det. time= 52.3 min (801.0 - 748.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	67.20'	639 cf	23.33'W x 38.80'L x 2.33'H Field A 2,112 cf Overall - 516 cf Embedded = 1,596 cf x 40.0% Voids
#2A	67.70'	516 cf	ADS_StormTech SC-310 +Cap x 35 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 35 Chambers in 7 Rows
		1,155 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.20'	0.270 in/hr Exfiltration over Surface area
#2	Primary	67.70'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 67.70' / 67.20' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	68.55'	4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 1.55 hrs HW=67.22' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)**Primary OutFlow** Max=2.16 cfs @ 12.10 hrs HW=68.88' (Free Discharge)
↑**2=Culvert** (Passes 2.16 cfs of 2.46 cfs potential flow)
↑**3=Broad-Crested Rectangular Weir** (Weir Controls 2.16 cfs @ 1.65 fps)**Summary for Pond 6P:**

Inflow Area = 0.805 ac, 34.71% Impervious, Inflow Depth = 6.61" for 100-yr event
 Inflow = 5.62 cfs @ 12.09 hrs, Volume= 0.444 af
 Outflow = 3.07 cfs @ 12.22 hrs, Volume= 0.379 af, Atten= 45%, Lag= 7.9 min
 Discarded = 0.03 cfs @ 12.22 hrs, Volume= 0.044 af
 Primary = 3.05 cfs @ 12.22 hrs, Volume= 0.334 af
 Routed to Link DP2 :

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 73.85' @ 12.22 hrs Surf.Area= 4,207 sf Storage= 5,706 cfPlug-Flow detention time= 136.8 min calculated for 0.379 af (85% of inflow)
Center-of-Mass det. time= 73.1 min (843.1 - 770.0)**MAB20250074.00_Post**Prepared by Bohler Engineering, PC
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Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	2,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
#2	72.00'	3,547 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
		6,357 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	931	0	0
73.00	1,395	1,163	1,163
74.00	1,900	1,648	2,811

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	1,133	0	0
73.00	1,730	1,432	1,432
74.00	2,500	2,115	3,547

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	12.0" Round Culvert L= 340.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 70.00' / 67.40' S= 0.0076 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	73.20'	6.0" Horiz. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#3	Discarded	72.00'	0.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.03 cfs @ 12.22 hrs HW=73.84' (Free Discharge)
↑**3=Exfiltration** (Exfiltration Controls 0.03 cfs)**Primary OutFlow** Max=3.03 cfs @ 12.22 hrs HW=73.84' (Free Discharge)
↑**1=Culvert** (Passes 3.03 cfs of 4.15 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 3.03 cfs @ 3.86 fps)**Summary for Link DP1:**

Inflow Area = 1.468 ac, 41.76% Impervious, Inflow Depth = 5.50" for 100-yr event
 Inflow = 7.55 cfs @ 12.14 hrs, Volume= 0.672 af
 Primary = 7.55 cfs @ 12.14 hrs, Volume= 0.672 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link DP2:

Inflow Area = 6.385 ac, 75.55% Impervious, Inflow Depth = 6.46" for 100-yr event
 Inflow = 39.00 cfs @ 12.12 hrs, Volume= 3.436 af
 Primary = 39.00 cfs @ 12.12 hrs, Volume= 3.436 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

APPENDIX F: STORMWATER CALCULATIONS

- MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL

MAB20250074.00_Post

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Type III 24-hr 2-yr Rainfall=3.11"

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Page 1

Stage-Area-Storage for Pond 1P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
73.60	3,035	0
73.65	3,035	61
73.70	3,035	121
73.75	3,035	182
73.80	3,035	243
73.85	3,035	303
73.90	3,035	364
73.95	3,035	425
74.00	3,035	486
74.05	3,035	546
74.10	3,035	607
74.15	3,035	732
74.20	3,035	857
74.25	3,035	982
74.30	3,035	1,105
74.35	3,035	1,227
74.40	3,035	1,348
74.45	3,035	1,468
74.50	3,035	1,587
74.55	3,035	1,704
74.60	3,035	1,819
74.65	3,035	1,933
74.70	3,035	2,045
74.75	3,035	2,155
74.80	3,035	2,263
74.85	3,035	2,369
74.90	3,035	2,472
74.95	3,035	2,573
75.00	3,035	2,671
75.05	3,035	2,766
75.10	3,035	2,857
75.15	3,035	2,943
75.20	3,035	3,023
75.25	3,035	3,098
75.30	3,035	3,168
75.35	3,035	3,235
75.40	3,035	3,299
75.45	3,035	3,360
75.50	3,035	3,421
75.55	3,035	3,482
75.60	3,035	3,542
75.65	3,035	3,603
75.70	3,035	3,664
75.75	3,035	3,725
75.80	3,035	3,785
75.85	3,035	3,846
75.90	3,035	3,907

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Stage-Area-Storage for Pond 2P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
75.50	3,120	0
75.55	3,120	62
75.60	3,120	125
75.65	3,120	187
75.70	3,120	250
75.75	3,120	312
75.80	3,120	374
75.85	3,120	437
75.90	3,120	499
75.95	3,120	562
76.00	3,120	624
76.05	3,120	753
76.10	3,120	882
76.15	3,120	1,010
76.20	3,120	1,137
76.25	3,120	1,263
76.30	3,120	1,388
76.35	3,120	1,511
76.40	3,120	1,633
76.45	3,120	1,753
76.50	3,120	1,872
76.55	3,120	1,989
76.60	3,120	2,105
76.65	3,120	2,218
76.70	3,120	2,329
76.75	3,120	2,439
76.80	3,120	2,545
76.85	3,120	2,649
76.90	3,120	2,750
76.95	3,120	2,847
77.00	3,120	2,941
77.05	3,120	3,030
77.10	3,120	3,112
77.15	3,120	3,189
77.20	3,120	3,261
77.25	3,120	3,330
77.30	3,120	3,396
77.35	3,120	3,459
77.40	3,120	3,521
77.45	3,120	3,584
77.50	3,120	3,646
77.55	3,120	3,708
77.60	3,120	3,771
77.65	3,120	3,833
77.70	3,120	3,896
77.75	3,120	3,958
77.80	3,120	4,020
77.85	3,120	4,062
77.90	3,120	4,062
77.95	3,120	4,062
78.00	3,120	4,062

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Page 3

Stage-Area-Storage for Pond 3P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
66.00	1,928	0	71.20	1,928	6,145
66.10	1,928	77	71.30	1,928	6,222
66.20	1,928	154	71.40	1,928	6,299
66.30	1,928	231	71.50	1,928	6,376
66.40	1,928	308			
66.50	1,928	386			
66.60	1,928	463			
66.70	1,928	540			
66.80	1,928	618			
66.90	1,928	695			
67.00	1,928	772			
67.10	1,928	849			
67.20	1,928	926			
67.30	1,928	1,003			
67.40	1,928	1,080			
67.50	1,928	1,157			
67.60	1,928	1,234			
67.70	1,928	1,311			
67.80	1,928	1,388			
67.90	1,928	1,465			
68.00	1,928	1,542			
68.10	1,928	1,619			
68.20	1,928	1,696			
68.30	1,928	1,773			
68.40	1,928	1,850			
68.50	1,928	1,927			
68.60	1,928	2,004			
68.70	1,928	2,081			
68.80	1,928	2,158			
68.90	1,928	2,235			
69.00	1,928	2,312			
69.10	1,928	2,389			
69.20	1,928	2,466			
69.30	1,928	2,543			
69.40	1,928	2,620			
69.50	1,928	2,697			
69.60	1,928	2,774			
69.70	1,928	2,851			
69.80	1,928	2,928			
69.90	1,928	3,005			
70.00	1,928	3,082			
70.10	1,928	3,159			
70.20	1,928	3,236			
70.30	1,928	3,313			
70.40	1,928	3,390			
70.50	1,928	3,467			
70.60	1,928	3,544			
70.70	1,928	3,621			
70.80	1,928	3,698			
70.90	1,928	3,775			
71.00	1,928	3,852			
71.10	1,928	3,929			

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Page 4

Stage-Area-Storage for Pond 4P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
67.50	1,071	0
67.55	1,071	21
67.60	1,071	43
67.65	1,071	64
67.70	1,071	86
67.75	1,071	107
67.80	1,071	129
67.85	1,071	150
67.90	1,071	171
67.95	1,071	193
68.00	1,071	214
68.05	1,071	257
68.10	1,071	300
68.15	1,071	343
68.20	1,071	385
68.25	1,071	427
68.30	1,071	469
68.35	1,071	510
68.40	1,071	550
68.45	1,071	591
68.50	1,071	630
68.55	1,071	669
68.60	1,071	708
68.65	1,071	746
68.70	1,071	783
68.75	1,071	820
68.80	1,071	855
68.85	1,071	890
68.90	1,071	924
68.95	1,071	957
69.00	1,071	988
69.05	1,071	1,018
69.10	1,071	1,046
69.15	1,071	1,072
69.20	1,071	1,097
69.25	1,071	1,120
69.30	1,071	1,143
69.35	1,071	1,164
69.40	1,071	1,186
69.45	1,071	1,207
69.50	1,071	1,229
69.55	1,071	1,250
69.60	1,071	1,272
69.65	1,071	1,293
69.70	1,071	1,314
69.75	1,071	1,336
69.80	1,071	1,357

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Page 5

Stage-Area-Storage for Pond 5P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
67.20	905	0
67.25	905	18
67.30	905	36
67.35	905	54
67.40	905	72
67.45	905	91
67.50	905	109
67.55	905	127
67.60	905	145
67.65	905	163
67.70	905	181
67.75	905	217
67.80	905	253
67.85	905	289
67.90	905	324
67.95	905	360
68.00	905	394
68.05	905	429
68.10	905	463
68.15	905	497
68.20	905	530
68.25	905	563
68.30	905	595
68.35	905	627
68.40	905	658
68.45	905	689
68.50	905	719
68.55	905	748
68.60	905	777
68.65	905	804
68.70	905	831
68.75	905	856
68.80	905	880
68.85	905	902
68.90	905	922
68.95	905	942
69.00	905	961
69.05	905	980
69.10	905	998
69.15	905	1,016
69.20	905	1,034
69.25	905	1,052
69.30	905	1,070
69.35	905	1,088
69.40	905	1,106
69.45	905	1,124
69.50	905	1,142

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Page 6

Stage-Area-Storage for Pond 6P:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
72.00	2,064	0	73.04	3,176	2,721
72.02	2,085	41	73.06	3,202	2,784
72.04	2,106	83	73.08	3,227	2,849
72.06	2,128	126	73.10	3,252	2,913
72.08	2,149	169	73.12	3,278	2,979
72.10	2,170	212	73.14	3,304	3,044
72.12	2,191	255	73.16	3,329	3,111
72.14	2,213	299	73.18	3,355	3,178
72.16	2,234	344	73.20	3,380	3,245
72.18	2,255	389	73.22	3,405	3,313
72.20	2,276	434	73.24	3,431	3,381
72.22	2,297	480	73.26	3,457	3,450
72.24	2,319	526	73.28	3,482	3,519
72.26	2,340	573	73.30	3,507	3,589
72.28	2,361	620	73.32	3,533	3,660
72.30	2,382	667	73.34	3,559	3,731
72.32	2,404	715	73.36	3,584	3,802
72.34	2,425	763	73.38	3,609	3,874
72.36	2,446	812	73.40	3,635	3,947
72.38	2,467	861	73.42	3,661	4,019
72.40	2,488	910	73.44	3,686	4,093
72.42	2,510	960	73.46	3,711	4,167
72.44	2,531	1,011	73.48	3,737	4,241
72.46	2,552	1,062	73.50	3,763	4,316
72.48	2,573	1,113	73.52	3,788	4,392
72.50	2,595	1,165	73.54	3,814	4,468
72.52	2,616	1,217	73.56	3,839	4,544
72.54	2,637	1,269	73.58	3,864	4,621
72.56	2,658	1,322	73.60	3,890	4,699
72.58	2,679	1,376	73.62	3,916	4,777
72.60	2,701	1,429	73.64	3,941	4,856
72.62	2,722	1,484	73.66	3,966	4,935
72.64	2,743	1,538	73.68	3,992	5,014
72.66	2,764	1,593	73.70	4,018	5,094
72.68	2,785	1,649	73.72	4,043	5,175
72.70	2,807	1,705	73.74	4,068	5,256
72.72	2,828	1,761	73.76	4,094	5,338
72.74	2,849	1,818	73.78	4,120	5,420
72.76	2,870	1,875	73.80	4,145	5,502
72.78	2,892	1,933	73.82	4,170	5,586
72.80	2,913	1,991	73.84	4,196	5,669
72.82	2,934	2,049	73.86	4,221	5,753
72.84	2,955	2,108	73.88	4,247	5,838
72.86	2,976	2,167	73.90	4,273	5,923
72.88	2,998	2,227	73.92	4,298	6,009
72.90	3,019	2,287	73.94	4,323	6,095
72.92	3,040	2,348	73.96	4,349	6,182
72.94	3,061	2,409	73.98	4,375	6,269
72.96	3,083	2,470	74.00	4,400	6,357
72.98	3,104	2,532			
73.00	3,125	2,595			
73.02	3,150	2,657			

Proposed Mixed Use Multi-Family Development
100 Old River Road
Andover, MA

Post-Construction Water Quality - BMP Accounting and Tracking Tool Calculations

Objective: Determine the reduction in total phosphorus (TP) loading for a given post-construction land use following the installation of stormwater Best Management Practices. Percent reduction shall be greater than or equal to 60% as required under Town of Andover Stormwater Management and Erosion Control Regulations Section IX.D

Methodology: Output from the U.S. EPA "BMP Accounting and Tracking Tool (BATT) version 2.1".

