SUPPLEMENTAL DRAINAGE PACKAGE

For

BERKELEY

PROPOSED

Flex/Light Industrial Building

0 & 161 Concord Road
Billerica, Massachusetts
Middlesex County

Prepared by:

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#MAB250096.00

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

I. EXECUTIVE SUMMARY

This supplemental drainage package is being provided as a result of site plan layout and drainage design modifications in response to a proposed change in use for the previously approved project. The proposed changes include a revised building footprint, parking lot layout, and loading docks. Additionally, the project's grading approach has been revised to reduce the required fill and lower retaining wall heights. The overall drainage design and approach largely stays the same with the previously approved project. As outlined in this supplemental package, the drainage design continues to meet or exceed the Massachusetts DEP Stormwater Standards, as well as the New Development Performance Standards from Section 6.7.006 of the Town of Billerica Stormwater Management Regulations.

This Project is seeking a waiver from the Department of Public Works Engineering Division (authorized agent) for Section 6.6.010.2.d.1 in the Board of Health Rules and Regulations, Chapter 6, Stormwater Management Regulations which requires stormwater volume attenuation. Site constraints include the presence of high groundwater (within 3 feet of existing grade) in addition to the presence of glacial till and very low infiltration rates. Typically, volume attenuation is required in municipalities who seek to reduce the volume of stormwater being discharged to the Town's drainage infrastructure in order to improve capacity. For this Project, the stormwater systems discharge into the adjacent resource areas and ultimately the Concord River, therefore, there are no existing capacity concerns or impacts.

The pre- and post-development drainage conditions were re-evaluated at the two (2) "design points" where stormwater runoff currently drains to under existing conditions. A summary of the existing and proposed conditions peak runoff rates and volumes for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below.

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	6.89	4.95	**-1.94**	14.55	13.37	**-1.18**	19.55	18.32	**-1.23**	27.40	27.10	**-0.30**
DP2	10.88	9.40	**-1.48**	24.57	21.83	**-2.74**	33.69	27.66	**-6.03**	48.19	42.75	**-5.44**

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

II. PROPOSED SITE CONDITIONS

The modified project consists of the construction of a new 147,700± sf freestanding flex/light industrial facility including paved parking and loading areas, landscaping, associated utilities, and a new stormwater management system. The Site, including the proposed parking areas, has been designed to drain to deep-sump, hooded catch basins. The catch basins will capture and convey stormwater runoff, via an underground pipe system, to one of three (3) proposed subsurface infiltration basins. Pretreatment of stormwater runoff will be provided by a combination of the deep-sump, hooded catch basins, water quality units prior to discharge into the proposed subsurface basins. Rooftop runoff has been designed to flow to the basins as well.

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points as in existing conditions. The site was subdivided into six (6) separate sub catchments for the proposed conditions.

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

III. 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 one of three (3) proposed subsurface infiltration systems. The project as proposed will involve the creation of 388,381 square feet of new impervious area and is required to infiltrate 3,237 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed infiltration systems will provide a total of 34,771 cubic feet of volume below the lowest outlet for groundwater recharge. Refer to **Appendix C** of this report for calculations documenting required and provided recharge volumes.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing that the proposed infiltration systems will drain within 46.3 hours, 71.9 hours, and 44.6 hours respectively are included in **Appendix C** of this report.

A four (4) foot separation to estimated seasonal high groundwater is provided and a groundwater mounding analysis is not required.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins, proprietary water quality units, and subsurface infiltration systems. TSS removal calculations are included in **Appendix C** of this report. The project as proposed has a post-construction impervious area of 399,010 square feet and is required to treat 33,251 cubic feet of water quality volume as defined in Stormwater Standard 4. The required water quality volume is equivalent to 1” of runoff from the proposed impervious areas. This requirement is based on Section 6.7.006.1.ii of the Town of Billerica Board

of Health Rules and Regulations to meet the required 90% Total Suspended Solids removal and 60% Total Phosphorus removal. The proposed infiltration systems will provide a total of 34,771 cubic feet of water quality volume below the lowest outlet for water quality treatment. Refer to **Appendix D** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

Based on provided daily vehicle trips, this project is not considered a "Land Uses with Higher Potential Pollutant Loads". However, the project has elected to continue to comply with this Standard as the previously approved project was considered a LUHPPL. Accordingly, the stormwater management system includes oil-grit separators (Stormceptor units) prior to discharge. In addition, the project will provide greater than 90% TSS removal prior to infiltration and treat the 1.0 in water quality volume, as further illustrated in **Appendix C** of this report.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

Not Applicable for this project.

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 has been prepared and was submitted under the initial application.

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

An Operation and Maintenance (O&M) Plan for this site has been prepared and was approved under the initial application. 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.

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 was submitted under the initial application.

IV. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler is consistent with the previously approved drainage design and 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 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 as described further herein.

APPENDIX A: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*

BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL SERVICES
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	7/6/2022	PB RESPONSE	WNG / ZLR
2	7/18/2022	PEER REVIEW RESPONSE	WNG / ZLR
3	7/28/2022	DPW AND PEER REVIEW RESPONSES	WNG / ZLR
4	3/9/2023	90% CONSTRUCTION SET	WNG/LF / ZLR
5	4/6/2023	100% CONSTRUCTION SET	WNG/LF / ZLR
6	3/1/2024	DPW REVIEW RESPONSE	WNG/LF / ZLR
7	10/10/2025	PB & CON COM AMENDMENT	LV/WNG / ZLR

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PERMIT SET

PROJECT No.:	MAB250096.00
DRAWN BY:	WNG
CHECKED BY:	ZLR
DATE:	07/28/2022
CAD I.D.:	P-DMAP-HYDR-MAB250096.00-0A

PROJECT:

SITE DEVELOPMENT PLANS

FOR

BERKELEY

PROPOSED FLEX INDUSTRIAL

MAP 68, BLOCK 22, LOT 1
MAP 69, BLOCK 29, LOT 2
0 & 161 CONCORD ROAD
TOWN OF BILLERICA, MIDDLESEX COUNTY, MA

BOHLER

45 FRANKLIN STREET, 5th FLOOR
BOSTON, MA 02110
Phone: (617) 849-8040

www.BohlerEngineering.com

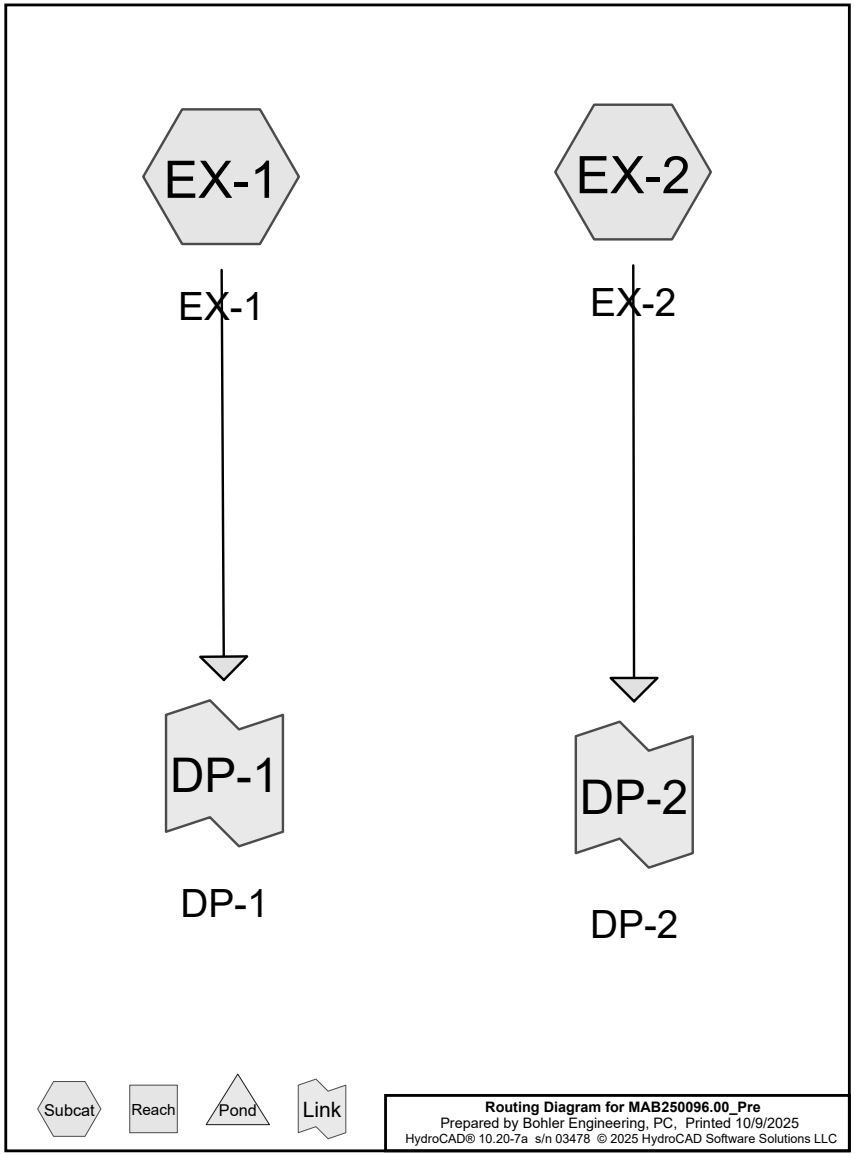
SHEET TITLE:

PRE DRAINAGE MAP

SHEET NUMBER:

PRE

REVISION 7 - 10/10/2025



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.375	80	>75% Grass cover, Good, HSG D (EX-1, EX-2)
0.244	98	Paved parking, HSG D (EX-1)
14.806	77	Woods, Good, HSG D (EX-1, EX-2)
16.425	**78**	**TOTAL AREA**

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: EX-1 Runoff Area=247,278 sf 4.29% Impervious Runoff Depth>1.17"
Flow Length=795' Tc=19.6 min CN=78 Runoff=5.62 cfs 0.554 af

Subcatchment EX-2: EX-2 Runoff Area=468,175 sf 0.00% Impervious Runoff Depth>1.11"
Flow Length=501' Tc=16.1 min CN=77 Runoff=10.87 cfs 0.998 af

Link DP-1: DP-1 Inflow=5.62 cfs 0.554 af
Primary=5.62 cfs 0.554 af

Link DP-2: DP-2 Inflow=10.87 cfs 0.998 af
Primary=10.87 cfs 0.998 af

Total Runoff Area = 16.425 ac Runoff Volume = 1.553 af Average Runoff Depth = 1.13"
98.52% Pervious = 16.181 ac 1.48% Impervious = 0.244 ac

Summary for Subcatchment EX-1: EX-1

Runoff = 5.62 cfs @ 12.29 hrs, Volume= 0.554 af, Depth> 1.17"
Routed to Link DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
207,097	77	Woods, Good, HSG D
29,572	80	>75% Grass cover, Good, HSG D
10,609	98	Paved parking, HSG D
247,278	78	Weighted Average
236,669		95.71% Pervious Area
10,609		4.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.5	65	0.0231	2.28		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
8.8	503	0.0360	0.95		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.1	177	0.0790	1.41		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.6	795	Total			

Summary for Subcatchment EX-2: EX-2

Runoff = 10.87 cfs @ 12.24 hrs, Volume= 0.998 af, Depth> 1.11"
Routed to Link DP-2 : DP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
437,871	77	Woods, Good, HSG D
30,304	80	>75% Grass cover, Good, HSG D
468,175	77	Weighted Average
468,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0140	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.6	51	0.0450	1.48		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	280	0.0450	1.06		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
1.7	120	0.0560	1.18		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.1	501	Total			

Summary for Link DP-1: DP-1

Inflow Area = 5.677 ac, 4.29% Impervious, Inflow Depth > 1.17" for 2-YR event
Inflow = 5.62 cfs @ 12.29 hrs, Volume= 0.554 af
Primary = 5.62 cfs @ 12.29 hrs, Volume= 0.554 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Summary for Link DP-2: DP-2

Inflow Area = 10.748 ac, 0.00% Impervious, Inflow Depth > 1.11" for 2-YR event
Inflow = 10.87 cfs @ 12.24 hrs, Volume= 0.998 af
Primary = 10.87 cfs @ 12.24 hrs, Volume= 0.998 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=247,278 sf 4.29% Impervious Runoff Depth>2.55"
Flow Length=795' Tc=19.6 min CN=78 Runoff=12.39 cfs 1.205 af

SubcatchmentEX-2: EX-2 Runoff Area=468,175 sf 0.00% Impervious Runoff Depth>2.46"
Flow Length=501' Tc=16.1 min CN=77 Runoff=24.54 cfs 2.206 af

Link DP-1: DP-1 Inflow=12.39 cfs 1.205 af
Primary=12.39 cfs 1.205 af

Link DP-2: DP-2 Inflow=24.54 cfs 2.206 af
Primary=24.54 cfs 2.206 af

Total Runoff Area = 16.425 ac Runoff Volume = 3.411 af Average Runoff Depth = 2.49"
98.52% Pervious = 16.181 ac 1.48% Impervious = 0.244 ac

Summary for Subcatchment EX-1: EX-1

Runoff = 12.39 cfs @ 12.27 hrs, Volume= 1.205 af, Depth> 2.55"
Routed to Link DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
207,097	77	Woods, Good, HSG D
29,572	80	>75% Grass cover, Good, HSG D
10,609	98	Paved parking, HSG D
247,278	78	Weighted Average
236,669		95.71% Pervious Area
10,609		4.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.5	65	0.0231	2.28		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
8.8	503	0.0360	0.95		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.1	177	0.0790	1.41		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.6	795	Total			

Summary for Subcatchment EX-2: EX-2

Runoff = 24.54 cfs @ 12.22 hrs, Volume= 2.206 af, Depth> 2.46"
Routed to Link DP-2 : DP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
437,871	77	Woods, Good, HSG D
30,304	80	>75% Grass cover, Good, HSG D
468,175	77	Weighted Average
468,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0140	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.6	51	0.0450	1.48		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	280	0.0450	1.06		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
1.7	120	0.0560	1.18		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.1	501	Total			

Summary for Link DP-1: DP-1

Inflow Area = 5.677 ac, 4.29% Impervious, Inflow Depth > 2.55" for 10-YR event
Inflow = 12.39 cfs @ 12.27 hrs, Volume= 1.205 af
Primary = 12.39 cfs @ 12.27 hrs, Volume= 1.205 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Summary for Link DP-2: DP-2

Inflow Area = 10.748 ac, 0.00% Impervious, Inflow Depth > 2.46" for 10-YR event
Inflow = 24.54 cfs @ 12.22 hrs, Volume= 2.206 af
Primary = 24.54 cfs @ 12.22 hrs, Volume= 2.206 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: EX-1 Runoff Area=247,278 sf 4.29% Impervious Runoff Depth>3.48"
Flow Length=795' Tc=19.6 min CN=78 Runoff=16.87 cfs 1.648 af

Subcatchment EX-2: EX-2 Runoff Area=468,175 sf 0.00% Impervious Runoff Depth>3.39"
Flow Length=501' Tc=16.1 min CN=77 Runoff=33.64 cfs 3.035 af

Link DP-1: DP-1 Inflow=16.87 cfs 1.648 af
Primary=16.87 cfs 1.648 af

Link DP-2: DP-2 Inflow=33.64 cfs 3.035 af
Primary=33.64 cfs 3.035 af

Total Runoff Area = 16.425 ac Runoff Volume = 4.683 af Average Runoff Depth = 3.42"
98.52% Pervious = 16.181 ac 1.48% Impervious = 0.244 ac

Summary for Subcatchment EX-1: EX-1

Runoff = 16.87 cfs @ 12.27 hrs, Volume= 1.648 af, Depth> 3.48"
Routed to Link DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
207,097	77	Woods, Good, HSG D
29,572	80	>75% Grass cover, Good, HSG D
10,609	98	Paved parking, HSG D
247,278	78	Weighted Average
236,669		95.71% Pervious Area
10,609		4.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.5	65	0.0231	2.28		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
8.8	503	0.0360	0.95		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.1	177	0.0790	1.41		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.6	795	Total			

Summary for Subcatchment EX-2: EX-2

Runoff = 33.64 cfs @ 12.22 hrs, Volume= 3.035 af, Depth> 3.39"
Routed to Link DP-2 : DP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
437,871	77	Woods, Good, HSG D
30,304	80	>75% Grass cover, Good, HSG D
468,175	77	Weighted Average
468,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0140	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.6	51	0.0450	1.48		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	280	0.0450	1.06		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
1.7	120	0.0560	1.18		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.1	501	Total			

Summary for Link DP-1: DP-1

Inflow Area = 5.677 ac, 4.29% Impervious, Inflow Depth > 3.48" for 25-YR event
Inflow = 16.87 cfs @ 12.27 hrs, Volume= 1.648 af
Primary = 16.87 cfs @ 12.27 hrs, Volume= 1.648 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Summary for Link DP-2: DP-2

Inflow Area = 10.748 ac, 0.00% Impervious, Inflow Depth > 3.39" for 25-YR event
Inflow = 33.64 cfs @ 12.22 hrs, Volume= 3.035 af
Primary = 33.64 cfs @ 12.22 hrs, Volume= 3.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentEX-1: EX-1 Runoff Area=247,278 sf 4.29% Impervious Runoff Depth>5.00"
Flow Length=795' Tc=19.6 min CN=78 Runoff=23.97 cfs 2.367 af

SubcatchmentEX-2: EX-2 Runoff Area=468,175 sf 0.00% Impervious Runoff Depth>4.89"
Flow Length=501' Tc=16.1 min CN=77 Runoff=48.12 cfs 4.384 af

Link DP-1: DP-1 Inflow=23.97 cfs 2.367 af
Primary=23.97 cfs 2.367 af

Link DP-2: DP-2 Inflow=48.12 cfs 4.384 af
Primary=48.12 cfs 4.384 af

Total Runoff Area = 16.425 ac Runoff Volume = 6.751 af Average Runoff Depth = 4.93"
98.52% Pervious = 16.181 ac 1.48% Impervious = 0.244 ac

Summary for Subcatchment EX-1: EX-1

Runoff = 23.97 cfs @ 12.27 hrs, Volume= 2.367 af, Depth> 5.00"
Routed to Link DP-1 : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
207,097	77	Woods, Good, HSG D
29,572	80	>75% Grass cover, Good, HSG D
10,609	98	Paved parking, HSG D
247,278	78	Weighted Average
236,669		95.71% Pervious Area
10,609		4.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.5	65	0.0231	2.28		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
8.8	503	0.0360	0.95		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.1	177	0.0790	1.41		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.6	795	Total			

Summary for Subcatchment EX-2: EX-2

Runoff = 48.12 cfs @ 12.22 hrs, Volume= 4.384 af, Depth> 4.89"
Routed to Link DP-2 : DP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
437,871	77	Woods, Good, HSG D
30,304	80	>75% Grass cover, Good, HSG D
468,175	77	Weighted Average
468,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0140	0.09		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.6	51	0.0450	1.48		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
4.4	280	0.0450	1.06		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
1.7	120	0.0560	1.18		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.1	501	Total			

Summary for Link DP-1: DP-1

Inflow Area = 5.677 ac, 4.29% Impervious, Inflow Depth > 5.00" for 100-YR event
Inflow = 23.97 cfs @ 12.27 hrs, Volume= 2.367 af
Primary = 23.97 cfs @ 12.27 hrs, Volume= 2.367 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Summary for Link DP-2: DP-2

Inflow Area = 10.748 ac, 0.00% Impervious, Inflow Depth > 4.89" for 100-YR event
Inflow = 48.12 cfs @ 12.22 hrs, Volume= 4.384 af
Primary = 48.12 cfs @ 12.22 hrs, Volume= 4.384 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

APPENDIX B: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*

SUBCATCHMENT PR-6
AREA = 150,632 SF (3.45 Ac)
Tc = 33.7 MIN.
CN =77

SUBCATCHMENT PR-2
AREA = ±265,300 SF (6.00 Ac)
Tc = 6.0 MIN. (MIN.)
CN = 98

SUBCATCHMENT PR-1
AREA = ±143,300 SF (3.38 Ac)
Tc = 6.0 MIN. (MIN.)
CN = 95

SUBCATCHMENT PR-3
AREA = ±14,390 SF (0.33 Ac)
Tc = 6.0 MIN. (MIN.)
CN = 96

SUBCATCHMENT PR-5
AREA = 132,030 SF (3.02 Ac)
Tc = 15.4 MIN.
CN = 78

SUBCATCHMENT PR-4
AREA = ±9,839 SF (0.23 Ac)
Tc = 6.0 MIN. (MIN.)
CN = 98

200-FT RIVERFRONT AREA

CONCORD ROAD (1935 COUNTY LAYOUT - VARIABLE WIDTH)