Subcatchment PR-1a to Infiltration System – 1P

The screenshot displays the 'BMP Land Use Information' tab of the BATT software. The 'Project Type' section has 'New Development*' selected. The 'Unique Project Identifier' is '1P' and 'Receiving Water' is 'N/A'. Under 'Select Land Area Treated by the BMP', 'Land Use Type' is 'HIGH DENSITY RESIDENTIAL (I)', 'Land Use Area (acre)' is '0.61', and 'Hydrologic Soil Group' is 'N/A'. The 'BMP Drainage Area' list contains one entry: 'HIGH DENSITY RESIDENTIAL (I), 0.61, N/A, 2.32, 1, 14.1, 1, 438.95, 1'. At the bottom, there are buttons for 'Refresh', 'Calculate Credit', 'Save', 'Close', and 'Next ->'.

Subcatchment PR-1: Phosphorus Loading

High Density Residential (Impervious Area) = 0.61 ac x 2.32 lb/year/ac = 1.41 lb/year

Total = 1.41 lb/year

Add Structural BMP

BMP Land Use Information | **BMP Information** | Property Information

Select BMP Type: **INFILTRATION BASIN**

Note: Click the Refresh button after changing the BMP type and/or the BMP

BMP Specifications

Infiltration Rate (in/hr): 0.27

Storage Volume (ft³): 1105

Calculate Storage Volume

BMP Location (Optional)

BMP Latitude (decimal degree):

BMP Longitude (decimal degree):

Operation

BMP Bu

BMP Ma

O&M P

Date

Date

Edit BMP Efficiencies

BMP Efficiency

Phosphorus

Calculated (%) 79.447

Edit Default Efficiency (If EPA Approved)

Nitrogen

Calculated (%) 89.971

Edit Default Efficiency (If EPA Approved)

Total Suspended Solids

Calculated (%) 95.981

Edit Default Efficiency (If EPA Approved)

Buttons: Back, Refresh, Calculate Credit, Default BMP Efficiency, Save, Close

Subsurface Infiltration System-1P: Storage Volume

Basin Volume (Per HydroCAD) = 1,105 CF

Total = 1,105 CF

Removal Phosphorus Load = 1.12 lb/yr (79.4%)

Subcatchment PR-2a to Infiltration System – 2P

BMP Land Use Information | **BMP Information** | Property Information

Project Type

New Development* Retrofit BMP Other

* If the associated project will alter land uses, enter a Land Use Change project separately.

Unique Project Identifier: 2P

Receiving Water: N/A

Select Land Area Treated by the BMP

Land Use Type: HIGH DENSITY RESIDENTIAL (I)

Land Use Area (acre): 1.44

Hydrologic Soil Group: N/A

Note: Land use types are followed by letter to represent pervious or impervious. P denotes pervious land use, and I denotes impervious land use.

Add ->

View/Edit Land Loading Rates

BMP Drainage Area *

Note: Click the Refresh button after changing the land use info in BMP drainage area.

HIGH DENSITY RESIDENTIAL (I), 1.44, N/A, 2.32, 1, 14.1, 1, 438.95, 1

Delete Selected Drainage Area

Buttons: Refresh, Calculate Credit, Save, Close, Next ->

Subcatchment PR-2a: Phosphorus Loading

High Density Residential (Impervious Area) = 1.44 ac x 2.32 lb/year/ac = 3.34 lb/year

Total = 3.31 lb/year

Select BMP Type: **INFILTRATION BASIN**

Note: Click the Refresh button after changing the BMP type and/or the BMP

BMP Specifications

Infiltration Rate (in/hr): **0.27**

Storage Volume (ft³): **2645**

Calculate Storage Volume

BMP Location (Optional)

BMP Latitude (decimal degree):

BMP Longitude (decimal degree):

Operation

BMP Bu

BMP Ma

O&M Pl

Date

Date

BMP Efficiency

Phosphorus

Calculated (%) **79.83**

Edit Default Efficiency (If EPA Approved)

Nitrogen

Calculated (%) **90.18**

Edit Default Efficiency (If EPA Approved)

Total Suspended Solids

Calculated (%) **96.12**

Edit Default Efficiency (If EPA Approved)

< Back **Refresh** **Calculate Credit** **Default BMP Efficiency** **Save** **Close**

Subsurface Infiltration System-2P: Storage Volume

Basin Volume (Per HydroCAD) = 2,645 CF

Total = 2,645 CF

Removal Phosphorus Load = 2.64 lb/yr (79.8%)

Subcatchment PR-2b to Infiltration System – 3P

BMP Land Use Information | BMP Information | Property Information

Project Type

New Development* Retrofit BMP Other

* If the associated project will alter land uses, enter a Land Use Change project separately.

Select Land Area Treated by the BMP

Land Use Type: **HIGH DENSITY RESIDENTIAL (I)**

Land Use Area (acre): **2.84**

Hydrologic Soil Group: **N/A**

Note: Land use types are followed by letter to represent pervious or impervious. P denotes pervious land use, and I denotes impervious land use.

Add ->

View/Edit Land Loading Rates

Unique Project Identifier: **3P**

Receiving Water: **N/A**

BMP Drainage Area *

Note: Click the Refresh button after changing the land use info in BMP drainage area.

Y RESIDENTIAL (I), 2.84, N/A, 2.32, 1, 14.1, 1, 438.95, 1

Delete Selected Drainage Area

Refresh **Calculate Credit** **Save** **Close** **Next ->**

Subcatchment PR-2b: Phosphorus Loading

High Density Residential (Impervious Area) = 2.84 ac x 2.32 lb/year/ac = 6.58 lb/year

Total = 6.58 lb/year

Infiltration System-3P: Storage Volume

Basin Volume (Per HydroCAD) = 3,030 CF

Total = 3,030 CF

Removal Phosphorus Load = 4.71 lb/yr (63.3%)

Subcatchment PR-2c to Infiltration System – 4P

Subcatchment PR-2c: Phosphorus Loading

High Density Residential (Impervious Area) = 0.34 ac x 2.32 lb/year/ac = 0.78 lb/year

Total = 0.78 lb/year

Select BMP Type INFILTRATION BASIN

Note: Click the Refresh button after changing the BMP type and/or the BMP

BMP Specifications

Infiltration Rate (in/hr) 0.27

Storage Volume (ft³) 1143

Calculate Storage Volume

BMP Location (Optional)

BMP Latitude (decimal degree)

BMP Longitude (decimal degree)

Operation

BMP Bu

BMP Ma

O&M P

Date

Date

BMP Efficiency

Phosphorus

Calculated (%) 91.892

Edit Default Efficiency (If EPA Approved)

Nitrogen

Calculated (%) 97.631

Edit Default Efficiency (If EPA Approved)

Total Suspended Solids

Calculated (%) 99.631

Edit Default Efficiency (If EPA Approved)

<- Back Refresh Calculate Credit Default BMP Efficiency Save Close

Infiltration System-4P: Storage Volume

Basin Volume (Per HydroCAD) = 1,143 CF

Total = 1,143 CF

Removal Phosphorus Load = 0.71 lb/yr (91.8%)

Subcatchment PR-2d to Infiltration System – 5P

BMP Land Use Information BMP Information Property Information

Project Type

New Development* Retrofit BMP Other

* If the associated project will alter land uses, enter a Land Use Change project separately.

Select Land Area Treated by the BMP

Land Use Type HIGH DENSITY RESIDENTIAL (I)

Land Use Area (acre) 0.29

Hydrologic Soil Group N/A

Note: Land use types are followed by letter to represent pervious or impervious. P denotes pervious land use, and I denotes impervious land use. Add ->

View/Edit Land Loading Rates

*** BMP Drainage Area Note**

The format of land use information stored in BMP drainage area: Land Use Type, Area, HSG, Phosphorus Land Loading Rate, Phosphorus Adjustment Factor, Nitrogen Land Loading Rate, Nitrogen Adjustment Factor, Sediment Land Loading Rate, Sediment Adjustment Factor.

Unique Project Identifier 5P

Receiving Water N/A

BMP Drainage Area *

Note: Click the Refresh button after changing the land use info in BMP drainage area.

Y RESIDENTIAL (I), 0.29, N/A, 2.32, 1, 14.1, 1, 438.95, 1

Delete Selected Drainage Area

Refresh Calculate Credit Save Close Next ->

Subcatchment PR-2d: Phosphorus Loading

High Density Residential (Impervious Area) = 0.29 ac x 2.32 lb/year/ac = 0.67 lb/year

Total = 0.67 lb/year

Select BMP Type: **INFILTRATION BASIN**

Note: Click the Refresh button after changing the BMP type and/or the BMP

BMP Specifications

Infiltration Rate (in/hr): **0.27**

Storage Volume (ft³): **748**

Calculate Storage Volume

BMP Location (Optional)

BMP Latitude (decimal degree):

BMP Longitude (decimal degree):

Operation

BMP Bu

BMP Ma

O&M P

Date:

Date:

BMP Efficiency

Phosphorus

Calculated (%) **87.764**

Edit Default Efficiency (If EPA Approved)

Nitrogen

Calculated (%) **95.211**

Edit Default Efficiency (If EPA Approved)

Total Suspended Solids

Calculated (%) **98.553**

Edit Default Efficiency (If EPA Approved)

<- Back Refresh Calculate Credit Default BMP Efficiency Save Close

Infiltration System-5P: Storage Volume

Basin Volume (Per HydroCAD) = 748 CF

Total = 748 CF

Removal Phosphorus Load = 0.58 lb/yr (87.7%)

Subcatchment PR-2e to Infiltration System – 6P

BMP Land Use Information BMP Information Property Information

Project Type

New Development* Retrofit BMP Other

* If the associated project will alter land uses, enter a Land Use Change project separately.

Unique Project Identifier: **6P**

Receiving Water: **N/A**

Select Land Area Treated by the BMP

Land Use Type: **HIGH DENSITY RESIDENTIAL (I)**

Land Use Area (acre): **0.82**

Hydrologic Soil Group: **N/A**

Note: Land use types are followed by letter to represent pervious or impervious. P denotes pervious land use, and I denotes impervious land use.

Add ->

View/Edit Land Loading Rates

BMP Drainage Area *

Note: Click the Refresh button after changing the land use info in BMP drainage area.

Y RESIDENTIAL (I), 0.82, N/A, 2.32, 1, 14.1, 1, 438.95, 1

Delete Selected Drainage Area

* BMP Drainage Area Note
 The format of land use information stored in BMP drainage area: Land Use Type, Area, HSG, Phosphorus Land Loading Rate, Phosphorus Adjustment Factor, Nitrogen Land Loading Rate, Nitrogen Adjustment Factor, Sediment Land Loading Rate, Sediment Adjustment Factor.

Refresh Calculate Credit Save Close Next ->

Subcatchment PR-2e: Phosphorus Loading

High Density Residential (Impervious Area) = 0.82 ac x 2.32 lb/year/ac = 1.90 lb/year

Total = 1.90 lb/year

BMP Land Use Information | BMP Information | Property Information

Select BMP Type **INFILTRATION BASIN**

Note: Click the Refresh button after changing the BMP type and/or the BMP

BMP Specifications

Infiltration Rate (in/hr) **0.27**

Storage Volume (ft³) **3245**

Calculate Storage Volume

BMP Location (Optional)

BMP Latitude (decimal degree)

BMP Longitude (decimal degree)

Operation

- BMP Bu
- BMP Ma
- O&M P

Date

Date

BMP Efficiency

Phosphorus

Calculated (%) **93.902**

Edit Default Efficiency (If EPA Approved)

Nitrogen

Calculated (%) **98.18**

Edit Default Efficiency (If EPA Approved)

Total Suspended Solids

Calculated (%) **100**

Edit Default Efficiency (If EPA Approved)

<- Back **Refresh** **Calculate Credit** **Default BMP Efficiency** **Save** **Close**

Infiltration System-6P: Storage Volume

Basin Volume (Per HydroCAD) = 3,245 CF

Total = 3,245 CF

Removal Phosphorus Load = 1.88 lb/yr (93.9%)

Mixed Use Multi-Family
100 Old River Road
Andover, MA
Bohler Job Number: MAB250074.00
January 9, 2026
Rev: March 3, 2026

MA DEP Standard 4: Weighted TSS Removal Rate

BMP	TSS Removal (%)*	Treated Area (ac)	TP Removal (%)*	Treated Area (ac)
1P	95	0.610	79	0.610
2P	96	1.440	79	1.440
3P	87	2.840	63	2.840
4P	99	0.340	91	0.340
5P	98	0.290	87	0.290
6P	100	0.826	93	0.826
WQI-2	90	0.150	0	0.150
Overall Site Weighted TSS Removal Rate	93	Overall Site Weighted TP Removal Rate	73	
DP1 Weighted TSS	94	DP1 Weighted TP	63	

*Removal Rates based on EPA Region 1's BMP Accounting and Tracking Tool (BATT)

NJCAT TECHNOLOGY VERIFICATION

**Removal Efficiency of Suspended Sediment with a
Median Particle Size of 110 microns**

**Cascade Separator™
Contech Engineered Solutions, LLC**

**November 2019
(Amended Table A-1 August 2020)**

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1. INTRODUCTION

In September 2019, the Cascade Separator™ received New Jersey Corporation for Advanced Technology (NJCAT) verification for testing completed under the New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device (NJDEP Protocol) dated January 25, 2013. The Cascade Separator met the NJDEP Protocol requirements by demonstrating 50% weighted TSS removal with a target median particle size (D_{50}) of 75 μm at a target inlet sediment concentration of 200 mg/L.