DP1

DP2

P-1

P-2

P-3

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LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL SERVICES
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	7/6/2022	PB RESPONSE	WNG / ZLR
2	7/18/2022	PEER REVIEW RESPONSE	WNG / ZLR
3	7/28/2022	DPW AND PEER REVIEW RESPONSES	WNG / ZLR
4	3/9/2023	90% CONSTRUCTION SET	WNG/LF / ZLR
5	4/6/2023	100% CONSTRUCTION SET	WNG/LF / ZLR
6	3/1/2024	DPW REVIEW RESPONSE	WNG/LF / ZLR
7	10/10/2025	PB & CON COM AMENDMENT	LV/WNG / ZLR

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PERMIT SET

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PROJECT No.: MAB250096.00
DRAWN BY: WNG
CHECKED BY: ZLR
DATE: 07/28/2022
CAD I.D.: P-DMAP-HYDR-MAB250096.00-0A

PROJECT:

SITE DEVELOPMENT PLANS

FOR

BERKELEY

PROPOSED
FLEX INDUSTRIAL

MAP 68, BLOCK 22, LOT 1
MAP 69, BLOCK 29, LOT 2
0 & 161 CONCORD ROAD
TOWN OF BILLERICA,
MIDDLESEX COUNTY, MA

BOHLER

45 FRANKLIN STREET, 5th FLOOR
BOSTON, MA 02110
Phone: (617) 849-8040

www.BohlerEngineering.com

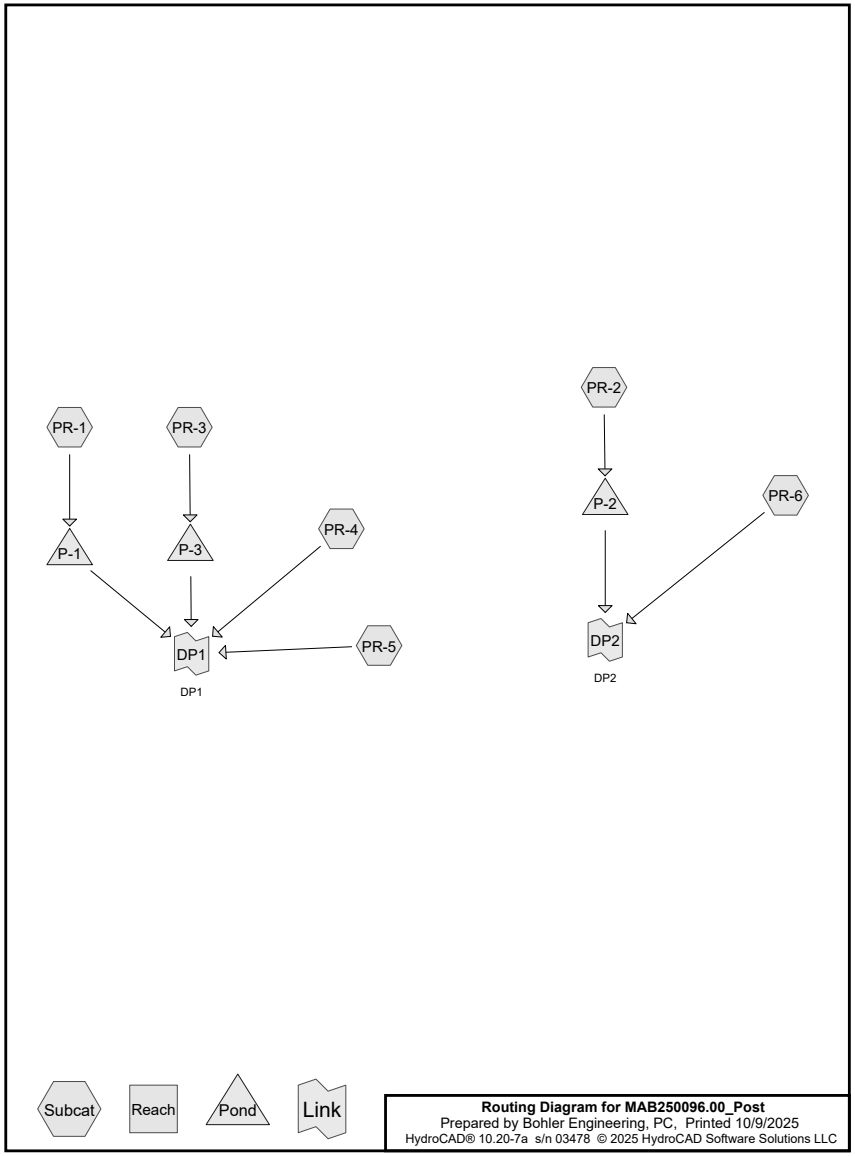
SHEET TITLE:

POST DRAINAGE MAP

SHEET NUMBER:

POST

REVISION 7 - 10/10/2025



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.599	80	>75% Grass cover, Good, HSG D (PR-1, PR-2, PR-3, PR-5)
5.776	98	Paved parking, HSG D (PR-1, PR-2, PR-3, PR-4)
3.384	98	Roofs, HSG D (PR-2)
5.666	77	Woods, Good, HSG D (PR-5, PR-6)
16.425	**89**	**TOTAL AREA**

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

SubcatchmentPR-1: Runoff Area=143,300 sf 82.00% Impervious Runoff Depth=2.65"
Tc=6.0 min CN=95 Runoff=9.46 cfs 0.728 af

SubcatchmentPR-2: Runoff Area=265,300 sf 97.68% Impervious Runoff Depth=2.98"
Tc=6.0 min CN=98 Runoff=18.53 cfs 1.511 af

SubcatchmentPR-3: Runoff Area=14,390 sf 87.00% Impervious Runoff Depth=2.76"
Tc=6.0 min CN=96 Runoff=0.97 cfs 0.076 af

SubcatchmentPR-4: Runoff Area=9,839 sf 100.00% Impervious Runoff Depth=2.98"
Tc=6.0 min CN=98 Runoff=0.69 cfs 0.056 af

SubcatchmentPR-5: Runoff Area=132,030 sf 0.00% Impervious Runoff Depth=1.28"
Flow Length=689' Tc=15.4 min CN=78 Runoff=3.31 cfs 0.323 af

SubcatchmentPR-6: Runoff Area=150,632 sf 0.00% Impervious Runoff Depth=1.22"
Flow Length=686' Tc=33.7 min CN=77 Runoff=2.57 cfs 0.351 af

Pond P-1: Peak Elev=165.00' Storage=16,098 cf Inflow=9.46 cfs 0.728 af
Discarded=0.06 cfs 0.130 af Primary=1.83 cfs 0.392 af Outflow=1.90 cfs 0.522 af

Pond P-2: Peak Elev=166.18' Storage=30,271 cf Inflow=18.53 cfs 1.511 af
Discarded=0.09 cfs 0.191 af Primary=8.80 cfs 0.852 af Outflow=8.88 cfs 1.044 af

Pond P-3: Peak Elev=176.51' Storage=2,046 cf Inflow=0.97 cfs 0.076 af
Discarded=0.02 cfs 0.041 af Primary=0.02 cfs 0.003 af Outflow=0.04 cfs 0.044 af

Link DP1: DP1 Inflow=5.17 cfs 0.774 af
Primary=5.17 cfs 0.774 af

Link DP2: DP2 Inflow=10.61 cfs 1.203 af
Primary=10.61 cfs 1.203 af

Total Runoff Area = 16.425 ac Runoff Volume = 3.046 af Average Runoff Depth = 2.23"
44.23% Pervious = 7.265 ac 55.77% Impervious = 9.160 ac

Summary for Subcatchment PR-1:

Runoff = 9.46 cfs @ 12.09 hrs, Volume= 0.728 af, Depth= 2.65"
Routed to Pond P-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
25,800	80	>75% Grass cover, Good, HSG D
117,500	98	Paved parking, HSG D
143,300	95	Weighted Average
25,800		18.00% Pervious Area
117,500		82.00% Impervious Area

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

Summary for Subcatchment PR-2:

Runoff = 18.53 cfs @ 12.09 hrs, Volume= 1.511 af, Depth= 2.98"
Routed to Pond P-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
6,150	80	>75% Grass cover, Good, HSG D
111,750	98	Paved parking, HSG D
147,400	98	Roofs, HSG D
265,300	98	Weighted Average
6,150		2.32% Pervious Area
259,150		97.68% Impervious Area

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

Summary for Subcatchment PR-3:

Runoff = 0.97 cfs @ 12.09 hrs, Volume= 0.076 af, Depth= 2.76"
Routed to Pond P-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
1,871	80	>75% Grass cover, Good, HSG D
12,519	98	Paved parking, HSG D
14,390	96	Weighted Average
1,871		13.00% Pervious Area
12,519		87.00% Impervious Area

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

Summary for Subcatchment PR-4:

Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.056 af, Depth= 2.98"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
9,839	98	Paved parking, HSG D
9,839		100.00% Impervious Area

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

Summary for Subcatchment PR-5:

Runoff = 3.31 cfs @ 12.22 hrs, Volume= 0.323 af, Depth= 1.28"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
35,850	80	>75% Grass cover, Good, HSG D
96,180	77	Woods, Good, HSG D
132,030	78	Weighted Average
132,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0320	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.7	58	0.0350	1.31		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
7.0	306	0.0210	0.72		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
0.9	275	0.0300	5.14	25.71	**Channel Flow, D-E** Area= 5.0 sf Perim= 7.0' r= 0.71' n= 0.040 Winding stream, pools & shoals
15.4	689	Total			

Summary for Subcatchment PR-6:

Runoff = 2.57 cfs @ 12.50 hrs, Volume= 0.351 af, Depth= 1.22"
Routed to Link DP2 : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.21"

Area (sf)	CN	Description
150,632	77	Woods, Good, HSG D
150,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	50	0.0140	0.03		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.21"
4.9	300	0.0420	1.02		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	147	0.0544	1.17		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.0	189	0.0950	1.54		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
33.7	686	Total			

Summary for Pond P-1:

Inflow Area = 3.290 ac, 82.00% Impervious, Inflow Depth = 2.65" for 2-YR event
Inflow = 9.46 cfs @ 12.09 hrs, Volume= 0.728 af
Outflow = 1.90 cfs @ 12.52 hrs, Volume= 0.522 af, Atten= 80%, Lag= 25.8 min
Discarded = 0.06 cfs @ 7.00 hrs, Volume= 0.130 af
Primary = 1.83 cfs @ 12.52 hrs, Volume= 0.392 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 165.00' @ 12.52 hrs Surf.Area= 6,713 sf Storage= 16,098 cf