Many jurisdictions in the United States are interested in data demonstrating solids removal for coarser particle sizes than that tested for NJDEP certification. A common standard used to evaluate and size hydrodynamic separators in other parts of North America is to utilize a sediment gradation with a D_{50} of 110 μm . The objective of this additional laboratory evaluation was to determine the total suspended solids (TSS) removal by the Cascade over a range of operating rates using a sediment gradation with a median particle size (D_{50}) of 110 μm at a target inlet sediment concentration of 280 mg/L. **The results of the study were submitted to NJCAT for verification, but the testing procedure falls outside of the NJDEP Protocol and process and therefore was not submitted to NJDEP for certification.**

2. DESCRIPTION OF TECHNOLOGY

The Cascade Separator is a manufactured treatment device (MTD) designed to protect waterways from stormwater runoff. The hydrodynamic separator device separates and traps trash, debris and sediment, even at high flow rates, and provides easy access for maintenance. The Cascade Separator is commonly used as a standalone stormwater quality control practice and as pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems and Low Impact Development designs.

The Cascade Separator (**Figure 1**) accepts flow through an inlet. Water enters the inlet chamber where a specially designed insert splits the flow into two flumes, creating vortices that rotate in opposite directions in the center chamber. This creates high and low velocity regions in the center chamber that facilitates the settling of particles. As water travels downward through the center chamber, sediment settles into the sump area where it is retained until maintenance is performed. The slanted skirt provides scour protection during peak events and its incline facilitates sediment transport into the sump. Treated stormwater moves upwards, leaves the center cylinder through the outlet window and travels through the outlet channel before exiting the system. Refer to the black flow arrows in **Figure 2** for the treatment flow path. The outlet deck incorporates two pipes that extend downward and allow the system to drain to the outlet pipe invert elevation after the storm event has subsided, while also preventing captured floating materials from leaving the system. The green arrows in **Figure 2** show the flow path through these components.

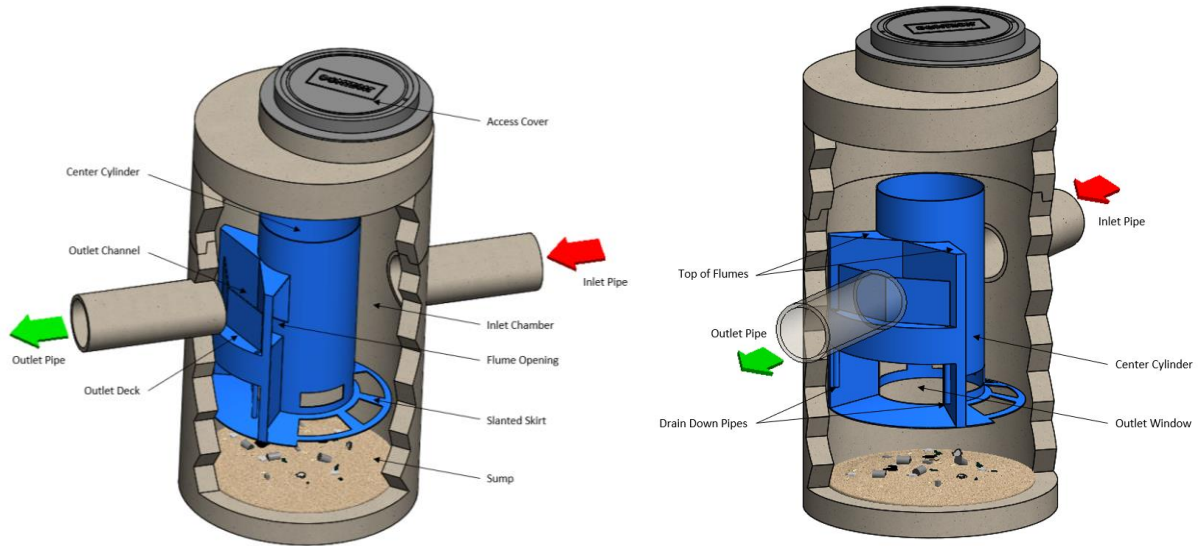


Figure 1: Model of the Cascade Separator

The Cascade Separator is designed to handle high flow rates without scouring previously captured pollutants. Each model is designed to allow a maximum flow rate through the treatment chambers and has an internal flow bypass for storm events that exceed the specific flow rate. While in internal bypass, the unit continues to treat the stormwater that enters the flumes while the excess flow passes over the flumes and exits the system untreated. This internal bypass feature allows the Cascade Separator to be installed online, therefore eliminating the need for additional bypass structures. The red arrows in **Figure 2** show how excess flow is bypassed over the flumes.

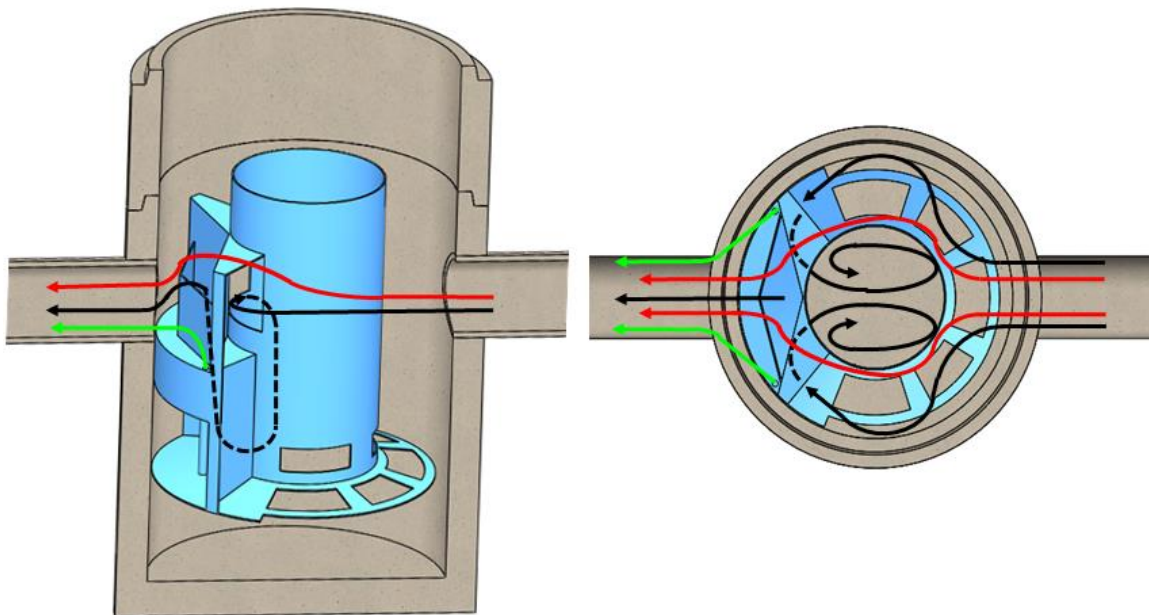


Figure 2: Cascade Separator Flow Paths

3. LABORATORY TESTING

All removal efficiency testing for this project was carried out at Contech's Portland, Oregon laboratory in April and May 2019. Independent third-party oversight was provided by Scott Wells, Ph.D. and his associate Chris Berger, Ph.D. Dr. Scott Wells and Dr. Chris Berger, from Portland State University, have extensive backgrounds in water quality including direct experience with the laboratory evaluation of stormwater MTDs. Dr. Scott Wells and Dr. Chris Berger have no conflict of interest that would disqualify them from serving as independent third-party observers during this testing process.

Test sediment samples for particle size distribution (PSD) analysis were processed in-house, under third-party observation according to ASTM D6913/D6913M-17 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis. Test sediment samples for moisture content were processed in-house, under third-party observation according to ASTM D2216-2019 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. TSS samples were processed in-house, under third-party observation according to ASTM D3977-97(2013) Standard Test Methods for Determining Sediment Concentration in Water Samples.

3.1. TEST UNIT

Laboratory testing was completed on a full-scale, dimensionally accurate 4 ft diameter Cascade Separator (CS-4) lab model, whose components and material are comparable to the commercially available product (**Figure 3**). The Cascade Separator was housed in a 4 ft diameter aluminum manhole with aluminum influent and effluent pipes, with the same inside diameter (ID) as a 24 in. PVC pipe (22.5 in. ID). The CS-4 has a depth of 48 in. from housing floor to effluent pipe invert. The CS-4 outlet channel height is 10.5 in. above the outlet pipe invert. The effective treatment area is 12.6 ft² and the maximum sediment storage capacity is 18.8 ft³, or a depth of 18 in. above the floor. Removal efficiency was conducted at 50% of the maximum sediment storage depth. To accomplish this, an aluminum false floor was installed at 50% of the sediment storage depth, or 39 in. below the outlet pipe invert. The CS-4 permanent pool volume is 40.8 ft³ from 50% sediment storage depth to outlet pipe invert. For this testing, the approximate full operation volume of 58.6 ft³ (50% sediment storage depth to internal bypass elevation, 56 in. height) will be used to calculate the detention time as it is more conservative.

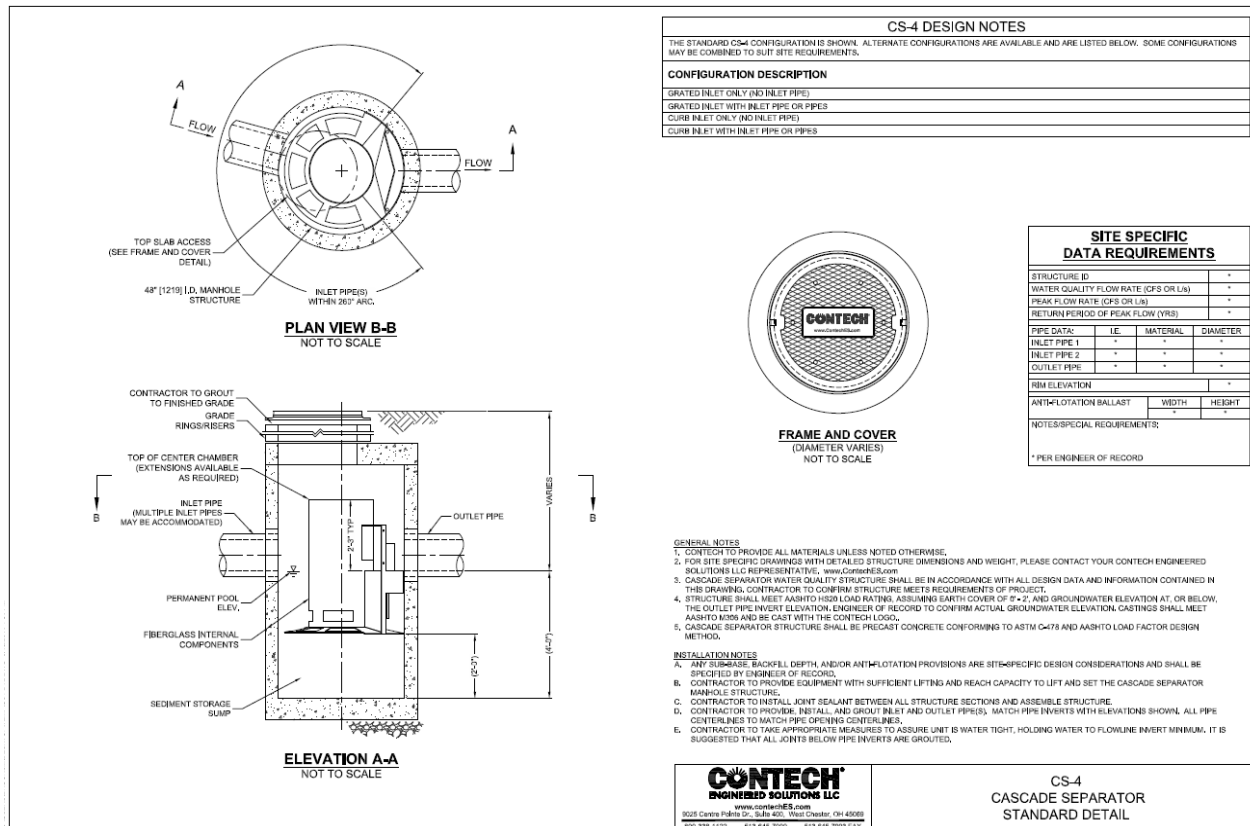


Figure 3: Cascade Separator Standard Detail

3.2. TEST SYSTEM

The Cascade Separator was tested on a recirculating laboratory system capable of delivering flow rates up to 5 cfs (**Figure 4**). During removal efficiency tests, clean water was drawn from a 3,500-gal influent tank using a 15 HP, Berkeley B6ZPLS centrifugal pump (Pump 1). Closed loop flow-control was maintained with a proportional-integral-derivative controlled variable frequency drive (VFD). The feedback signal to the VFD was provided from a Seametrics IMAG 4700 8 in. flowmeter. All flow from Pump 1 to the test unit was measured by the flowmeter (+/- 1.0% of reading) and logged at 5 sec intervals. Influent flow traveled through an inlet junction and into the influent pipe where background TSS samples were taken from a 3/4 in. PVC pipe sampling port at the bottom of the influent pipe, upstream of the sediment injection point (**Figure 5**). Influent water was then dosed with sediment at the crown of the pipe from an Auger Feeders VF2 volumetric sediment feeder, located 112.5 in. upstream of the test unit (**Figure 6**). Influent water entered the manhole housing, was treated by the Cascade Separator, and exited the unit via the effluent pipe. Water exited the effluent pipe in a free-fall stream, where effluent TSS grab samples were taken by making a single sweeping pass through the cross section of the effluent stream before it entered the 2,350 gal effluent tank (**Figure 7**).

Effluent water traveled through an array of bag filters located inside the effluent tank and was then pumped through cartridge filter housings using a 25 HP Berkeley B5ZPBHS centrifugal pump (Pump 2). To maintain water balance between the isolated influent and effluent tanks, a closed-looped flow-control on Pump 2 was maintained using feedback from a Seametrics IMAG 4700 8

in. flowmeter. The filtered water was discharged into the influent tank for re-use. Flocculants were not used to reduce background TSS at any time.

The test water temperature was maintained using a Coates 32024CPH 24 kW heater, which recirculated influent water. Water temperature was measured in the inlet junction with an Omega HSRTD-3-100-B-80-E resistance temperature detector and logged at 5 sec intervals.

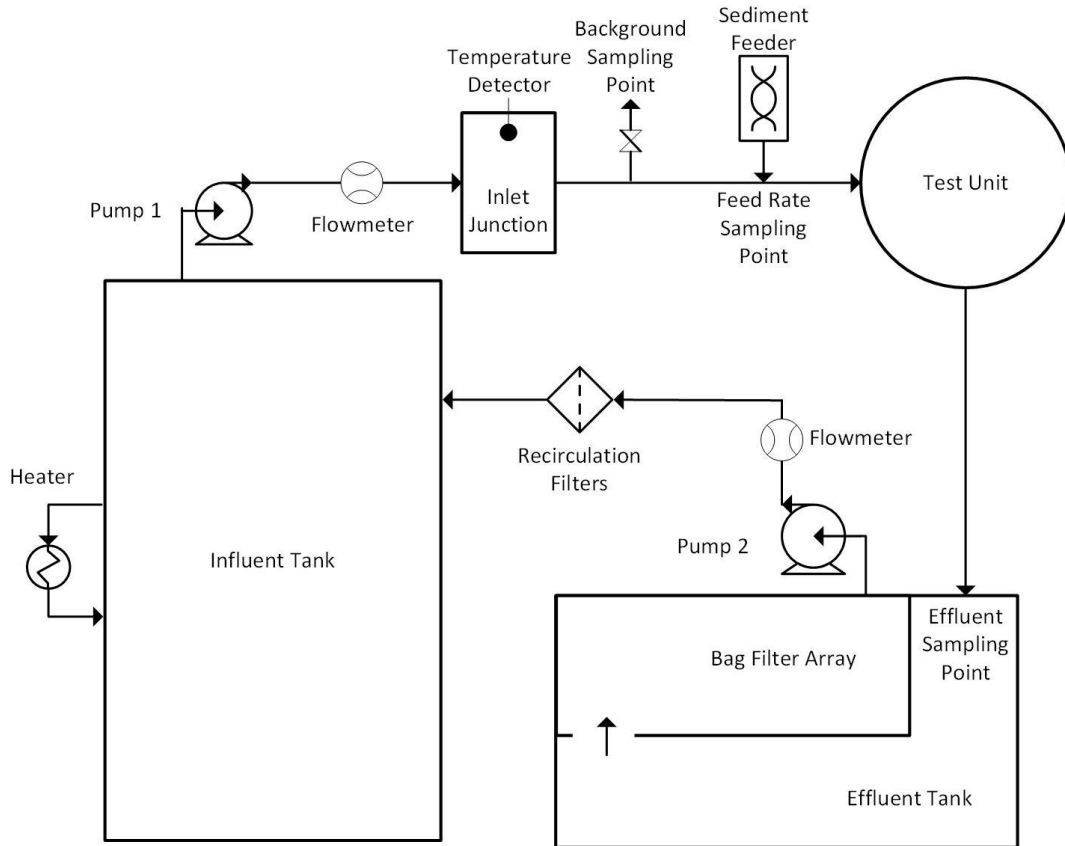


Figure 4: Lab Setup for Removal Efficiency Tests

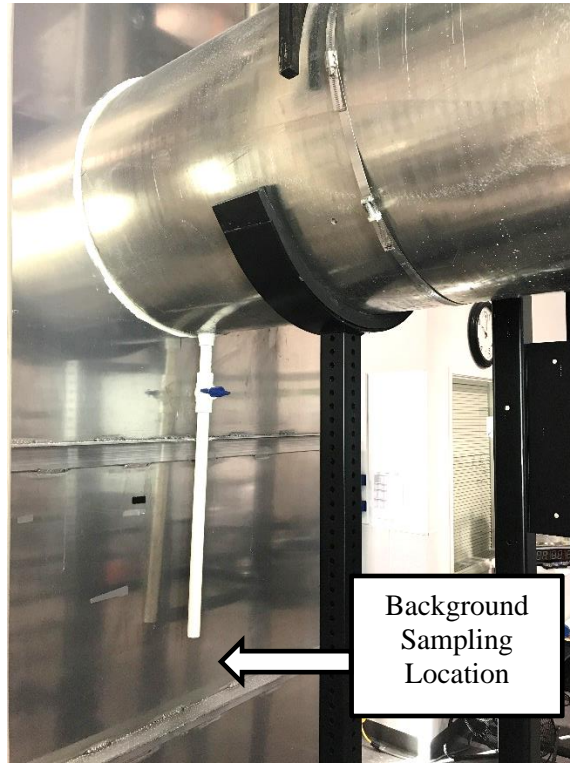


Figure 5: Background Sampling Location

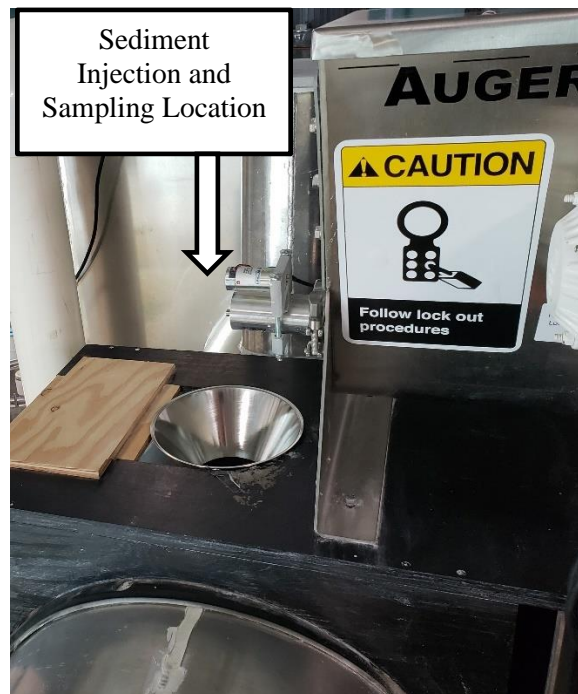


Figure 6: Sediment Injection Location and Feed Rate Sampling Location

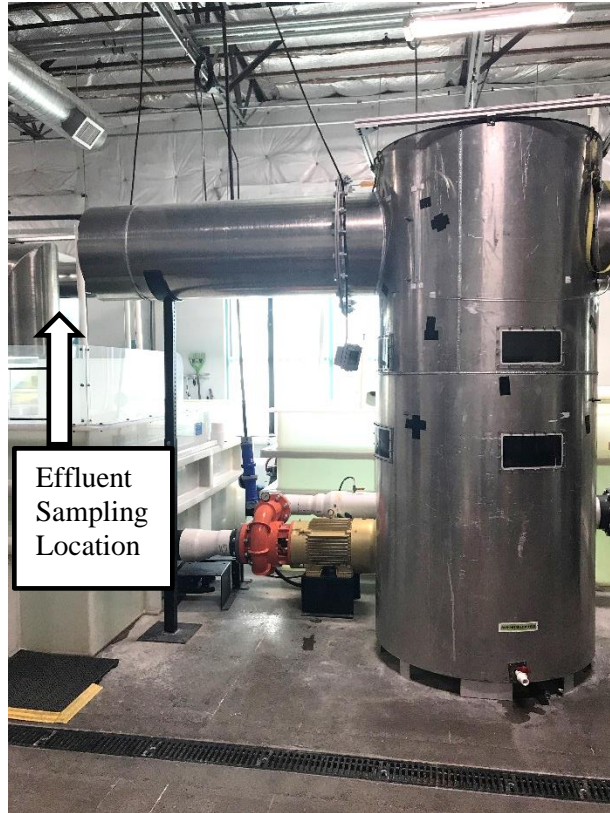


Figure 7: Manhole and Effluent Grab Sampling Location

3.3. TEST SEDIMENT

The sediment used for removal efficiency tests was a custom silica blend with a specific gravity of 2.65. The test sediment was blended in-house and used as an alternative to US Silica OK-110 sediment (**Figure 8**), which is no longer produced commercially. The custom sediment had a target D_{50} of 110 μm , with a range of particle sizes from 53 μm to 250 μm . After blending, the test sediment was batched, labeled and stored in covered bins for the duration of this project. Sediment sampling and analysis were conducted in-house, under third party observation. Twelve subsamples, taken from various locations within the test sediment bins were composited. From the composite, three samples were taken for PSD analysis and three samples for moisture content analysis. The average PSD (**Table 2**) derived from the three samples was used to determine compliance with the target PSD (**Figure 8**). The average sediment moisture content was used in feed rate calculations (**Equation 1**) and carried through in influent mass calculations (**Equation 2**).

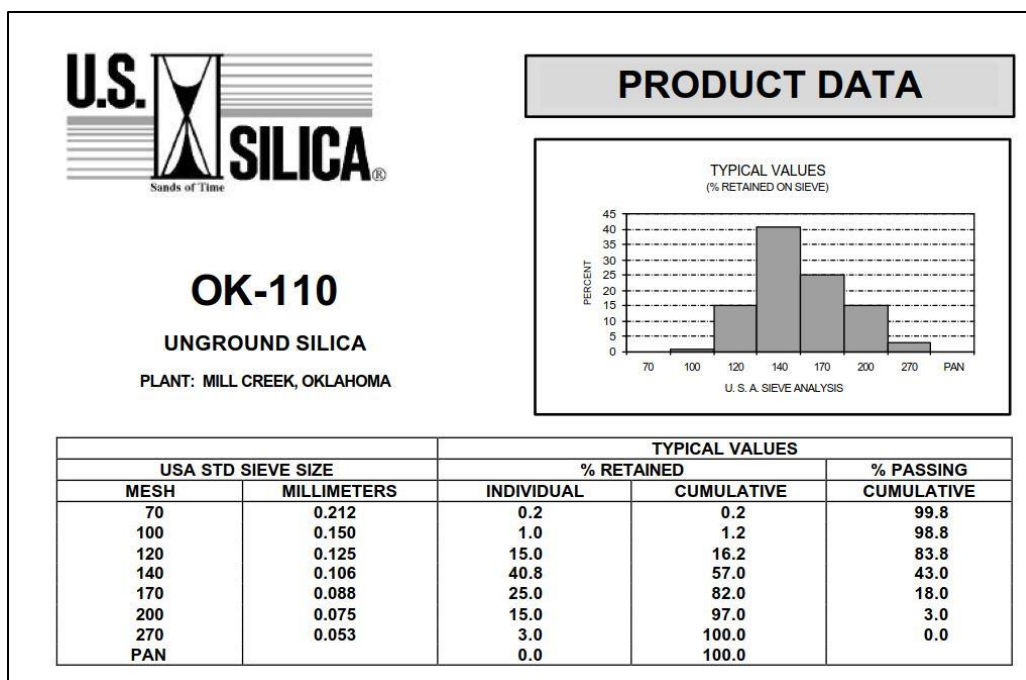


Figure 8: US Silica OK-110 Product Data Sheet

3.4. REMOVAL EFFICIENCY TESTING PROCEDURE

Three separate, continuous removal efficiency tests were performed over a range of hydraulic loading rates. The three resulting removal efficiency values at each hydraulic loading rate were plotted with a curve fit applied.