Plug-Flow detention time= 229.4 min calculated for 0.522 af (72% of inflow)

Center-of-Mass det. time= 139.8 min (920.7 - 780.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,343 cf	**89.63'W x 74.90'L x 8.00'H Field A** 53,700 cf Overall - 50,344 cf Embedded = 3,356 cf x 40.0% Voids
#2A	162.50'	41,247 cf	**StormTrap SingleTrap 7-0** x 36 Inside #1 Inside= 101.7"W x 84.0"H => 52.88 sf x 15.40'L = 814.2 cf Outside= 101.7"W x 90.0"H => 63.59 sf x 15.40'L = 979.1 cf 36 Chambers in 9 Rows 76.31' x 61.58' Core + 6.66' Border = 89.63' x 74.90' System
		42,590 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**15.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	168.25'	**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
#3	Device 1	164.00'	**15.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	166.75'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 7.00 hrs HW=162.08' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.83 cfs @ 12.52 hrs HW=165.00' (Free Discharge)
└**1=Culvert** (Passes 1.83 cfs of 7.55 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 1.83 cfs @ 4.39 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond P-2:

Inflow Area = 6.090 ac, 97.68% Impervious, Inflow Depth = 2.98" for 2-YR event
Inflow = 18.53 cfs @ 12.09 hrs, Volume= 1.511 af
Outflow = 8.88 cfs @ 12.25 hrs, Volume= 1.044 af, Atten= 52%, Lag= 9.9 min
Discarded = 0.09 cfs @ 3.80 hrs, Volume= 0.191 af
Primary = 8.80 cfs @ 12.25 hrs, Volume= 0.852 af
Routed to Link DP2 : DP2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 166.18' @ 12.25 hrs Surf.Area= 8,858 sf Storage= 30,271 cf

Plug-Flow detention time= 213.7 min calculated for 1.044 af (69% of inflow)
Center-of-Mass det. time= 118.4 min (874.7 - 756.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,772 cf	**98.10'W x 90.29'L x 7.00'H Field A** 62,006 cf Overall - 57,577 cf Embedded = 4,429 cf x 40.0% Voids
#2A	162.50'	46,490 cf	**StormTrap SingleTrap 6-0** x 50 Inside #1 Inside= 101.7"W x 72.0"H => 45.09 sf x 15.40'L = 694.1 cf Outside= 101.7"W x 78.0"H => 55.11 sf x 15.40'L = 848.5 cf 50 Chambers in 10 Rows 84.79' x 76.98' Core + 6.66' Border = 98.10' x 90.29' System
		48,261 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**24.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	168.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	165.10'	**30.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 3.80 hrs HW=162.07' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=8.80 cfs @ 12.25 hrs HW=166.18' (Free Discharge)
└**1=Culvert** (Passes 8.80 cfs of 24.75 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 8.80 cfs @ 3.52 fps)

Summary for Pond P-3:

Inflow Area = 0.330 ac, 87.00% Impervious, Inflow Depth = 2.76" for 2-YR event
Inflow = 0.97 cfs @ 12.09 hrs, Volume= 0.076 af
Outflow = 0.04 cfs @ 14.76 hrs, Volume= 0.044 af, Atten= 96%, Lag= 160.5 min
Discarded = 0.02 cfs @ 14.40 hrs, Volume= 0.041 af
Primary = 0.02 cfs @ 14.76 hrs, Volume= 0.003 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 176.51' @ 14.76 hrs Surf.Area= 1,348 sf Storage= 2,046 cf

Plug-Flow detention time= 412.8 min calculated for 0.044 af (58% of inflow)
Center-of-Mass det. time= 306.0 min (1,080.0 - 774.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	174.50'	267 cf	**30.27'W x 44.10'L x 3.00'H Field A** 4,005 cf Overall - 3,338 cf Embedded = 668 cf x 40.0% Voids
#2A	175.00'	2,316 cf	**StormTrap SingleTrap 2-0** x 4 Inside #1 Inside= 101.7"W x 24.0"H => 15.05 sf x 15.40'L = 231.7 cf Outside= 101.7"W x 30.0"H => 21.20 sf x 15.40'L = 326.4 cf 4 Chambers in 2 Rows 16.96' x 30.79' Core + 6.66' Border = 30.27' x 44.10' System
#3	174.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,646 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	176.50'	**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
#2	Discarded	174.00'	**0.680 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 14.40 hrs HW=176.50' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.01 cfs @ 14.76 hrs HW=176.51' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.26 fps)

Summary for Link DP1: DP1

Inflow Area = 6.877 ac, 46.69% Impervious, Inflow Depth = 1.35" for 2-YR event
Inflow = 5.17 cfs @ 12.23 hrs, Volume= 0.774 af
Primary = 5.17 cfs @ 12.23 hrs, Volume= 0.774 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: DP2

Inflow Area = 9.548 ac, 62.31% Impervious, Inflow Depth = 1.51" for 2-YR event
Inflow = 10.61 cfs @ 12.31 hrs, Volume= 1.203 af
Primary = 10.61 cfs @ 12.31 hrs, Volume= 1.203 af, Atten= 0%, Lag= 0.0 min

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

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

SubcatchmentPR-1: Runoff Area=143,300 sf 82.00% Impervious Runoff Depth=4.46"
Tc=6.0 min CN=95 Runoff=15.42 cfs 1.222 af

SubcatchmentPR-2: Runoff Area=265,300 sf 97.68% Impervious Runoff Depth=4.80"
Tc=6.0 min CN=98 Runoff=29.33 cfs 2.438 af

SubcatchmentPR-3: Runoff Area=14,390 sf 87.00% Impervious Runoff Depth=4.57"
Tc=6.0 min CN=96 Runoff=1.57 cfs 0.126 af

SubcatchmentPR-4: Runoff Area=9,839 sf 100.00% Impervious Runoff Depth=4.80"
Tc=6.0 min CN=98 Runoff=1.09 cfs 0.090 af

SubcatchmentPR-5: Runoff Area=132,030 sf 0.00% Impervious Runoff Depth=2.75"
Flow Length=689' Tc=15.4 min CN=78 Runoff=7.28 cfs 0.694 af

SubcatchmentPR-6: Runoff Area=150,632 sf 0.00% Impervious Runoff Depth=2.66"
Flow Length=686' Tc=33.7 min CN=77 Runoff=5.76 cfs 0.766 af

Pond P-1: Peak Elev=166.72' Storage=26,189 cf Inflow=15.42 cfs 1.222 af
Discarded=0.06 cfs 0.140 af Primary=3.20 cfs 0.874 af Outflow=3.27 cfs 1.014 af

Pond P-2: Peak Elev=167.31' Storage=39,037 cf Inflow=29.33 cfs 2.438 af
Discarded=0.09 cfs 0.199 af Primary=15.68 cfs 1.769 af Outflow=15.77 cfs 1.968 af

Pond P-3: Peak Elev=176.68' Storage=2,249 cf Inflow=1.57 cfs 0.126 af
Discarded=0.02 cfs 0.045 af Primary=0.87 cfs 0.046 af Outflow=0.89 cfs 0.091 af

Link DP1: DP1 Inflow=11.67 cfs 1.704 af
Primary=11.67 cfs 1.704 af

Link DP2: DP2 Inflow=20.05 cfs 2.535 af
Primary=20.05 cfs 2.535 af

Total Runoff Area = 16.425 ac Runoff Volume = 5.336 af Average Runoff Depth = 3.90"
44.23% Pervious = 7.265 ac 55.77% Impervious = 9.160 ac

Summary for Subcatchment PR-1:

Runoff = 15.42 cfs @ 12.09 hrs, Volume= 1.222 af, Depth= 4.46"
Routed to Pond P-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
25,800	80	>75% Grass cover, Good, HSG D
117,500	98	Paved parking, HSG D
143,300	95	Weighted Average
25,800		18.00% Pervious Area
117,500		82.00% Impervious Area

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

Summary for Subcatchment PR-2:

Runoff = 29.33 cfs @ 12.09 hrs, Volume= 2.438 af, Depth= 4.80"
Routed to Pond P-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
6,150	80	>75% Grass cover, Good, HSG D
111,750	98	Paved parking, HSG D
147,400	98	Roofs, HSG D
265,300	98	Weighted Average
6,150		2.32% Pervious Area
259,150		97.68% Impervious Area

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

Summary for Subcatchment PR-3:

Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.126 af, Depth= 4.57"
Routed to Pond P-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
1,871	80	>75% Grass cover, Good, HSG D
12,519	98	Paved parking, HSG D
14,390	96	Weighted Average
1,871		13.00% Pervious Area
12,519		87.00% Impervious Area

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

Summary for Subcatchment PR-4:

Runoff = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af, Depth= 4.80"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
9,839	98	Paved parking, HSG D
9,839		100.00% Impervious Area

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

Summary for Subcatchment PR-5:

Runoff = 7.28 cfs @ 12.21 hrs, Volume= 0.694 af, Depth= 2.75"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
35,850	80	>75% Grass cover, Good, HSG D
96,180	77	Woods, Good, HSG D
132,030	78	Weighted Average
132,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0320	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.7	58	0.0350	1.31		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
7.0	306	0.0210	0.72		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
0.9	275	0.0300	5.14	25.71	**Channel Flow, D-E** Area= 5.0 sf Perim= 7.0' r= 0.71' n= 0.040 Winding stream, pools & shoals
15.4	689	Total			

Summary for Subcatchment PR-6:

Runoff = 5.76 cfs @ 12.47 hrs, Volume= 0.766 af, Depth= 2.66"
Routed to Link DP2 : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=5.04"

Area (sf)	CN	Description
150,632	77	Woods, Good, HSG D
150,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	50	0.0140	0.03		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.21"
4.9	300	0.0420	1.02		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	147	0.0544	1.17		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.0	189	0.0950	1.54		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
33.7	686	Total			

Summary for Pond P-1:

Inflow Area = 3.290 ac, 82.00% Impervious, Inflow Depth = 4.46" for 10-YR event
Inflow = 15.42 cfs @ 12.09 hrs, Volume= 1.222 af
Outflow = 3.27 cfs @ 12.50 hrs, Volume= 1.014 af, Atten= 79%, Lag= 24.9 min
Discarded = 0.06 cfs @ 4.85 hrs, Volume= 0.140 af
Primary = 3.20 cfs @ 12.50 hrs, Volume= 0.874 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 166.72' @ 12.50 hrs Surf.Area= 6,713 sf Storage= 26,189 cf