Each continuous test started with the highest target flow rate and continued with flow rates decreasing incrementally through the target values: 1.50 cfs, 1.20 cfs, 0.90 cfs, 0.60 cfs and 0.30 cfs. During each continuous test, each flow rate trial commenced once the feed rate was set and the flow rate was stabilized at the target rate for a minimum of three detention times. A sediment feed rate sample was taken at the beginning of each flow rate trial and a minimum of three detention times passed before the six effluent samples and six paired background samples were taken. After all effluent and background samples were collected, the second feed rate sample was taken. Each flow rate trial ended following the second feed rate sample. The flow rate and corresponding feed rate were then re-adjusted and allowed to stabilize before starting the next flow rate trial. Testing continued in this manner until the full set of flow rates were evaluated. The sampling procedure was the same for all flow rate trials, but the sample spacing and trial duration varied to accommodate differences in detention time (**Table 1**). The system was cleaned prior to each continuous test, but not between the flow rate trials within a test.

Table 1: Continuous Test Sampling Plan

Time (mm:ss)	Sample		
START OF CONTINUOUS TEST			
<i>Stabilize flow for minimum duration of 01:57</i>			
00:00	START 1.5 CFS TRIAL		
00:00	FEED 1		
03:00		EFF 1	BACK 1
03:30		EFF 2	BACK 2
04:00		EFF 3	BACK 3
04:30		EFF 4	BACK 4
05:00		EFF 5	BACK 5
05:30		EFF 6	BACK 6
05:30	FEED 2		
06:30	STOP 1.5 CFS TRIAL		
<i>Stabilize flow for minimum duration of 02:27</i>			
00:00	START 1.2 CFS TRIAL		
00:00	FEED 1		
03:30		EFF 1	BACK 1
04:00		EFF 2	BACK 2
04:30		EFF 3	BACK 3
05:00		EFF 4	BACK 4
05:30		EFF 5	BACK 5
06:00		EFF 6	BACK 6
06:00	FEED 2		
07:00	STOP 1.2 CFS TRIAL		
<i>Stabilize flow for minimum duration of 03:15</i>			
00:00	START 0.9 CFS TRIAL		
00:00	FEED 1		
04:30		EFF 1	BACK 1
05:00		EFF 2	BACK 2
05:30		EFF 3	BACK 3
06:00		EFF 4	BACK 4
06:30		EFF 5	BACK 5
07:00		EFF 6	BACK 6
07:00	FEED 2		
08:00	STOP 0.9 CFS TRIAL		

Time (mm:ss) <i>Continued</i>	Sample <i>Continued</i>		
<i>Stabilize flow for minimum duration of 04:53</i>			
00:00	START 0.6 CFS TRIAL		
00:00	FEED 1		
06:00		EFF 1	BACK 1
06:30		EFF 2	BACK 2
07:00		EFF 3	BACK 3
07:30		EFF 4	BACK 4
08:00		EFF 5	BACK 5
08:30		EFF 6	BACK 6
08:30	FEED 2		
09:30	STOP 0.6 CFS TRIAL		
<i>Stabilize flow for minimum duration of 09:46</i>			
00:00	START 0.3 CFS TRIAL		
00:00	FEED 1		
11:00		EFF 1	BACK 1
11:30		EFF 2	BACK 2
12:00		EFF 3	BACK 3
12:30		EFF 4	BACK 4
13:00		EFF 5	BACK 5
13:30		EFF 6	BACK 6
13:30	FEED 2		
14:30	STOP 0.3 CFS TRIAL		
END OF CONTINUOUS TEST			

During all testing the flow rate was held steady at $\pm 10\%$ of the target value with a target coefficient of variation (COV) of less than 0.03. Water temperature remained below 80 °F during all testing.

For each flow trial, sediment was injected at a known rate to produce a target average influent concentration of 280 mg/L ($\pm 10\%$) with a COV of less than 0.10. Feed rates were determined by sampling the injection stream once at the beginning and once at the end of each flow trial. Samples were collected in clean, 1 L bottles at the injection point (**Figure 6**) for a target duration of 60 s. Sediment sample collection time was measured using a Thomas Scientific 1235026 traceable stopwatch. The samples were weighed to the mg (in-house) using an Ohaus AR3130 calibrated balance and feed rate for each run was calculated using **Equation 1**. Average influent TSS concentration was calculated from the average test feed rate and average flow rate for the flow trial using **Equation 2**.

$$\text{Feed Rate (g/min)} = \frac{\text{Mass}_{\text{sample+bottle}}(\text{g}) - \text{Mass}_{\text{bottle}}(\text{g})}{\text{Time}_{\text{collection}}(\text{s}) \times \frac{\text{min}}{60 \text{ s}}} \times [1 - \text{Sediment Moisture Content}]$$

Equation 1

$$\text{Average Influent TSS (mg/L)} = \frac{\text{Average Feed Rate (g/min)} \times \frac{1000 \text{ mg}}{\text{g}}}{\text{Average Flow Rate (gal/min)} \times \frac{3.78541 \text{ L}}{\text{gal}}}$$

Equation 2

Six effluent grab samples were collected at evenly-spaced intervals during each flow rate trial. After the first feed rate sample was collected, effluent sampling began after a minimum of three detention times passed. Each sample volume was a minimum of 0.5 L. Samples were collected in clean, 1 L bottles by sweeping the bottle through the cross-section of the free-discharge effluent stream in a single pass. In the cases where the effluent TSS concentration was non-detect (ND), a value of half the detection limit was substituted. The detection limit is 1.55 mg/L.

Background samples were taken simultaneously with every effluent sample. Each sample was a minimum of 0.5 L in volume and was collected in a clean, 1 L bottle from the background sampling port. Background samples were collected after the sampling port was opened and the line was flushed for 3 sec. In the cases where the background TSS concentration was non-detect (ND), a value of half the detection limit was substituted. Average background concentration did not exceed 20 mg/L during any test. Paired effluent and background TSS concentration measurements were used to calculate an average adjusted effluent TSS value (**Equation 3**).

$$\text{Average Adjusted Effluent TSS (mg/L)} = \frac{1}{6} \sum_{i=1}^6 [\text{Effluent TSS (mg/L)} - \text{Background TSS (mg/L)}]_i$$

Equation 3

Removal efficiency at each flow rate was calculated using **Equation 4**. All removal efficiency values were plotted against the applicable hydraulic loading rate with a linear curve fit applied. The curve fit equation was used to determine the hydraulic loading rate at which 80% removal efficiency and 80% annualized weighted removal efficiency would occur. The New Jersey rainfall weighting factors used for the annualized removal efficiency determination are outlined in Table 1 of Appendix A, Section A in the NJDEP Protocol.

$$\text{Removal Efficiency (\%)} = \frac{\text{Average Influent TSS (mg/L)} - \text{Average Adjusted Effluent (mg/L)}}{\text{Average Influent TSS (mg/L)}} \times 100$$

Equation 4

4. PERFORMANCE CLAIMS

Some of the following performance claims are specific to the 4 ft Cascade Separator, the model size tested in this study. Additional information for all models is provided in **Table A-1**.

VERIFIED TOTAL SUSPENDED SOLIDS REMOVAL RATE

In general, the ‘point on a curve’ method to size an MTD for a target removal efficiency of a target particle size is a straightforward approach. The hydraulic loading rate which achieves the target removal efficiency is determined by interpolating or using a curve fit equation from the hydraulic loading rate v removal efficiency data set, which typically spans a large range of tested flow rates.

The testing performed on the Cascade Separator resulted in a hydraulic loading rate v removal efficiency curve fit equation on a data set spanning from 0.31 to 1.51 cfs. Removal efficiencies ranged from 60.3% to 100% respectively. The curve fit equation was used to determine that the hydraulic loading rate of 33.78 gpm/ft² of effective treatment area achieved 80% removal efficiency of the target particle size with a D₅₀ of 110 μm at the target sediment inlet concentration of 280 mg/L.

VERIFIED ANNUALIZED TOTAL SUSPENDED SOLIDS REMOVAL RATE

Net annual sizing is another method for sizing MTDs for a target removal efficiency of a target particle size. This sizing method predicts MTD performance over a typical rain year by using annual rainfall intensity distributions from long-term records to develop a model. The net annual model will vary based on regional rainfall differences, allowing sizing for specific site needs. The model ties the annual occurrence of rainfall intensities to expected performance by applying weighting factors to the MTD removal efficiencies over a range of hydraulic loading rates. The fractional removal efficiencies are then summed to represent the net annualized removal efficiency of the MTD at the treatment flow rate.

In this laboratory testing, the New Jersey rainfall weighting factors in the NJDEP protocol were applied to the Cascade curve fit equation to determine the hydraulic loading rate at which an annualized weighted removal efficiency of 80% would occur. The Cascade Separator achieved 80% annualized TSS removal of the 110 μm test particle size at a hydraulic loading rate of 52.99 gpm/ft².

MAXIMUM SEDIMENT STORAGE DEPTH AND VOLUME

The maximum sediment storage depth is 18 in. on all Cascade Separator models. The CS-4 has a maximum sediment storage volume of 18.8 ft³.

EFFECTIVE TREATMENT AREA

The effective treatment area, or sedimentation area is 12.6 ft² on the CS-4.

DETENTION TIME AND VOLUME

The operational volume of the CS-4 is 58.6 ft³ from the 50% maximum sediment storage depth to inlet water surface elevation at full treatment capacity. Detention time will vary by flow rate, the detention time for the annualized maximum treatment flow rate (MTFR) of 1.48 cfs (666 gpm) is 39 s.

ONLINE OR OFFLINE INSTALLATION

In September 2019, the Cascade Separator received NJDEP certification qualifying it for online installation for the New Jersey water quality design storm.

5. SUPPORTING DOCUMENTATION

Copies of collected and measured data, spreadsheets containing original data from all performance test runs and particle size analysis, as well as all pertinent calculations have been provided to NJCAT for verification.

5.1. TEST SEDIMENT PSD

The average moisture content of the test sediment was determined to be 0.02%. The average PSD of the test sediment and US Silica standard are presented in **Table 2** and **Figure 9**. For a clear comparison, the percent finer values were interpolated to match the particle diameters listed in the US Silica OK-110 product data sheet (**Figure 8**). The test sediment distribution has a D₅₀ particle size of 110 μm.

Table 2: Average Removal Efficiency Test Sediment PSD

Particle Diameter (μm)	Percent Finer by Mass (%)	
	US Silica OK-110 (Typical)	Average Test Sediment
500	-	99.9
212	99.8	99.2
150	98.8	98.2
125	83.8	79.0
106	43.0	41.9
88	18.0	18.6
75	3.0	1.4
53	0.0	0.1
D50	109 μm	110 μm

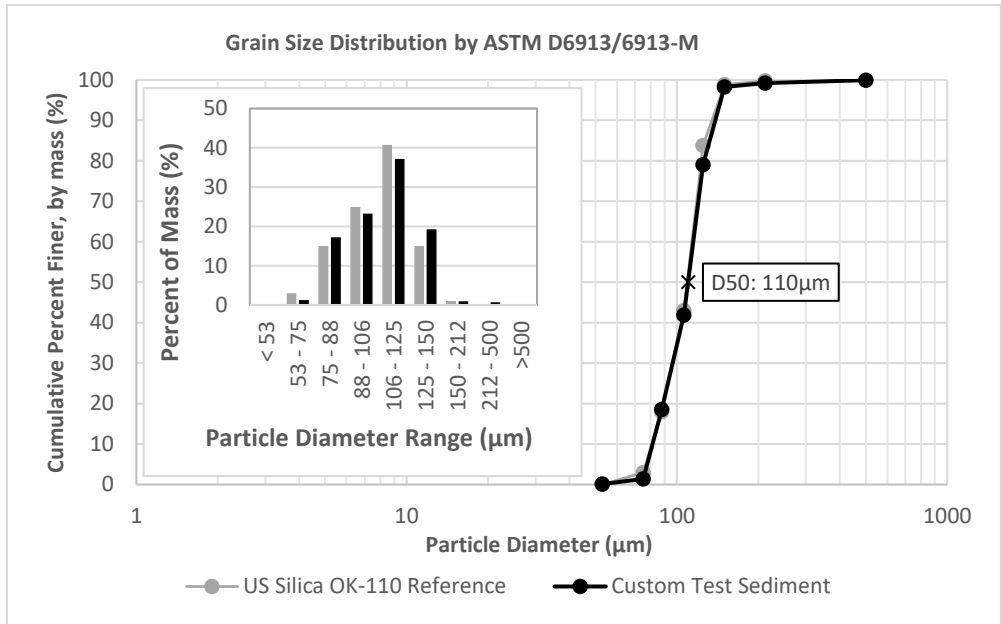


Figure 9: Test Sediment PSD

5.2. REMOVAL EFFICIENCY TEST RESULTS

A total of three continuous tests, comprised of five flow rate trials each, were conducted to evaluate TSS removal of a sediment gradation with a D50 of 110 μm. The CS-4 Cascade Separator achieved a TSS removal efficiency of 80% at a flow rate of 0.946 cfs or 424 gpm (33.78 gpm/ft²) and an annualized weighted removal efficiency of 80% at a flow rate of 1.484 cfs or 666 gpm (52.99 gpm/ft²). These performance claims were determined from a curve that is based on the verified test data generated in this study. This approach, while not typical of previous NJCAT verifications, is standard engineering practice.

Summary results from all continuous tests are included in **Table 3**, **Table 4** and **Figure 10**. Detailed results including sampling times, sample data and QA/QC results from each test are presented in **Table 5** through **Table 25**.