Plug-Flow detention time= 188.5 min calculated for 1.012 af (83% of inflow)

Center-of-Mass det. time= 120.5 min (888.5 - 768.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,343 cf	**89.63'W x 74.90'L x 8.00'H Field A** 53,700 cf Overall - 50,344 cf Embedded = 3,356 cf x 40.0% Voids
#2A	162.50'	41,247 cf	**StormTrap SingleTrap 7-0** x 36 Inside #1 Inside= 101.7"W x 84.0"H => 52.88 sf x 15.40'L = 814.2 cf Outside= 101.7"W x 90.0"H => 63.59 sf x 15.40'L = 979.1 cf 36 Chambers in 9 Rows 76.31' x 61.58' Core + 6.66' Border = 89.63' x 74.90' System
		42,590 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**15.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	168.25'	**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
#3	Device 1	164.00'	**15.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	166.75'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 4.85 hrs HW=162.08' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=3.20 cfs @ 12.50 hrs HW=166.72' (Free Discharge)
└**1=Culvert** (Passes 3.20 cfs of 10.02 cfs potential flow)
├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
├**3=Orifice/Grate** (Orifice Controls 3.20 cfs @ 7.69 fps)
└**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond P-2:

Inflow Area = 6.090 ac, 97.68% Impervious, Inflow Depth = 4.80" for 10-YR event
Inflow = 29.33 cfs @ 12.09 hrs, Volume= 2.438 af
Outflow = 15.77 cfs @ 12.22 hrs, Volume= 1.968 af, Atten= 46%, Lag= 8.0 min
Discarded = 0.09 cfs @ 2.40 hrs, Volume= 0.199 af
Primary = 15.68 cfs @ 12.22 hrs, Volume= 1.769 af
Routed to Link DP2 : DP2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 167.31' @ 12.22 hrs Surf.Area= 8,858 sf Storage= 39,037 cf

Plug-Flow detention time= 167.7 min calculated for 1.965 af (81% of inflow)
Center-of-Mass det. time= 93.3 min (841.2 - 747.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,772 cf	**98.10'W x 90.29'L x 7.00'H Field A** 62,006 cf Overall - 57,577 cf Embedded = 4,429 cf x 40.0% Voids
#2A	162.50'	46,490 cf	**StormTrap SingleTrap 6-0** x 50 Inside #1 Inside= 101.7"W x 72.0"H => 45.09 sf x 15.40'L = 694.1 cf Outside= 101.7"W x 78.0"H => 55.11 sf x 15.40'L = 848.5 cf 50 Chambers in 10 Rows 84.79' x 76.98' Core + 6.66' Border = 98.10' x 90.29' System
		48,261 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**24.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	168.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	165.10'	**30.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 2.40 hrs HW=162.07' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=15.62 cfs @ 12.22 hrs HW=167.30' (Free Discharge)
└**1=Culvert** (Passes 15.62 cfs of 29.47 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 15.62 cfs @ 6.25 fps)

Summary for Pond P-3:

Inflow Area = 0.330 ac, 87.00% Impervious, Inflow Depth = 4.57" for 10-YR event
Inflow = 1.57 cfs @ 12.09 hrs, Volume= 0.126 af
Outflow = 0.89 cfs @ 12.22 hrs, Volume= 0.091 af, Atten= 43%, Lag= 8.1 min
Discarded = 0.02 cfs @ 12.15 hrs, Volume= 0.045 af
Primary = 0.87 cfs @ 12.22 hrs, Volume= 0.046 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 176.68' @ 12.22 hrs Surf.Area= 1,348 sf Storage= 2,249 cf

Plug-Flow detention time= 242.9 min calculated for 0.091 af (72% of inflow)
Center-of-Mass det. time= 152.7 min (914.9 - 762.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	174.50'	267 cf	**30.27'W x 44.10'L x 3.00'H Field A** 4,005 cf Overall - 3,338 cf Embedded = 668 cf x 40.0% Voids
#2A	175.00'	2,316 cf	**StormTrap SingleTrap 2-0** x 4 Inside #1 Inside= 101.7"W x 24.0"H => 15.05 sf x 15.40'L = 231.7 cf Outside= 101.7"W x 30.0"H => 21.20 sf x 15.40'L = 326.4 cf 4 Chambers in 2 Rows 16.96' x 30.79' Core + 6.66' Border = 30.27' x 44.10' System
#3	174.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,646 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	176.50'	**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
#2	Discarded	174.00'	**0.680 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 12.15 hrs HW=176.61' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.81 cfs @ 12.22 hrs HW=176.67' (Free Discharge)
└**1=Broad-Crested Rectangular Weir**(Weir Controls 0.81 cfs @ 1.17 fps)

Summary for Link DP1: DP1

Inflow Area = 6.877 ac, 46.69% Impervious, Inflow Depth = 2.97" for 10-YR event
Inflow = 11.67 cfs @ 12.22 hrs, Volume= 1.704 af
Primary = 11.67 cfs @ 12.22 hrs, Volume= 1.704 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: DP2

Inflow Area = 9.548 ac, 62.31% Impervious, Inflow Depth = 3.19" for 10-YR event
Inflow = 20.05 cfs @ 12.34 hrs, Volume= 2.535 af
Primary = 20.05 cfs @ 12.34 hrs, Volume= 2.535 af, Atten= 0%, Lag= 0.0 min

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

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

SubcatchmentPR-1: Runoff Area=143,300 sf 82.00% Impervious Runoff Depth=5.59"
Tc=6.0 min CN=95 Runoff=19.09 cfs 1.533 af

SubcatchmentPR-2: Runoff Area=265,300 sf 97.68% Impervious Runoff Depth=5.94"
Tc=6.0 min CN=98 Runoff=36.03 cfs 3.016 af

SubcatchmentPR-3: Runoff Area=14,390 sf 87.00% Impervious Runoff Depth=5.71"
Tc=6.0 min CN=96 Runoff=1.93 cfs 0.157 af

SubcatchmentPR-4: Runoff Area=9,839 sf 100.00% Impervious Runoff Depth=5.94"
Tc=6.0 min CN=98 Runoff=1.34 cfs 0.112 af

SubcatchmentPR-5: Runoff Area=132,030 sf 0.00% Impervious Runoff Depth=3.74"
Flow Length=689' Tc=15.4 min CN=78 Runoff=9.91 cfs 0.944 af

SubcatchmentPR-6: Runoff Area=150,632 sf 0.00% Impervious Runoff Depth=3.64"
Flow Length=686' Tc=33.7 min CN=77 Runoff=7.89 cfs 1.048 af

Pond P-1: Peak Elev=167.47' Storage=30,653 cf Inflow=19.09 cfs 1.533 af
Discarded=0.06 cfs 0.143 af Primary=5.28 cfs 1.180 af Outflow=5.35 cfs 1.323 af

Pond P-2: Peak Elev=167.90' Storage=43,588 cf Inflow=36.03 cfs 3.016 af
Discarded=0.09 cfs 0.201 af Primary=18.21 cfs 2.344 af Outflow=18.29 cfs 2.545 af

Pond P-3: Peak Elev=176.78' Storage=2,360 cf Inflow=1.93 cfs 0.157 af
Discarded=0.02 cfs 0.046 af Primary=1.66 cfs 0.075 af Outflow=1.68 cfs 0.121 af

Link DP1: DP1 Inflow=16.21 cfs 2.310 af
Primary=16.21 cfs 2.310 af

Link DP2: DP2 Inflow=24.79 cfs 3.392 af
Primary=24.79 cfs 3.392 af

Total Runoff Area = 16.425 ac Runoff Volume = 6.809 af Average Runoff Depth = 4.97"
44.23% Pervious = 7.265 ac 55.77% Impervious = 9.160 ac

Summary for Subcatchment PR-1:

Runoff = 19.09 cfs @ 12.09 hrs, Volume= 1.533 af, Depth= 5.59"
Routed to Pond P-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
25,800	80	>75% Grass cover, Good, HSG D
117,500	98	Paved parking, HSG D
143,300	95	Weighted Average
25,800		18.00% Pervious Area
117,500		82.00% Impervious Area

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

Summary for Subcatchment PR-2:

Runoff = 36.03 cfs @ 12.09 hrs, Volume= 3.016 af, Depth= 5.94"
Routed to Pond P-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
6,150	80	>75% Grass cover, Good, HSG D
111,750	98	Paved parking, HSG D
147,400	98	Roofs, HSG D
265,300	98	Weighted Average
6,150		2.32% Pervious Area
259,150		97.68% Impervious Area

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

Summary for Subcatchment PR-3:

Runoff = 1.93 cfs @ 12.09 hrs, Volume= 0.157 af, Depth= 5.71"
Routed to Pond P-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
1,871	80	>75% Grass cover, Good, HSG D
12,519	98	Paved parking, HSG D
14,390	96	Weighted Average
1,871		13.00% Pervious Area
12,519		87.00% Impervious Area

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

Summary for Subcatchment PR-4:

Runoff = 1.34 cfs @ 12.09 hrs, Volume= 0.112 af, Depth= 5.94"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
9,839	98	Paved parking, HSG D
9,839		100.00% Impervious Area

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

Summary for Subcatchment PR-5:

Runoff = 9.91 cfs @ 12.21 hrs, Volume= 0.944 af, Depth= 3.74"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
35,850	80	>75% Grass cover, Good, HSG D
96,180	77	Woods, Good, HSG D
132,030	78	Weighted Average
132,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0320	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.7	58	0.0350	1.31		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
7.0	306	0.0210	0.72		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
0.9	275	0.0300	5.14	25.71	**Channel Flow, D-E** Area= 5.0 sf Perim= 7.0' r= 0.71' n= 0.040 Winding stream, pools & shoals
15.4	689	Total			

Summary for Subcatchment PR-6:

Runoff = 7.89 cfs @ 12.47 hrs, Volume= 1.048 af, Depth= 3.64"
Routed to Link DP2 : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=6.18"

Area (sf)	CN	Description
150,632	77	Woods, Good, HSG D
150,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	50	0.0140	0.03		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.21"
4.9	300	0.0420	1.02		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	147	0.0544	1.17		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.0	189	0.0950	1.54		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
33.7	686	Total			

Summary for Pond P-1:

Inflow Area = 3.290 ac, 82.00% Impervious, Inflow Depth = 5.59" for 25-YR event
Inflow = 19.09 cfs @ 12.09 hrs, Volume= 1.533 af
Outflow = 5.35 cfs @ 12.43 hrs, Volume= 1.323 af, Atten= 72%, Lag= 20.5 min
Discarded = 0.06 cfs @ 4.00 hrs, Volume= 0.143 af
Primary = 5.28 cfs @ 12.43 hrs, Volume= 1.180 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 167.47' @ 12.43 hrs Surf.Area= 6,713 sf Storage= 30,653 cf

Plug-Flow detention time= 173.6 min calculated for 1.321 af (86% of inflow)

Center-of-Mass det. time= 114.0 min (876.9 - 762.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,343 cf	**89.63'W x 74.90'L x 8.00'H Field A** 53,700 cf Overall - 50,344 cf Embedded = 3,356 cf x 40.0% Voids
#2A	162.50'	41,247 cf	**StormTrap SingleTrap 7-0** x 36 Inside #1 Inside= 101.7"W x 84.0"H => 52.88 sf x 15.40'L = 814.2 cf Outside= 101.7"W x 90.0"H => 63.59 sf x 15.40'L = 979.1 cf 36 Chambers in 9 Rows 76.31' x 61.58' Core + 6.66' Border = 89.63' x 74.90' System
		42,590 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**15.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	168.25'	**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
#3	Device 1	164.00'	**15.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	166.75'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 4.00 hrs HW=162.08' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=5.28 cfs @ 12.43 hrs HW=167.47' (Free Discharge)
└**1=Culvert** (Passes 5.28 cfs of 10.93 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 3.65 cfs @ 8.75 fps)
  └**4=Orifice/Grate** (Orifice Controls 1.63 cfs @ 3.26 fps)

Summary for Pond P-2:

Inflow Area = 6.090 ac, 97.68% Impervious, Inflow Depth = 5.94" for 25-YR event
Inflow = 36.03 cfs @ 12.09 hrs, Volume= 3.016 af
Outflow = 18.29 cfs @ 12.23 hrs, Volume= 2.545 af, Atten= 49%, Lag= 8.8 min
Discarded = 0.09 cfs @ 1.90 hrs, Volume= 0.201 af
Primary = 18.21 cfs @ 12.23 hrs, Volume= 2.344 af
Routed to Link DP2 : DP2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 167.90' @ 12.23 hrs Surf.Area= 8,858 sf Storage= 43,588 cf

Plug-Flow detention time= 153.1 min calculated for 2.545 af (84% of inflow)
Center-of-Mass det. time= 86.1 min (830.8 - 744.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,772 cf	**98.10'W x 90.29'L x 7.00'H Field A** 62,006 cf Overall - 57,577 cf Embedded = 4,429 cf x 40.0% Voids
#2A	162.50'	46,490 cf	**StormTrap SingleTrap 6-0** x 50 Inside #1 Inside= 101.7"W x 72.0"H => 45.09 sf x 15.40'L = 694.1 cf Outside= 101.7"W x 78.0"H => 55.11 sf x 15.40'L = 848.5 cf 50 Chambers in 10 Rows 84.79' x 76.98' Core + 6.66' Border = 98.10' x 90.29' System
		48,261 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**24.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	168.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	165.10'	**30.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 1.90 hrs HW=162.07' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=18.18 cfs @ 12.23 hrs HW=167.89' (Free Discharge)
└**1=Culvert** (Passes 18.18 cfs of 31.69 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 18.18 cfs @ 7.27 fps)

Summary for Pond P-3:

Inflow Area = 0.330 ac, 87.00% Impervious, Inflow Depth = 5.71" for 25-YR event
Inflow = 1.93 cfs @ 12.09 hrs, Volume= 0.157 af
Outflow = 1.68 cfs @ 12.14 hrs, Volume= 0.121 af, Atten= 13%, Lag= 3.3 min
Discarded = 0.02 cfs @ 12.05 hrs, Volume= 0.046 af
Primary = 1.66 cfs @ 12.14 hrs, Volume= 0.075 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 176.78' @ 12.14 hrs Surf.Area= 1,348 sf Storage= 2,360 cf

Plug-Flow detention time= 200.1 min calculated for 0.121 af (77% of inflow)
Center-of-Mass det. time= 119.2 min (876.8 - 757.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	174.50'	267 cf	**30.27'W x 44.10'L x 3.00'H Field A** 4,005 cf Overall - 3,338 cf Embedded = 668 cf x 40.0% Voids
#2A	175.00'	2,316 cf	**StormTrap SingleTrap 2-0** x 4 Inside #1 Inside= 101.7"W x 24.0"H => 15.05 sf x 15.40'L = 231.7 cf Outside= 101.7"W x 30.0"H => 21.20 sf x 15.40'L = 326.4 cf 4 Chambers in 2 Rows 16.96' x 30.79' Core + 6.66' Border = 30.27' x 44.10' System
#3	174.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,646 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	176.50'	**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
#2	Discarded	174.00'	**0.680 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 12.05 hrs HW=176.64' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.63 cfs @ 12.14 hrs HW=176.77' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.63 cfs @ 1.49 fps)

Summary for Link DP1: DP1

Inflow Area = 6.877 ac, 46.69% Impervious, Inflow Depth = 4.03" for 25-YR event
Inflow = 16.21 cfs @ 12.22 hrs, Volume= 2.310 af
Primary = 16.21 cfs @ 12.22 hrs, Volume= 2.310 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: DP2

Inflow Area = 9.548 ac, 62.31% Impervious, Inflow Depth = 4.26" for 25-YR event
Inflow = 24.79 cfs @ 12.36 hrs, Volume= 3.392 af
Primary = 24.79 cfs @ 12.36 hrs, Volume= 3.392 af, Atten= 0%, Lag= 0.0 min

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

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

SubcatchmentPR-1: Runoff Area=143,300 sf 82.00% Impervious Runoff Depth=7.35"
Tc=6.0 min CN=95 Runoff=24.77 cfs 2.015 af

SubcatchmentPR-2: Runoff Area=265,300 sf 97.68% Impervious Runoff Depth=7.71"
Tc=6.0 min CN=98 Runoff=46.42 cfs 3.913 af

SubcatchmentPR-3: Runoff Area=14,390 sf 87.00% Impervious Runoff Depth=7.47"
Tc=6.0 min CN=96 Runoff=2.50 cfs 0.206 af

SubcatchmentPR-4: Runoff Area=9,839 sf 100.00% Impervious Runoff Depth=7.71"
Tc=6.0 min CN=98 Runoff=1.72 cfs 0.145 af

SubcatchmentPR-5: Runoff Area=132,030 sf 0.00% Impervious Runoff Depth=5.34"
Flow Length=689' Tc=15.4 min CN=78 Runoff=14.07 cfs 1.350 af

SubcatchmentPR-6: Runoff Area=150,632 sf 0.00% Impervious Runoff Depth=5.23"
Flow Length=686' Tc=33.7 min CN=77 Runoff=11.29 cfs 1.507 af

Pond P-1: Peak Elev=168.48' Storage=36,588 cf Inflow=24.77 cfs 2.015 af
Discarded=0.06 cfs 0.147 af Primary=8.35 cfs 1.658 af Outflow=8.41 cfs 1.805 af

Pond P-2: Peak Elev=168.61' Storage=48,261 cf Inflow=46.42 cfs 3.913 af
Discarded=0.09 cfs 0.203 af Primary=32.79 cfs 3.238 af Outflow=32.87 cfs 3.442 af

Pond P-3: Peak Elev=176.84' Storage=2,439 cf Inflow=2.50 cfs 0.206 af
Discarded=0.02 cfs 0.048 af Primary=2.34 cfs 0.121 af Outflow=2.36 cfs 0.169 af

Link DP1: DP1 Inflow=23.40 cfs 3.274 af
Primary=23.40 cfs 3.274 af

Link DP2: DP2 Inflow=39.65 cfs 4.745 af
Primary=39.65 cfs 4.745 af

Total Runoff Area = 16.425 ac Runoff Volume = 9.136 af Average Runoff Depth = 6.67"
44.23% Pervious = 7.265 ac 55.77% Impervious = 9.160 ac

Summary for Subcatchment PR-1:

Runoff = 24.77 cfs @ 12.09 hrs, Volume= 2.015 af, Depth= 7.35"
Routed to Pond P-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
25,800	80	>75% Grass cover, Good, HSG D
117,500	98	Paved parking, HSG D
143,300	95	Weighted Average
25,800		18.00% Pervious Area
117,500		82.00% Impervious Area

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

Summary for Subcatchment PR-2:

Runoff = 46.42 cfs @ 12.09 hrs, Volume= 3.913 af, Depth= 7.71"
Routed to Pond P-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
6,150	80	>75% Grass cover, Good, HSG D
111,750	98	Paved parking, HSG D
147,400	98	Roofs, HSG D
265,300	98	Weighted Average
6,150		2.32% Pervious Area
259,150		97.68% Impervious Area

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

Summary for Subcatchment PR-3:

Runoff = 2.50 cfs @ 12.09 hrs, Volume= 0.206 af, Depth= 7.47"
Routed to Pond P-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
1,871	80	>75% Grass cover, Good, HSG D
12,519	98	Paved parking, HSG D
14,390	96	Weighted Average
1,871		13.00% Pervious Area
12,519		87.00% Impervious Area

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

Summary for Subcatchment PR-4:

Runoff = 1.72 cfs @ 12.09 hrs, Volume= 0.145 af, Depth= 7.71"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
9,839	98	Paved parking, HSG D
9,839		100.00% Impervious Area

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

Summary for Subcatchment PR-5:

Runoff = 14.07 cfs @ 12.21 hrs, Volume= 1.350 af, Depth= 5.34"
Routed to Link DP1 : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
35,850	80	>75% Grass cover, Good, HSG D
96,180	77	Woods, Good, HSG D
132,030	78	Weighted Average
132,030		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0320	0.12		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.21"
0.7	58	0.0350	1.31		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
7.0	306	0.0210	0.72		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
0.9	275	0.0300	5.14	25.71	**Channel Flow, D-E** Area= 5.0 sf Perim= 7.0' r= 0.71' n= 0.040 Winding stream, pools & shoals
15.4	689	Total			

Summary for Subcatchment PR-6:

Runoff = 11.29 cfs @ 12.46 hrs, Volume= 1.507 af, Depth= 5.23"
Routed to Link DP2 : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=7.95"