Table 3: Summary of Removal Efficiency Results

Average Flow Rate (cfs)	Average Hydraulic Loading Rate (gpm/ft ²)	Flow Rate (cfs)	Hydraulic Loading Rate (gpm/ft ²)	Influent TSS (mg/L)	Adjusted Effluent TSS (mg/L)	Removal Efficiency (%)	Average Removal Efficiency (%)
1.51	54.0	1.51	54.0	279	111	60.3	61.2
		1.51	54.0	275	102	62.8	
		1.51	54.0	277	110	60.4	
1.21	43.2	1.21	43.3	275	80.5	70.7	69.9
		1.21	43.2	274	81.1	70.4	
		1.21	43.3	275	86.3	68.7	
0.91	32.5	0.91	32.5	286	53.8	81.2	81.2
		0.91	32.5	281	53.2	81.1	
		0.91	32.5	277	51.5	81.4	
0.61	21.7	0.61	21.7	274	16.6	94.0	94.0
		0.61	21.7	269	14.2	94.7	
		0.61	21.7	268	18.2	93.2	
0.31	11.0	0.31	11.0	262	0.30	99.9	99.9
		0.31	11.0	272	0.28	99.9	
		0.31	11.0	260	0.13	100	

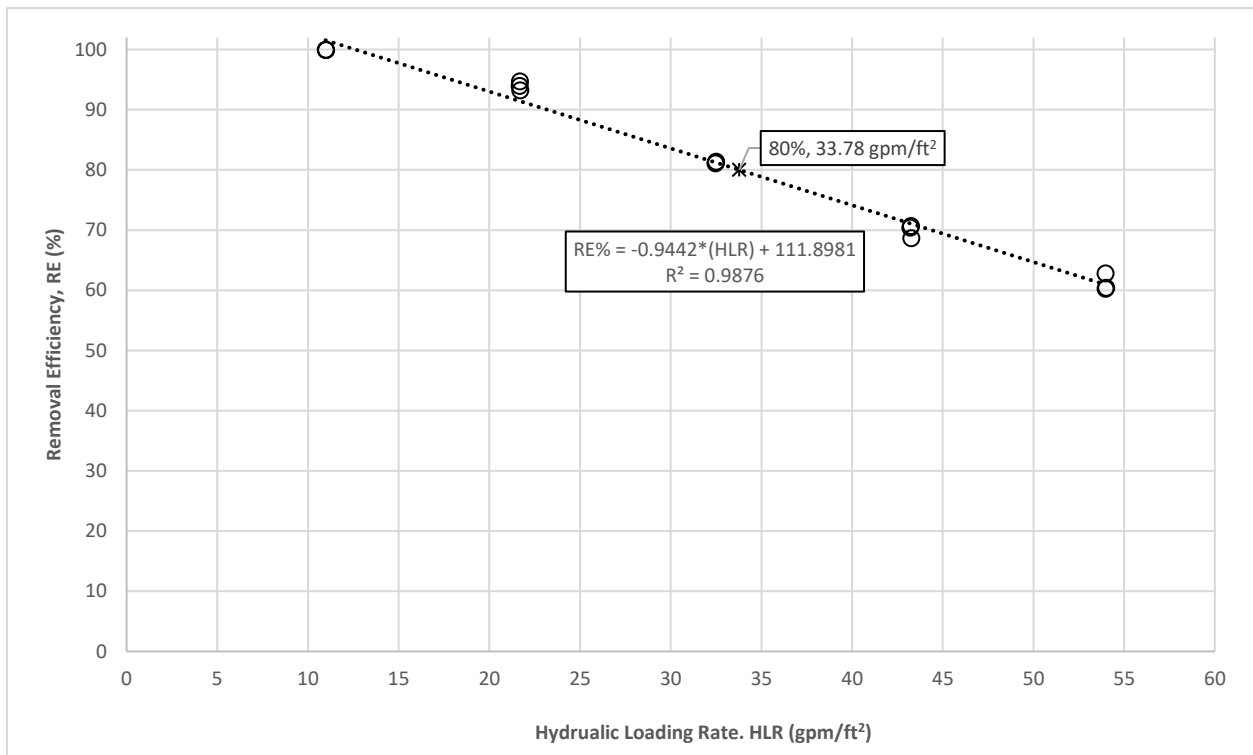


Figure 10: Removal Efficiency Results

Table 4: Annualized Removal Efficiency Results*

Annualized Treatment Hydraulic Loading Rate (gpm/ft ²)	Annualized Treatment Flow Rate for CS-4 (cfs)	Percent of Treatment Flow Rate (%)	Flow Rate (cfs)	Removal Efficiency (%)	Weighting Factor	Weighted Removal Efficiency (%)
52.99	1.48	25	0.37	99.4	0.25	24.8
		50	0.74	86.9	0.30	26.1
		75	1.11	74.4	0.20	14.9
		100	1.48	61.9	0.15	9.3
		125	1.85	49.4	0.10	4.9
Annualized Removal Efficiency at 52.99 gpm/ft ² (%):						80.0

*Per NJDEP Protocol methodology

TEST 01 RESULTS

The results from Test 01 (T01) are summarized in **Table 5**. Complete sample data for each flow rate trial can be found in **Table 6** through **Table 10**. QA/QC results can be found in **Table 11**. The flow rate COV for trial T01-0.3 (0.05) exceeded the QA/QC limit of 0.03

The slightly higher flow rate variability (**Table 11**) did not appear to impact the removal efficiency result for this flow trial. The removal for T01-0.3 was 99.9%, which is equivalent to the removal efficiencies in the repeat flow rate trials (T02-0.3 at 99.9% and T03-0.3 at 100%). If the data point for this trial was excluded from the linear fit (**Figure 10**), the Cascade CS-4 would still achieve a removal efficiency of 80% at 0.946 cfs. The data point for trial T01-0.3 is considered representative and is included in the data set used for calculations.

Table 5: Test 01 Summary Results

Flow Trial ID	Average Flow Rate (cfs)	Average Hydraulic Loading Rate (gpm/ft ²)	Detention Time (mm:ss)	Sediment Injection Duration (min)	Average Influent TSS (mg/L)	Average Adjusted Effluent TSS Conc. (mg/L)	Removal Efficiency (%)
T01-1.5	1.51	54.0	0:38	4.50	279	111	60.3
T01-1.2	1.21	43.3	0:48	5.00	275	80.5	70.7
T01-0.9	0.91	32.5	1:04	6.00	286	53.8	81.2
T01-0.6	0.61	21.7	1:36	7.50	274	16.6	94.0
T01-0.3	0.31	11.0	3:10	12.50	262	0.30	99.9

Table 6: T01-1.5 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:00	764	ND	0.78
Background 2	3:30	807	ND	0.78
Background 3	4:00	739	ND	0.78
Background 4	4:30	737	ND	0.78
Background 5	5:00	762	ND	0.78
Background 6	5:30	885	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:00	863	97.6	96.8
Effluent 2	3:30	959	108	107
Effluent 3	4:00	987	118	117
Effluent 4	4:30	957	123	122
Effluent 5	5:00	966	108	107
Effluent 6	5:30	997	115	114
<i>Average</i>				<i>111</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	717.669	60	717.669	279
Feed Rate 2	5:30	715.508	60	715.508	279
<i>Average</i>				<i>716.589</i>	<i>279</i>

Table 7: T01-1.2 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:30	908	ND	0.78
Background 2	4:00	655	ND	0.78
Background 3	4:30	837	ND	0.78
Background 4	5:00	765	ND	0.78
Background 5	5:30	804	ND	0.78
Background 6	6:00	748	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:30	885	84.7	83.9
Effluent 2	4:00	962	83.1	82.3
Effluent 3	4:30	951	77.8	77.1
Effluent 4	5:00	880	81.1	80.3
Effluent 5	5:30	866	89.5	88.7
Effluent 6	6:00	976	71.8	71.0
<i>Average</i>				80.5

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	564.704	60	564.704	274
Feed Rate 2	6:00	565.431	60	565.431	275
<i>Average</i>				565.068	275

Table 8: T01-0.9 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	4:30	860	ND	0.78
Background 2	5:00	862	ND	0.78
Background 3	5:30	913	ND	0.78
Background 4	6:00	861	ND	0.78
Background 5	6:30	654	ND	0.78
Background 6	7:00	934	ND	0.78
Average				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	4:30	929	53.0	52.2
Effluent 2	5:00	922	43.0	42.2
Effluent 3	5:30	973	59.2	58.4
Effluent 4	6:00	932	57.2	56.4
Effluent 5	6:30	955	66.5	65.7
Effluent 6	7:00	860	48.4	47.6
Average				53.8

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	442.820	60	442.820	287
Feed Rate 2	7:00	440.314	60	440.314	285
Average				441.567	286

Table 9: T01-0.6 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	6:00	761	ND	0.78
Background 2	6:30	768	ND	0.78
Background 3	7:00	803	ND	0.78
Background 4	7:30	772	ND	0.78
Background 5	8:00	862	ND	0.78
Background 6	8:30	750	ND	0.78
			Average	0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	6:00	788	17.0	16.2
Effluent 2	6:31	882	17.7	16.9
Effluent 3	7:00	954	18.6	17.8
Effluent 4	7:30	932	18.3	17.6
Effluent 5	8:00	890	15.0	14.2
Effluent 6	8:30	966	17.6	16.8
			Average	16.6

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	285.438	60	285.438	277
Feed Rate 2	8:30	280.455	60	280.455	272
			Average	282.947	274

Table 10: T01-0.3 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	11:00	878	ND	0.78
Background 2	11:30	857	ND	0.78
Background 3	12:00	770	ND	0.78
Background 4	12:30	851	ND	0.78
Background 5	13:00	827	ND	0.78
Background 6	13:30	730	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	11:00	895	1.79	1.01
Effluent 2	11:30	969	ND	0.00
Effluent 3	12:00	938	ND	0.00
Effluent 4	12:30	930	ND	0.00
Effluent 5	13:00	836	1.56	0.78
Effluent 6	13:30	902	ND	0.00
<i>Average</i>				0.30

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	137.291	60	137.291	262
Feed Rate 2	13:30	136.488	60	136.488	261
<i>Average</i>				136.889	262

Table 11: Test 01 QA/QC

FLOW RATE AND WATER TEMPERATURE					
Test ID	QAQC PASS/FAIL	Target Flow Rate (ft ³ /s)	Average Flow Rate (ft ³ /s) (±10% of Target)	Flow Rate COV (<0.03)	Maximum Water Temperature (°F) (<80 °F)
T01-1.5	PASS	1.50	1.51	0.01	76.5
T01-1.2	PASS	1.20	1.21	0.01	76.4
T01-0.9	PASS	0.90	0.91	0.005	76.3
T01-0.6	PASS	0.60	0.61	0.01	76.2
T01-0.3	PASS*	0.30	0.31	0.05	76.1
INFLUENT AND BACKGROUND CONCENTRATION					
Test ID	QAQC PASS/FAIL	Target Influent TSS (mg/L)	Average Influent TSS (mg/L) (±10% of Target)	Feed Rate COV (<0.1)	Average Background TSS (<20 mg/L)
T01-1.5	PASS	280	279	0.002	0.78
T01-1.2	PASS	280	275	0.001	0.78
T01-0.9	PASS	280	286	0.004	0.78
T01-0.6	PASS	280	274	0.01	0.78
T01-0.3	PASS	280	262	0.004	0.78

*See the paragraphs on page 15 prior to Table 5 for discussion

TEST 02 RESULTS

The results from Test 02 (T02) are summarized in **Table 12**. Complete sample data for each flow rate trial can be found in **Table 13** through **Table 17**. QA/QC results can be found in **Table 18**.

Table 12: Test 02 Summary Results

Flow Trial ID	Average Flow Rate (ft ³ /s)	Average Hydraulic Loading Rate (gpm/ft ²)	Detention Time (mm:ss)	Sediment Injection Duration (min)	Average Influent TSS (mg/L)	Average Adjusted Effluent TSS (mg/L)	Removal Efficiency (%)
T02-1.5	1.51	54.0	0:38	4.50	275	102	62.8
T02-1.2	1.21	43.2	0:48	5.00	274	81.1	70.4
T02-0.9	0.91	32.5	1:04	6.00	281	53.2	81.1
T02-0.6	0.61	21.7	1:36	7.50	269	14.2	94.7
T02-0.3	0.31	11.0	3:10	12.50	272	0.28	99.9

Table 13: T02-1.5 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:00	825	ND	0.78
Background 2	3:30	778	ND	0.78
Background 3	4:00	777	ND	0.78
Background 4	4:30	741	ND	0.78
Background 5	5:00	698	ND	0.78
Background 6	5:30	707	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:00	889	102	101
Effluent 2	3:30	966	110	109
Effluent 3	4:00	952	99.0	98.2
Effluent 4	4:30	887	89.8	89.0
Effluent 5	5:00	906	100	99
Effluent 6	5:30	992	118	117
<i>Average</i>				102

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	701.788	60	701.788	273
Feed Rate 2	5:30	710.498	60	710.498	277
<i>Average</i>				706.143	275

Table 14: T02-1.2 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:30	804	ND	0.78
Background 2	4:00	889	ND	0.78
Background 3	4:30	908	ND	0.78
Background 4	5:00	803	ND	0.78
Background 5	5:30	774	ND	0.78
Background 6	6:00	776	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:30	941	80.5	79.7
Effluent 2	4:00	955	81.2	80.4
Effluent 3	4:30	944	85.4	84.6
Effluent 4	5:00	956	85.0	84.3
Effluent 5	5:30	839	81.0	80.2
Effluent 6	6:00	947	78.2	77.5
<i>Average</i>				81.1

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	560.833	60	560.833	273
Feed Rate 2	6:00	566.118	60	566.118	275
<i>Average</i>				563.475	274

Table 15: T02-0.9 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	4:30	739	ND	0.78
Background 2	5:00	839	ND	0.78
Background 3	5:30	739	ND	0.78
Background 4	6:00	780	ND	0.78
Background 5	6:30	859	ND	0.78
Background 6	7:00	788	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	4:30	687	63.5	62.7
Effluent 2	5:00	950	55.1	54.3
Effluent 3	5:30	898	54.1	53.3
Effluent 4	6:00	946	55.2	54.4
Effluent 5	6:30	972	50.2	49.5
Effluent 6	7:00	962	45.6	44.8
<i>Average</i>				<i>53.2</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	436.119	60	436.119	282
Feed Rate 2	7:00	433.142	60	433.142	280
<i>Average</i>				<i>434.630</i>	<i>281</i>

Table 16: T02-0.6 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	6:00	794	ND	0.78
Background 2	6:30	913	ND	0.78
Background 3	7:00	849	ND	0.78
Background 4	7:30	808	ND	0.78
Background 5	8:00	894	ND	0.78
Background 6	8:30	770	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	6:00	895	21.6	20.8
Effluent 2	6:30	851	16.0	15.2
Effluent 3	7:00	954	13.2	12.4
Effluent 4	7:30	962	12.1	11.3
Effluent 5	8:00	953	13.1	12.3
Effluent 6	8:30	966	13.8	13.0
<i>Average</i>				14.2

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	276.959	60	276.959	268
Feed Rate 2	8:30	277.038	60	277.038	269
<i>Average</i>				276.999	269

Table 17: T02-0.3 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	11:00	906	ND	0.78
Background 2	11:30	871	ND	0.78
Background 3	12:00	836	ND	0.78
Background 4	12:30	823	ND	0.78
Background 5	13:00	772	ND	0.78
Background 6	13:30	833	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	11:00	956	ND	0.00
Effluent 2	11:30	945	1.59	0.81
Effluent 3	12:00	939	ND	0.00
Effluent 4	12:30	932	ND	0.00
Effluent 5	13:00	917	1.64	0.86
Effluent 6	13:30	936	ND	0.00
<i>Average</i>				<i>0.28</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	142.224	60	142.224	272.1
Feed Rate 2	13:30	141.984	60	141.984	271.7
<i>Average</i>				<i>142.104</i>	<i>272</i>

Table 18: Test 02 QA/QC

FLOW RATE AND WATER TEMPERATURE					
Test ID	QAQC PASS/FAIL	Target Flow Rate (ft ³ /s)	Average Flow Rate (ft ³ /s) (±10% of Target)	Flow Rate COV (<0.03)	Maximum Water Temperature (°F) (<80 °F)
T02-1.5	PASS	1.50	1.51	0.01	75.9
T02-1.2	PASS	1.20	1.21	0.01	76.0
T02-0.9	PASS	0.90	0.91	0.01	75.9
T02-0.6	PASS	0.60	0.61	0.005	75.9
T02-0.3	PASS	0.30	0.31	0.02	76.0
INFLUENT AND BACKGROUND CONCENTRATION					
Test ID	QAQC PASS/FAIL	Target Influent TSS (mg/L)	Average Influent TSS (mg/L) (±10% of Target)	Feed Rate COV (<0.1)	Average Background TSS (<20 mg/L)
T02-1.5	PASS	280	275	0.01	0.78
T02-1.2	PASS	280	274	0.01	0.78
T02-0.9	PASS	280	281	0.005	0.78
T02-0.6	PASS	280	269	0.0002	0.78
T02-0.3	PASS	280	272	0.001	0.78

TEST 03 RESULTS

The results from Test 03 (T03) are summarized in **Table 19**. Complete sample data for each flow rate trial can be found in **Table 20** through **Table 24**. QA/QC results can be found in **Table 25**.

Table 19: Test 03 Summary Results

Flow Trial ID	Average Flow Rate (ft ³ /s)	Average Hydraulic Loading Rate (gpm/ft ²)	Detention Time (mm:ss)	Sediment Injection Duration (min)	Average Influent TSS (mg/L)	Average Adjusted Effluent TSS (mg/L)	Removal Efficiency (%)
T03-1.5	1.51	54.0	0:38	4.50	277	110	60.4
T03-1.2	1.21	43.3	0:48	5.00	275	86.3	68.7
T03-0.9	0.91	32.5	1:04	6.00	277	51.5	81.4
T03-0.6	0.61	21.7	1:36	7.50	268	18.2	93.2
T03-0.3	0.31	11.0	3:10	12.50	260	0.13	100

Table 20: T03-1.5 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:00	858	ND	0.78
Background 2	3:30	755	ND	0.78
Background 3	4:00	724	ND	0.78
Background 4	4:30	735	ND	0.78
Background 5	5:00	753	ND	0.78
Background 6	5:30	752	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:00	950	115	114
Effluent 2	3:30	935	108	107
Effluent 3	4:00	938	100	98.9
Effluent 4	4:30	918	107	106
Effluent 5	5:00	914	118	118
Effluent 6	5:30	980	115	115
<i>Average</i>				<i>110</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	710.513	60	710.513	277
Feed Rate 2	5:30	713.565	60	713.565	278
<i>Average</i>				<i>712.039</i>	<i>277</i>

Table 21: T03-1.2 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	3:30	736	ND	0.78
Background 2	4:00	820	ND	0.78
Background 3	4:30	741	ND	0.78
Background 4	5:00	851	ND	0.78
Background 5	5:30	865	ND	0.78
Background 6	6:00	819	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	3:30	919	86.1	85.3
Effluent 2	4:00	971	92.5	91.7
Effluent 3	4:30	964	90.3	89.5
Effluent 4	5:00	964	82.6	81.8
Effluent 5	5:30	966	89.8	89.0
Effluent 6	6:00	970	81.4	80.6
<i>Average</i>				<i>86.3</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	563.549	60	563.549	274
Feed Rate 2	6:00	569.778	60	569.778	277
<i>Average</i>				<i>566.664</i>	<i>275</i>

Table 22: T03-0.9 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	4:30	835	ND	0.78
Background 2	5:00	787	ND	0.78
Background 3	5:30	724	ND	0.78
Background 4	6:00	830	ND	0.78
Background 5	6:30	806	ND	0.78
Background 6	7:00	765	ND	0.78
<i>Average</i>				<i>0.78</i>

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	4:30	924	52.5	51.7
Effluent 2	5:00	960	52.2	51.4
Effluent 3	5:30	931	51.8	51.0
Effluent 4	6:00	982	59.6	58.8
Effluent 5	6:30	955	45.4	44.7
Effluent 6	7:00	943	52.5	51.7
<i>Average</i>				<i>51.5</i>

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	429.416	60	429.416	278
Feed Rate 2	7:00	426.248	60	426.248	276
<i>Average</i>				<i>427.832</i>	<i>277</i>

Table 23: T03-0.6 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	6:00	795	ND	0.78
Background 2	6:30	831	ND	0.78
Background 3	7:00	769	ND	0.78
Background 4	7:30	845	ND	0.78
Background 5	8:00	812	ND	0.78
Background 6	8:30	862	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	6:00	936	17.0	16.2
Effluent 2	6:30	943	18.0	17.3
Effluent 3	7:00	951	18.9	18.1
Effluent 4	7:30	966	21.5	20.8
Effluent 5	8:00	962	19.5	18.8
Effluent 6	8:30	951	19.0	18.2
<i>Average</i>				18.2

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	276.698	60	276.698	268
Feed Rate 2	8:30	276.160	60	276.160	267
<i>Average</i>				276.429	268

Table 24: T03-0.3 Background TSS, Effluent TSS and Feed Rate

Background Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Reported Background TSS (mg/L)	Background TSS (mg/L)
Background 1	11:00	765	ND	0.78
Background 2	11:30	737	ND	0.78
Background 3	12:00	771	ND	0.78
Background 4	12:30	820	ND	0.78
Background 5	13:00	775	ND	0.78
Background 6	13:30	799	ND	0.78
<i>Average</i>				0.78

Effluent Sample ID	Test Time (mm:ss)	Sample Volume (mL)	Effluent TSS (mg/L)	Adjusted Effluent TSS (mg/L)
Effluent 1	11:00	902	1.55	0.77
Effluent 2	11:30	921	ND	0.00
Effluent 3	12:00	954	ND	0.00
Effluent 4	12:30	966	ND	0.00
Effluent 5	13:00	851	ND	0.00
Effluent 6	13:30	932	ND	0.00
<i>Average</i>				0.13

Feed Rate Sample ID	Test Time (mm:ss)	Moisture Corrected Sample Mass (g)	Sampling Duration (s)	Feed Rate (g/min)	Calculated Influent TSS (mg/L)
Feed Rate 1	0:00	133.795	60	133.795	256
Feed Rate 2	13:30	137.289	60	137.289	263
<i>Average</i>				135.542	260

Table 25: Test 03 QA/QC

FLOW RATE AND WATER TEMPERATURE					
Test ID	QAQC PASS/FAIL	Target Flow Rate (ft ³ /s)	Average Flow Rate (ft ³ /s) (±10% of Target)	Flow Rate COV (<0.03)	Maximum Water Temperature (°F) (<80 °F)
T03-1.5	PASS	1.50	1.51	0.01	76.0
T03-1.2	PASS	1.20	1.21	0.01	76.0
T03-0.9	PASS	0.90	0.91	0.01	76.0
T03-0.6	PASS	0.60	0.61	0.01	76.0
T03-0.3	PASS	0.30	0.31	0.01	76.0
INFLUENT AND BACKGROUND CONCENTRATION					
Test ID	QAQC PASS/FAIL	Target Influent TSS (mg/L)	Average Influent TSS (mg/L) (±10% of Target)	Feed Rate COV (<0.1)	Average Background TSS (<20 mg/L)
T03-1.5	PASS	280	277	0.003	0.78
T03-1.2	PASS	280	275	0.01	0.78
T03-0.9	PASS	280	277	0.01	0.78
T03-0.6	PASS	280	268	0.001	0.78
T03-0.3	PASS	280	260	0.02	0.78

6. DESIGN LIMITATIONS

Contech’s engineering staff typically works with the site design engineer to ensure all potential constraints are addressed during the specification process and that the Cascade Separator treatment system will function as intended. Each install will have unique limitations or requirements, the following limitations should be considered general and not all-inclusive.

REQUIRED SOIL CHARACTERISTICS

The Cascade Separator is an enclosed system that is typically housed within a concrete manhole. The functionality of the Cascade Separator system is not affected by existing soil conditions at install location and as such the unit can be installed in all soil types.

SLOPE

It is generally not advisable to install the Cascade Separator unit with steep pipe slopes. When the Cascade Separator is being considered with pipe slopes exceeding 10% Contech recommends contacting their engineering staff to evaluate the design prior to specification.

FLOW RATE

The hydraulic loading rate for 80% removal of 110 µm particles is 33.78 gpm/ft² of effective treatment area. The hydraulic loading rate for 80% annualized removal efficiency is 52.99 gpm/ft².

MAINTENANCE REQUIREMENTS

The Cascade Separator system must be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants depends heavily on specific site activities. See Maintenance Plan below for a more detailed discussion of maintenance and inspection requirements.

DRIVING HEAD

The driving head required for a given Cascade Separator model is typically a function of the model size and storm sewer characteristics. Contech's engineering staff consults with the design engineer on each project to ensure there will not be any adverse impacts to the hydraulic grade-line as a result of installing the Cascade Separator unit.

INSTALLATION LIMITATIONS

Prior to installation, Contech provides contractors detailed installation and assembly instructions and is also available to consult onsite during installation. Pick weights for Cascade Separator components are provided prior to delivery so that the contractor can secure proper equipment for lifting Cascade Separator units into place.

CONFIGURATIONS

Cascade Separator units can be installed online or offline. Online units can convey excess flows around the treatment chambers of the unit without the need for an external bypass structure. Contech's engineering staff can help determine the pipe size based on the site requirements.

LOAD LIMITATIONS

Cascade Separator units are typically designed for HS-20 loading (32,000 pounds per truck axle). If additional loading is expected it is advisable to contact Contech to assess loading options.

PRETREATMENT REQUIREMENTS

There are no pre-treatment requirements for the Cascade Separator stormwater treatment system.

LIMITATIONS ON TAILWATER

If tailwater is present it is important to increase the available driving head within the unit to ensure that the full treatment flow rate is still treated prior to any internal bypass.

DEPTH TO SEASONAL HIGH-WATER TABLE

Cascade Separator unit performance is not typically impacted by high groundwater. Occasionally, when groundwater is expected to be within several feet of finished grade it may be necessary to add a base extension to the unit to counter buoyant forces. If high groundwater is expected, Contech's engineering staff can evaluate whether anti-buoyancy measures are required during the design process.