Area (sf)	CN	Description
150,632	77	Woods, Good, HSG D
150,632		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	50	0.0140	0.03		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.21"
4.9	300	0.0420	1.02		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	147	0.0544	1.17		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.0	189	0.0950	1.54		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
33.7	686	Total			

Summary for Pond P-1:

Inflow Area = 3.290 ac, 82.00% Impervious, Inflow Depth = 7.35" for 100-YR event
Inflow = 24.77 cfs @ 12.09 hrs, Volume= 2.015 af
Outflow = 8.41 cfs @ 12.37 hrs, Volume= 1.805 af, Atten= 66%, Lag= 16.8 min
Discarded = 0.06 cfs @ 3.15 hrs, Volume= 0.147 af
Primary = 8.35 cfs @ 12.37 hrs, Volume= 1.658 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 168.48' @ 12.37 hrs Surf.Area= 6,713 sf Storage= 36,588 cf

Plug-Flow detention time= 155.1 min calculated for 1.802 af (89% of inflow)

Center-of-Mass det. time= 105.0 min (862.2 - 757.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,343 cf	**89.63'W x 74.90'L x 8.00'H Field A** 53,700 cf Overall - 50,344 cf Embedded = 3,356 cf x 40.0% Voids
#2A	162.50'	41,247 cf	**StormTrap SingleTrap 7-0** x 36 Inside #1 Inside= 101.7"W x 84.0"H => 52.88 sf x 15.40'L = 814.2 cf Outside= 101.7"W x 90.0"H => 63.59 sf x 15.40'L = 979.1 cf 36 Chambers in 9 Rows 76.31' x 61.58' Core + 6.66' Border = 89.63' x 74.90' System
		42,590 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**15.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	168.25'	**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
#3	Device 1	164.00'	**15.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	166.75'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 3.15 hrs HW=162.08' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=8.31 cfs @ 12.37 hrs HW=168.48' (Free Discharge)
└**1=Culvert** (Passes 8.31 cfs of 12.04 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Weir Controls 1.22 cfs @ 1.34 fps)
  ├**3=Orifice/Grate** (Orifice Controls 4.16 cfs @ 10.00 fps)
  └**4=Orifice/Grate** (Orifice Controls 2.92 cfs @ 5.84 fps)

Summary for Pond P-2:

Inflow Area = 6.090 ac, 97.68% Impervious, Inflow Depth = 7.71" for 100-YR event
Inflow = 46.42 cfs @ 12.09 hrs, Volume= 3.913 af
Outflow = 32.87 cfs @ 12.19 hrs, Volume= 3.442 af, Atten= 29%, Lag= 6.4 min
Discarded = 0.09 cfs @ 1.45 hrs, Volume= 0.203 af
Primary = 32.79 cfs @ 12.19 hrs, Volume= 3.238 af
Routed to Link DP2 : DP2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 168.61' @ 12.19 hrs Surf.Area= 8,858 sf Storage= 48,261 cf

Plug-Flow detention time= 134.1 min calculated for 3.442 af (88% of inflow)
Center-of-Mass det. time= 76.9 min (818.2 - 741.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	162.00'	1,772 cf	**98.10'W x 90.29'L x 7.00'H Field A** 62,006 cf Overall - 57,577 cf Embedded = 4,429 cf x 40.0% Voids
#2A	162.50'	46,490 cf	**StormTrap SingleTrap 6-0** x 50 Inside #1 Inside= 101.7"W x 72.0"H => 45.09 sf x 15.40'L = 694.1 cf Outside= 101.7"W x 78.0"H => 55.11 sf x 15.40'L = 848.5 cf 50 Chambers in 10 Rows 84.79' x 76.98' Core + 6.66' Border = 98.10' x 90.29' System
		48,261 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	162.50'	**24.0" Round Culvert** L= 100.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 162.50' / 161.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	168.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	165.10'	**30.0" W x 12.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	162.00'	**0.415 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 1.45 hrs HW=162.07' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=32.07 cfs @ 12.19 hrs HW=168.59' (Free Discharge)
└**1=Culvert** (Passes 32.07 cfs of 34.14 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Weir Controls 11.27 cfs @ 2.37 fps)
  └**3=Orifice/Grate** (Orifice Controls 20.80 cfs @ 8.32 fps)

Summary for Pond P-3:

Inflow Area = 0.330 ac, 87.00% Impervious, Inflow Depth = 7.47" for 100-YR event
Inflow = 2.50 cfs @ 12.09 hrs, Volume= 0.206 af
Outflow = 2.36 cfs @ 12.12 hrs, Volume= 0.169 af, Atten= 6%, Lag= 1.8 min
Discarded = 0.02 cfs @ 11.85 hrs, Volume= 0.048 af
Primary = 2.34 cfs @ 12.12 hrs, Volume= 0.121 af
Routed to Link DP1 : DP1

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 176.84' @ 12.12 hrs Surf.Area= 1,348 sf Storage= 2,439 cf

Plug-Flow detention time= 167.4 min calculated for 0.169 af (82% of inflow)
Center-of-Mass det. time= 95.9 min (848.4 - 752.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	174.50'	267 cf	**30.27'W x 44.10'L x 3.00'H Field A** 4,005 cf Overall - 3,338 cf Embedded = 668 cf x 40.0% Voids
#2A	175.00'	2,316 cf	**StormTrap SingleTrap 2-0** x 4 Inside #1 Inside= 101.7"W x 24.0"H => 15.05 sf x 15.40'L = 231.7 cf Outside= 101.7"W x 30.0"H => 21.20 sf x 15.40'L = 326.4 cf 4 Chambers in 2 Rows 16.96' x 30.79' Core + 6.66' Border = 30.27' x 44.10' System
#3	174.00'	63 cf	**4.00'D x 5.00'H Vertical Cone/Cylinder**
		2,646 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	176.50'	**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
#2	Discarded	174.00'	**0.680 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 11.85 hrs HW=176.60' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.27 cfs @ 12.12 hrs HW=176.84' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.27 cfs @ 1.68 fps)

Summary for Link DP1: DP1

Inflow Area = 6.877 ac, 46.69% Impervious, Inflow Depth = 5.71" for 100-YR event
Inflow = 23.40 cfs @ 12.21 hrs, Volume= 3.274 af
Primary = 23.40 cfs @ 12.21 hrs, Volume= 3.274 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: DP2

Inflow Area = 9.548 ac, 62.31% Impervious, Inflow Depth = 5.96" for 100-YR event
Inflow = 39.65 cfs @ 12.20 hrs, Volume= 4.745 af
Primary = 39.65 cfs @ 12.20 hrs, Volume= 4.745 af, Atten= 0%, Lag= 0.0 min

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

APPENDIX C: STORMWATER CALCULATIONS

- *MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*

Prop. Flex/Light Industrial Building
161 Concord Road
Billerica, MA
Bohler Job Number: MAB2250096.00
October 10, 2025

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - D Soils (0.10 in.)	
Existing Site Impervious Area (ac)	0.244
Proposed Site Impervious Area (ac)	9.160
Proposed Increase in Site Impervious Area (ac)	8.916
Recharge Volume Required (cf)	**3,237**

Total Recharge Volume Required (cf)	**3,237**

Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**9.160**
%Impervious Directed to Infiltration BMP	100%
Adjustment Factor	1.00
Adjusted Total Recharge Volume Required (cf)	**3,237**

Provided Recharge Volume*	
P-1	10,818
P-2	21,917
P-3	2,036
Total Recharge Volume Provided (cf)	**34,771**

Provided greater than or Equal to Required

*Volume provided below lowest outlet in cubic feet (cf)

Prepared By:
BOHLER
45 Franklin St, Fl. 5
Boston, MA 02110
(617) 849-8040

Prop. Flex/Light Industrial Building
161 Concord Road
Billerica, MA
Bohler Job Number: MAB2250096.00
October 10, 2025

MA DEP Standard 3: Drawdown Time Calculations

Drawdown Time - P-1	
Volume below outlet pipe (Rv) (cf)	10,818
Soil Type	In-situ Hydraulic Conductivity
Infiltration rate (K)*	0.42
Bottom Area (sf)	6,750
Drawdown time (Hours)*	**46.3**
Drawdown Time - P-2	
Volume below outlet pipe (Rv) (cf)	21,917
Soil Type	In-situ Hydraulic Conductivity
Infiltration rate (K)*	0.42
Bottom Area (sf)	8,820
Drawdown time (Hours)**	**71.9**
Drawdown Time - P-3	
Volume below outlet pipe (Rv) (cf)	2,036
Soil Type	In-situ Hydraulic Conductivity
Infiltration rate (K)*	0.42
Bottom Area (sf)	1,320
Drawdown time (Hours)**	**44.6**

*Infiltration Rates taken from Rawls Table
**Drawdown time = Rv / (K) x (bottom area)

Prepared By:
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Prop. Flex/Light Industrial Building
161 Concord Road
Billerica, MA
Bohler Job Number: MAB2250096.00
October 10, 2025

MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required	
Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	399,010
Required Water Quality Volume (cf)	**33,251**
*Water Quality volume runoff is equal to 1.0 inches of runoff times the total impervious area of the post development project site.	

Water Quality Volume Provided*	
P-1	10,818
P-2	21,917
P-3	2,036
0	0
0	0
Total Provided Water Quality Volume (cf)	**34,771**

Required Water Quality Volume Provided

*Volume provided below lowest outlet pipe in cubic feet (cf)

Prepared By:
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45 Franklin St, Fl. 5
Boston, MA 02110
(617) 849-8040

Stage-Area-Storage for Pond P-1:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	**6,713**	0	167.20	6,713	29,037
162.10	6,713	269	167.30	6,713	29,626
162.20	6,713	537	167.40	6,713	30,216
162.30	6,713	806	167.50	6,713	30,805
162.40	6,713	1,074	167.60	6,713	31,394
162.50	6,713	1,343	167.70	6,713	31,983
162.60	6,713	1,932	167.80	6,713	32,572
162.70	6,713	2,521	167.90	6,713	33,162
162.80	6,713	3,110	168.00	6,713	33,751
162.90	6,713	3,699	168.10	6,713	34,340
163.00	6,713	4,289	168.20	6,713	34,929
163.10	6,713	4,878	168.30	6,713	35,519
163.20	6,713	5,467	168.40	6,713	36,108
163.30	6,713	6,056	168.50	6,713	36,697
163.40	6,713	6,646	168.60	6,713	37,286
163.50	6,713	7,235	168.70	6,713	37,876
163.60	6,713	7,824	168.80	6,713	38,465
163.70	6,713	8,413	168.90	6,713	39,054
163.80	6,713	9,003	169.00	6,713	39,643
163.90	6,713	9,592	169.10	6,713	40,233
164.00	6,713	10,181	169.20	6,713	40,822
164.10	6,713	10,770	169.30	6,713	41,411
164.20	6,713	11,360	169.40	6,713	42,000
164.30	6,713	11,949	169.50	6,713	42,590
164.40	6,713	12,538	169.60	6,713	**42,590**
164.50	6,713	13,127	169.70	6,713	**42,590**
164.60	6,713	13,717	169.80	6,713	42,590
164.70	6,713	14,306	169.90	6,713	42,590
164.80	6,713	14,895	170.00	6,713	42,590
164.90	6,713	15,484			
165.00	6,713	16,074			
165.10	6,713	16,663			
165.20	6,713	17,252			
165.30	6,713	17,841			
165.40	6,713	18,431			
165.50	6,713	19,020			
165.60	6,713	19,609			
165.70	6,713	20,198			
165.80	6,713	20,788			
165.90	6,713	21,377			
166.00	6,713	21,966			
166.10	6,713	22,555			
166.20	6,713	23,145			
166.30	6,713	23,734			
166.40	6,713	24,323			
166.50	6,713	24,912			
166.60	6,713	25,502			
166.70	6,713	26,091			
166.80	6,713	26,680			
166.90	6,713	27,269			
167.00	6,713	27,859			
167.10	6,713	28,448			

Stage-Area-Storage for Pond P-2:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	**8,858**	0	167.20	8,858	38,189
162.10	8,858	354	167.30	8,858	38,963
162.20	8,858	709	167.40	8,858	39,738
162.30	8,858	1,063	167.50	8,858	40,513
162.40	8,858	1,417	167.60	8,858	41,288
162.50	8,858	1,772	167.70	8,858	42,063
162.60	8,858	2,546	167.80	8,858	42,838
162.70	8,858	3,321	167.90	8,858	43,612
162.80	8,858	4,096	168.00	8,858	44,387
162.90	8,858	4,871	168.10	8,858	45,162
163.00	8,858	5,646	168.20	8,858	45,937
163.10	8,858	6,421	168.30	8,858	46,712
163.20	8,858	7,195	168.40	8,858	47,487
163.30	8,858	7,970	168.50	8,858	**48,261**
163.40	8,858	8,745	168.60	8,858	**48,261**
163.50	8,858	9,520	168.70	8,858	48,261
163.60	8,858	10,295	168.80	8,858	48,261
163.70	8,858	11,070	168.90	8,858	48,261
163.80	8,858	11,844	169.00	8,858	48,261
163.90	8,858	12,619			
164.00	8,858	13,394			
164.10	8,858	14,169			
164.20	8,858	14,944			
164.30	8,858	15,719			
164.40	8,858	16,493			
164.50	8,858	17,268			
164.60	8,858	18,043			
164.70	8,858	18,818			
164.80	8,858	19,593			
164.90	8,858	20,368			
165.00	8,858	21,142			
165.10	8,858	21,917			
165.20	8,858	22,692			
165.30	8,858	23,467			
165.40	8,858	24,242			
165.50	8,858	25,016			
165.60	8,858	25,791			
165.70	8,858	26,566			
165.80	8,858	27,341			
165.90	8,858	28,116			
166.00	8,858	28,891			
166.10	8,858	29,665			
166.20	8,858	30,440			
166.30	8,858	31,215			
166.40	8,858	31,990			
166.50	8,858	32,765			
166.60	8,858	33,540			
166.70	8,858	34,314			
166.80	8,858	35,089			
166.90	8,858	35,864			
167.00	8,858	36,639			
167.10	8,858	37,414			

Stage-Area-Storage for Pond P-3:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
174.00	13	0	176.60	1,348	2,153
174.05	13	1	176.65	1,348	2,211
174.10	13	1	176.70	1,348	2,270
174.15	13	2	176.75	1,348	2,329
174.20	13	3	176.80	1,348	2,387
174.25	13	3	176.85	1,348	2,446
174.30	13	4	176.90	1,348	2,504
174.35	13	4	176.95	1,348	2,563
174.40	13	5	177.00	1,348	2,621
174.45	13	6	177.05	1,348	2,622
174.50	**1,348**	6	177.10	1,348	2,622
174.55	1,348	34	177.15	1,348	2,623
174.60	1,348	61	177.20	1,348	2,624
174.65	1,348	88	177.25	1,348	2,624
174.70	1,348	116	177.30	1,348	2,625
174.75	1,348	143	177.35	1,348	2,626
174.80	1,348	170	177.40	1,348	2,626
174.85	1,348	198	177.45	1,348	2,627
174.90	1,348	225	177.50	1,348	2,627
174.95	1,348	252	177.55	1,348	2,628
175.00	1,348	280	177.60	1,348	2,629
175.05	1,348	338	177.65	1,348	2,629
175.10	1,348	397	177.70	1,348	2,630
175.15	1,348	455	177.75	1,348	2,631
175.20	1,348	514	177.80	1,348	2,631
175.25	1,348	572	177.85	1,348	2,632
175.30	1,348	631	177.90	1,348	2,633
175.35	1,348	689	177.95	1,348	2,633
175.40	1,348	748	178.00	1,348	2,634
175.45	1,348	806	178.05	1,348	2,634
175.50	1,348	865	178.10	1,348	2,635
175.55	1,348	924	178.15	1,348	2,636
175.60	1,348	982	178.20	1,348	2,636
175.65	1,348	1,041	178.25	1,348	2,637
175.70	1,348	1,099	178.30	1,348	2,638
175.75	1,348	1,158	178.35	1,348	2,638
175.80	1,348	1,216	178.40	1,348	2,639
175.85	1,348	1,275	178.45	1,348	2,639
175.90	1,348	1,333	178.50	1,348	2,640
175.95	1,348	1,392	178.55	1,348	2,641
176.00	1,348	1,450	178.60	1,348	2,641
176.05	1,348	1,509	178.65	1,348	2,642
176.10	1,348	1,567	178.70	1,348	2,643
176.15	1,348	1,626	178.75	1,348	2,643
176.20	1,348	1,685	178.80	1,348	2,644
176.25	1,348	1,743	178.85	1,348	2,644
176.30	1,348	1,802	178.90	1,348	2,645
176.35	1,348	1,860	178.95	1,348	2,646
176.40	1,348	1,919	179.00	1,348	**2,646**
176.45	1,348	1,977			
176.50	1,348	2,036			
176.55	1,348	2,094			

Prop. Flex/Light Industrial Building
161 Concord Road
Billerica, MA
Bohler Job Number: MAB2250096.00
October 10, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: CB (typ.), Water Quality Unit (WQU-1,WQU-2)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**0.91**	**0.75**	**0.68**	**0.07**
		Total TSS Removal =	**93%**	

*Equals remaining load from previous BMP (E) which enters BMP

Prepared By:
BOHLER
45 Franklin St, Fl. 5
Boston, MA 02110
(617) 849-8040

Prop. Flex/Light Industrial Building
161 Concord Road
Billerica, MA
Bohler Job Number: MAB2250096.00
October 10, 2025

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Water Quality Inlet (WQI-1,WQI-2, WQI-3)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Water Quality Inlet	**0.94**	**1.00**	**0.94**	**0.06**
		Total TSS Removal =	**94%**	

*Equals remaining load from previous BMP (E) which enters BMP

Prepared By:
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(617) 849-8040

Brief Stormceptor Sizing Report - WQI 1

Project Information & Location			
Project Name	Berkeley GMP Lab Building	**Project Number**	707852
City	Billerica	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/29/2022
Designer Information		**EOR Information (optional)**	
Name	Dave Adams	**Name**	
Company	Contech Engineered Solutions	**Company**	Bohler
Phone #	207-885-6191	**Phone #**	
Email	dave.adams@conteches.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQI 1
Target TSS Removal (%)	80
TSS Removal (%) Provided	94
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	94
STC 900	97
STC 1200	97
STC 1800	97
STC 2400	98
STC 3600	98
STC 4800	99
STC 6000	99
STC 7200	99
STC 11000	99
STC 13000	100
STC 16000	100

Stormceptor®

CONTECH ENGINEERED SOLUTIONS
A QUIKRETE® COMPANY

Sizing Details

Drainage Area

Total Area (acres)	0.17
Imperviousness %	100.0

Rainfall

Station Name	BOSTON WSFO AP
State/Province	Massachusetts
Station ID #	0770
Years of Records	58
Latitude	42°21'38"N
Longitude	71°0'38"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	0.00000

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

OK-110

Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Estimated Net Annual Solids Load Reduction
Based on the Rational Rainfall Method

CONTECH ENGINEERED SOLUTIONS

CASCADE separator™

BERKELEY GMP LAB BUILDING

BILLERICA, MA

WQU 1

AREA	1.86	acres	**CASCADE MODEL**	CS-5
WEIGHTED C	0.95			
TC	6.00	minutes	**RAINFALL STATION**	69

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Hydraulic Loading Rate (gpm/ft2)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	0.81	100.0	10.2
0.04	9.6%	1.62	100.0	9.6
0.06	9.4%	2.42	100.0	9.4
0.08	7.7%	3.23	100.0	7.7
0.10	8.6%	4.04	100.0	8.6
0.12	6.3%	4.85	100.0	6.3
0.14	4.7%	5.65	100.0	4.7
0.16	4.6%	6.46	100.0	4.6
0.18	3.5%	7.27	100.0	3.5
0.20	4.3%	8.08	100.0	4.3
0.25	8.0%	10.10	100.0	8.0
0.30	5.6%	12.12	100.0	5.6
0.35	4.4%	14.14	98.6	4.3
0.40	2.5%	16.16	96.7	2.4
0.45	2.5%	18.18	94.8	2.4
0.50	1.4%	20.20	92.9	1.3
0.75	5.0%	30.29	83.4	4.2
1.00	1.0%	40.39	73.9	0.8
1.50	0.0%	60.59	54.9	0.0
2.00	0.0%	80.01	36.3	0.0
3.00	0.5%	80.01	24.2	0.1
				98.2
			Removal Efficiency Adjustment[2] =	6.5%
			Predicted % Annual Rainfall Treated =	93.4%
			Predicted Net Annual Load Removal Efficiency =	**91.7%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.