ADDITIONAL LIMITATIONS

Each Cascade Separator has a recommended maximum inlet and outlet pipe size. When the size of the main storm drain exceeds the Cascade Separator maximum pipe size, Contech recommends

contacting their engineering staff. In some conditions a larger pipe can be accommodated. The maximum pipe diameter for each Cascade Separator model is shown in **Table A-1**.

MAINTENANCE PLAN

The Cascade Separator system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation. Additional information on maintenance, including a simple Inspection & Maintenance Log form, can be found in the Cascade Separator Inspection and Maintenance Guide at:

<https://www.conteches.com/Portals/0/Documents/Maintenance%20Guides/Cascade-Maintenance%20Guide.pdf?ver=2018-11-05-093254-300>

INSPECTION

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in the Cascade Separator Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

The Cascade Separator system should be cleaned when the level of sediment in the sump has reached a depth of 9 in. or more to avoid exceeding the maximum 18 in. sediment depth (from standard sump floor level). The system should also be cleaned when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than

larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% (9 in.) of the total height of sediment storage sump.

CLEANING

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum hose down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.

7. STATEMENTS

The following signed conflict of interest and testing oversight statements from the third-party observer (Scott A. Wells and associates) are provided.



Scott A. Wells and Associates

Environmental Engineering and Modeling
2382 SW Cedar Street
Portland, OR 97205 USA

May 10, 2019

To Whom It May Concern:

Scott A. Wells and Associates provides environmental consulting services focusing on water quality and hydrodynamic models of hydraulic structures, rivers, reservoirs, and estuary systems. We are familiar with stormwater treatment research having conducted many studies in the past on the efficiency of particle and oil and grease removal using a CDS device. We also are familiar with the use of an analytical laboratory to process samples, proper sample technique, and calculations of flow, pollutant concentration, and pollutant loading. Our clients include the federal government (EPA, USBR, Corps of Engineers), state government (such as the Washington Department of Ecology and Departments of Environmental Quality in Idaho and Oregon), private consulting firms and government organizations in both the United States and abroad (China, Israel, Brazil, Canada). Either Scott Wells, Ph.D., P.E., or Chris Berger, Ph.D., P.E., will served as observers for this series of tests.

Scott Wells and Associates has provided the service of third party review of stormwater device testing to Contech Engineered Solutions between 2007 and 2018. Beyond this past review work, Scott Wells and Associates and Contech have no relationships that would constitute a conflict of interest, as outlined in *Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology* (NJDEP 2013). For example, we have no ownership stake, do not receive commissions, do not have licensing agreements, do not receive funds or grants beyond those associated with the testing program.

Let me know if you have further questions on potential conflicts of interest.

Truly,

Scott A. Wells, P.E., Ph.D.

Christopher J. Berger, P. E., Ph.D.

503-935-6379

drswells@outlook.com



Scott A. Wells and Associates

Environmental Engineering and Modeling
2382 SW Cedar Street
Portland, OR 97205 USA

May 10, 2019

To Whom It May Concern:

Re: Cascade Separator Removal Efficiency of Suspended Sediment with Median Particle Size of 110 microns

Performance testing of the Contech Cascade Separator was overseen by Dr. Chris Berger and Dr. Scott Wells between April 22 and May 2, 2019 at the Contech Portland, Oregon laboratory. All phases of the analytical testing were also observed at the Contech laboratory. These tests included the particle size distribution by sieve analysis, moisture content, and sediment concentration in water samples. The flow rates and frequency of sampling reported for the performance tests were observed and are reported accurately. The test used applicable protocol, as outlined in the quality assurance project plan, and their Technical Bulletin (02) accurately reflects the testing observed by Dr. Berger and Dr. Wells.

Let us know if you have further questions on our observations of the testing performed in the laboratory.

Truly,

Scott A. Wells, P.E., Ph.D.

Christopher J. Berger, P. E., Ph.D.

503-935-6379

drswells@outlook.com

VERIFICATION APPENDIX

INTRODUCTION

- Contech Engineered Solutions is the manufacturer of the Cascade Separator hydrodynamic separation MTD

Contech Engineered Solutions
9025 Centre Point Drive
West Chester, OH 45069
Phone: (513) 645-7000
Fax: (513) 645-7993
www.ContechES.com

- MTD: Contech Cascade Separator™. Verified Contech Cascade models are shown in **Table A-1**.
- The Cascade Separator demonstrated a net annual 80% TSS removal rate of 110µm particles at the target influent sediment concentration of 280 mg/L.
- In September 2019, the Cascade Separator received NJDEP certification qualifying it for online installation for the New Jersey water quality design storm.

DETAILED SPECIFICATION

- Sizing table for the Cascade Separator is attached (**Table A-1**)
- Prior to installation, Contech provides contractors detailed installation and assembly instructions and is also available to consult onsite during installation.
- Maximum sediment depth for all units is 18 in. Recommended sediment depth prior to cleaning is 9 inches or more.
- See Contech Cascade Separator Inspection and Maintenance Guide for additional detailed maintenance information at:
<https://www.conteches.com/Portals/0/Documents/Maintenance%20Guides/Cascade-Maintenance%20Guide.pdf?ver=2018-11-05-093254-300>

Table A-1: Cascade Separator Treatment Flow Rate, and Standard Dimensions

Model Number	Manhole Diameter (ft)	Annualized Maximum Treatment Flow Rate (cfs)	Hydraulic Loading Rate ¹ (gpm/ft ²)	100% Maximum Sediment Storage Depth (in)	100% Maximum Sediment Storage Volume (ft ³)
CS-3	3	0.84	52.99	18	10.6
CS-4	4	1.48	52.99	18	18.8
CS-5	5	2.31	52.99	18	29.5
CS-6	6	3.33	52.99	18	42.4
CS-8	8	5.93	52.99	18	75.4
CS-10	10	9.27	52.99	18	117.8
CS-12	12	13.35	52.99	18	169.6
Model Number	Effective Treatment Area (ft ²)	Effective Treatment Depth ² (in)	Chamber Depth ³ (in)	Aspect Ratio ⁴	Maximum Pipe Diameter (in)
CS-3	7.1	27	36	0.75	18
CS-4	12.6	39	48	0.81	24
CS-5	19.6	45	54	0.75	30
CS-6	28.3	51	60	0.71	42
CS-8	50.3	66	75	0.69	48
CS-10	78.5	83	92	0.69	60
CS-12	113.1	99	108	0.69	72

¹ Hydraulic loading rate is defined as the ratio of treatment flow rate to effective treatment area

² Effective treatment depth is defined as depth from effluent invert to 50% maximum sediment storage depth

³ Chamber depth is defined as depth from effluent invert to sump floor

⁴ Aspect ratio is defined as the ratio of effective treatment depth to manhole diameter. All models are geometrically proportional to the tested CS-4 within the allowable $\pm 15\%$ tolerance (0.69 -0.93)



UNIVERSITY OF MASSACHUSETTS AT AMHERST

Water Resources Research Center
Blaisdell House, UMass
310 Hicks Way
Amherst, MA 01003

Massachusetts Stormwater
Evaluation Project

(413) 545-5532
(413) 545-2304 FAX
www.mastep.net

MASTEP Technology Review

Technology Name: Stormceptor

Studies Reviewed: Final NJCAT Technology Verification Stormceptor STC900 September 2004, Coventry University Study, 1996; Technology Assessment, University of Massachusetts, 1997.

Date: November 23, 2007

Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: This rating is primarily based on the 2005 NJCAT Technology Verification study. In general, this was a well-conducted test, which in large part followed NJDEP test guidelines for laboratory studies. MASTEP considers NJDEP laboratory test guidelines to be essentially the equivalent of TARP field protocols. Issues of concern: the study measured suspended sediment concentration (SSC) rather than total suspended solids (TSS). Although SSC is considered by many scientists to be the preferred method, it is at odds with Massachusetts stormwater regulations, which are based on TSS treatment. Comparing SSC and TSS results is considered an inexact science. The test was conducted with higher influent sediment concentrations than is preferred, but results were fairly consistent across all ranges studied. The particle size distribution also appears to be higher than the target test range. There are additional field studies that in general support the results obtained in this laboratory studies. These studies do not satisfy TARP protocols, but they do not contradict results obtained in the NJCAT study.

TARP Requirements Not Met*:

- Measurements in TSS.
- Influent sediment concentration is 100 – 300 mg/l: actual was 153-460.
- No documentation of a Quality Assurance Project Plan
- Third party studies are preferred. This was conducted by Stormceptor personnel, with sample analyses conducted by an external laboratory.

* Criteria also based on NJDEP laboratory testing guidelines.

APPENDIX G: OPERATION AND MAINTENANCE

- PROPOSED OPERATION AND MAINTENANCE PLAN AND MAP

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

By: JMC/SVP Old River Road LLC

Peter Mahoney

Name & Title

Date

Peter Mahoney, Vice President

3/3/26

STORMWATER OPERATION AND MAINTENANCE PLAN

*John M Corcoran & Co; SV&P
100 Old River Road
Andover, MA*

RESPONSIBLE PARTY DURING CONSTRUCTION:

*John M Corcoran & Co; SV&P
100 Grandview Road Suite 205
Braintree, MA*

RESPONSIBLE PARTY POST CONSTRUCTION:

*John M Corcoran & Co; SV&P
100 Grandview Road Suite 205
Braintree, MA*

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP). Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations Swept areas shall include all parking, drive aisles, and access aisles All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: \$1,000/year

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect two (2) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed

and properly disposed of off-site in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: \$500/year per structure.

3. Riprap apron / Scour Hole: Riprap and scour holes should be checked at least annually and after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap is damaged, it should be repaired before further damage can take place. Note and repair any erosion, stone displacement or low spots in the areas. Woody vegetation should be removed from the riprap annually.

Approximate Maintenance Budget: \$250/year per location.

4. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

Approximate Maintenance Budget: \$1,000/year per unit.

5. Underground Infiltration Basins: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and riprap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: Cleaning - \$1,000/year, Inspection - \$200/year

6. Bioretention Areas: shall be inspected and cleared of trash monthly; mowed 2 to 12 times per year; mulched annually; fertilized annually; dead vegetation removed annually; pruned annually; replace entire media and all vegetation as needed. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: \$2,000/year per area

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM
POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

***Mixed Use Multi-family
100 Old River Road
Andover, MA***

RESPONSIBLE PARTY:

***John M Corcoran & Co; SV&P
100 Grandview Road Suite 205
Braintree, MA***

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points/ Flared End Sections / Rip Rap:	
Infiltration Basin:	
Water Quality Units:	
Other:	

Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):

Catch Basins:

Discharge Points / Flared End Sections / Rip Rap:

Infiltration Basin:

Water Quality Units:

Other:

Comments:

LONG-TERM POLLUTION PREVENTION PLAN

*John M Corcoran & Co; SV&P
100 Old River Road
Andover, MA*

RESPONSIBLE PARTY DURING CONSTRUCTION:

*John M Corcoran & Co; SV&P
100 Grandview Road Suite 205
Braintree, MA*

RESPONSIBLE PARTY POST CONSTRUCTION:

*John M Corcoran & Co; SV&P
100 Grandview Road Suite 205
Braintree, MA*

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for “good housekeeping” including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots, drive aisles and access aisles a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the “O&M Plan”.
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.
- No outdoor maintenance or washing of vehicles allowed.
- Trash and other debris shall be removed from all areas of the site at least twice yearly.
- Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.

- Plants shall be pruned as necessary.
- The use of fertilizers will be kept at a level consistent with typical residential use. Fertilizer will be applied a maximum of once to twice per year during the initial planting and stabilization of landscaped areas. Once plants are established and growing well fertilizer will be applied judiciously.
- The use of pesticides will be kept at a level consistent with typical residential use. Where possible mechanical methods (i.e. pest traps) or biological methods (i.e. beneficial insects) of pest control shall be implemented. If pesticides (insecticide, herbicide, and fungicide) are required to be used, a pesticide which poses the lowest risk to public health and the environment shall be used.
- Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.
- Snow piles shall be located adjacent to or on pervious surfaces in upland areas. This will allow snow melt water to filter into the soil, leaving behind sand and debris which can be removed in the springtime.
- In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams, or other water bodies).
- In no case shall snow be disposed of or stored in the detention basins, infiltration basins or bioretention areas.
- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.
- The amount of sand and deicing chemicals shall be kept at the minimum amount required to provide safe pedestrian and vehicle travel.
- Deicing chemicals are recommended as a pretreatment to storm events to minimize the amount of applied sand.
- The primary agents used for deicing at parking lots, sidewalks and the access roads shall consist of salt alternatives such as calcium carbonate (CaCO₃) or potassium chloride (KCl).
- Recycle materials whenever possible. Provide separate containers for recycle materials. Recycling products will be removed by a certified waste hauler.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan:

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss the Spill Prevention and Response Procedures:

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

SPILL PREVENTION AND RESPONSE PROCEDURES **(POST CONSTRUCTION)**

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.
2. The minimum practical quantity of all such materials will be kept on site.
3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.
4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.
5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)
2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.
3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).
4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

Cause of Spill: _____

Measures Taken to Clean up Spill: _____

Type of equipment: _____ Make: _____ Size: _____

License or S/N: _____

Location and Method of Disposal _____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: _____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCY PHONE: (888) 372-7341

